DE 14-182

YEATON ASSOCIATES, INC.

NHPUC 22AUG'14AM9:52

August 19, 2014

State of New Hampshire
Public Utilities Commission
21 S. Fruit St, Suite 10
Concord, NH 03301-2429

Attn: Ms. Debra Howland, Executive Director

Re: DE 14-182 Littleton Regional Healthcare, Additional Information

Dear Ms. Howland:

Yeaton Associates has received a Deficiency Letter from the Commission dated August 14, 2014, in which the Commission described additional information that is required in order to complete their review of the Littleton Regional Healthcare application for certification as a Class I Thermal REC eligible facility. Enclosed, please find our responses to the four questions posed in the letter, and additional support documents.

Also enclosed are two copies of the responses and support documents, along with two copies of this cover letter.

Please let me know if you have any questions or need additional information.

Respectfully,

Wayne G. Fillion, P.E.
President

Enclosure

1. Please describe the fuels that the boiler is designed to use. If the boiler is designed to use multiple fuels, does Littleton Regional Healthcare intend to use non-biomass fuel?

a. If Littleton Regional Healthcare intends to use multiple fuels, please describe how biomass fuel use will be segregated for accurate REC accounting.

Response:

The system is designed to use wood chips exclusively. The attachment, "Approved Boiler Submittal", provides a complete description of the system as installed. Although the top fire-tube section of the boiler is capable of being used with multiple fuel sources, no fossil fuel burners have been installed. Only a biomass burning furnace is installed. No fossil fuel source has been provided to the stand-alone boiler building.

2. Attachment 3-3 of the application discusses Chapter 9 of the "Instruction Manual" for the Electromagnetic Flow Meter and implies that Chapter 9 is included with the application, but it appears to have been omitted. Please provide Chapter 9 for Commission Staff to review.

Response:

Attachment 3_3 has been now been modified to include Chapter 9 of the "Instruction Manual". It is attached. The omission of Chapter 9 was an error, and we apologize.

3. The alternative methodology provided in Attachment 3-4 doesn't use the hourly time interval required in Puc 2506.04(m). Please explain why this alternative method using the daily method needs to be utilized.

   a. Once the interim period expires, does Littleton Regional Hospital propose to continue using this alternative methodology?

Response:

Each day since March 1, 2014, the staff has maintained a hand-written boiler room checklist that includes a daily observation of the current cumulative total pounds of boiler feedwater. It is this hand-written record that we are using for our calculations. A sample checklist is attached, for the month of June. This hand-written checklist is the only record of boiler feedwater consumption, because although the electromagnetic

feedwater detector is capable of electronic output (both digital and analogue), and can be connected to the building energy management system for automatic hourly tracking, this connection has never been performed. We must therefore rely upon the methodology outlined in proposed Puc 2505.02(e)(2) until the final rules are in place. When the interim period expires and final rules are in place, it is our intention that LRH shall fully comply with Puc 2506.04(m).

4. The application lists the initial operation date of the Littleton Regional Healthcare biomass facility as January 15, 2014. The sample calculation for April 2014 lists 569 megawatt hours. Please provide calculations for January 15, 2014 through March 31,2014.

Response:

Please see the attached Spreadsheet, "Calculation Spreadsheet", for all calculated monthly MWh values.

March – present:

MWh calculations are performed as described in "Littleton Regional Healthcare Part 3 - Interim Alternative Metering Method.pdf" previously provided.

Jan 15 – February:

Note that prior to March 1, staff at LRH did not record daily feedwater gpm, and so we have had to come up with an alternate calculation method. Please see the Worksheet entitled "Chip Deliveries Jan-May" in the attachment "Calculations Spreadsheet" for calculations and results. Briefly, because using the feedwater flow rate yields the most accurate estimate of useful thermal energy, flow data from March through present is compared to chip usage for the same period to derive an average value for boiler MWh output per pound of chips delivered. This average value is then applied to the period of January 15 through February, for which only purchased tonnage data is available.

66 Jackson Street | Littleton, NH 03561 | Ph: 603.444.6578 | Fax: 603.444.2364
www.yeatonassociates.com

YEATON ASSOCIATES, INC.

Attachment

Approved Boiler Submittal

66 Jackson Street | Littleton, NH 03561 | Ph: 603.444.6578 | Fax: 603.444.2364
www.yeatonassociates.com

X
___ Reviewed - no exception taken
___ Reviewed with notes - no resubmission required
___ Reviewed with notes - resubmission required
___ Not approved - resubmission required.

Date 6.3.13
By WGF

Review is only for conformance with the design concept of the project and compliance with contract documents. Contractor is responsible for quantities, dimension and for coordination of the work of all trades.

YEATON ASSOCIATES, INC.

SHOP DRAWING REVIEW
☒ No Exception Taken ☐ Make Corrections Noted
☐ Revise and Resubmit ☐ Comments Attached

This check is only for review of general conformance with the design concept of the project and general compliance with information given in the contract documents. The contractor is responsible for confirming and correlating all quantities and dimensions and performing his work in a satisfactory manner.

DANIEL HEBERT, INC.
GENERAL CONTRACTORS

Date 5-31-13 By

Messersmith

Wood Chip Heating System For Littleton Regional Hospital

May 16, 2013

VIA Email to: dhebert@dhigc.com

Littleton Regional Hospital

Re: Littleton Regional Hospital
Messersmith Wood Chip Heating System Submittal Package

Dear: Mr. Daniel Hebert

Please find enclosed the submittal package for the Messersmith Wood Chip Heating System for the above referenced project. This package contains information on the following.

Messersmith Literature
Messersmith Introduction Cover Letter
Messersmith Scope of Work & List of Electrical Motors
Messersmith Installation Drawings
Messersmith Combustion Description
Messersmith Brochure
Patz 8916 Conveyor Brochure
Messersmith Control Panel Wiring Drawings

Hurst N 65 Boiler
Cut Sheet on Hurst Boiler N 65 975
- ✓ 3” Angle Nibco F869-B, 250# CL, Flgd
- ✓ 3” Davis 15FGAW, Flgd, 150#
- ✓ 2" 250# Apollo Ball

Cut Sheet on Hurst Boiler N 65 1300
- ✓ 4" Nibco F869-B, 250# CI, Flgd.
- ✓ 4" Davis 15FGAW, Flgd. 150#
- ✓ 2" 250# Apollo Ball

Both boilers
- ✓ 2" UB Steel 425 quick acting
- ✓ 1.25" UB Steel 425 quick acting
- ✓ 2" UB Steel 525 slow acting
- ✓ 1.25" UB Steel slow acting
- ✓ Blowdown separator tank w/aftercooler
- ✓ Surface blowdown
- ✓ Worcester 0.75" NPT Feedwater Valve
- ✓ M&M 193A-7B LWCO

Hurst N 65 Boiler Brochure

B.E.T. Automatic Tube Cleaner Literature
Cut Sheet x 2
Fuel Efficiency Brochure
Air Compressor Brochure marked for 10 hp & 120 gal tank VR 10-12

Norarc stack drawing
30" x 65' painted

ESP
ESP Cut Sheet
ESP brochure marked for standard small model

Maintenance, Service and Warranty Information

cc: dhebert@dhigc.com (Daniel Hebert)

SCOPE OF WORK SUBMITTAL 5-16-13
Littleton Regional Hospital
Littleton, NH

WORK TO BE DONE BY MESSERSMITH:

1. Two Messersmith Combustor Furnaces with:
   - Ash auger inside the firebox,
   - Inclined ash auger and barrels,
   - Underfire and overfire blowers,
   - Dampers, motors and overfire motor VFD's.
2. Two Hurst Boilers Model N65, 150 PSI steam design pressure (one 150 BHP, one 200 BHP) each with access platform, mud drum preheaters (with manual valve) and:
   - Trim:
     - Primary LWCO with shunt switch (installed at factory)
     - Auxiliary LWCO with HWLA & shunt switch (installed at factory)
     - Relief valve (s)
     - Pressuretrol Manual reset, with pigtail & coupling
     - Pressuretrol Automatic reset, with pigtail & coupling
     - Pressure transducer, with pigtail & coupling
     - 10" Pressure gauge, with pigtail & coupling
   - Fuel Efficiency B.E.T. Automatic Tube Cleaner,
3. A Champion Air Compressor to operate both boiler tube cleaners and economizer tube cleaner, with 10 HP motor and 120-gallon receiver.
4. 25 HP Induced Draft Fan with Variable Frequency Drive.
5. Messersmith Unloading and Conveyor System to accommodate chip bin per drawing, including:
   - Steel beam about 48' long, Note: Beams & walls need substantial support at each end from concrete or other building structure. If walls are CMU, they must be filled in the areas of Messersmith beam & wall attachment. Beam & wall are bolted or welded to this supporting structure.
   - Steel wall about 16' above beam,
   - Ladder into the chip bin,
   - Two traveling augers for wood chips,
   - Two belt conveyors, one with chip screen to remove oversized fuel,
   - Metering bin and metering augers w/rotation counters,
   - Stoker augers,
   - All motors.
6. Messersmith Fire Prevention System, located over metering bin and stoker augers.
7. Two Messersmith Boiler Control Panels each with Horner HE NX251 Operator Control Stations and three phase motor starters. One Messersmith Fuel System Control Panel with three phase motor starters.
8. All Breeching between Hurst Boilers and Stack.
9. A Weis type Small 250/1F-3,5x2-8 electrostatic precipitator particulate removal device with service catwalk and ash barrels.
10. A Norarc insulated, freestanding stack having:
    - A 26" ID and being 65' high,
    - Outer shell will be epoxy painted (color chosen by customer),

- Inner liner will consist of 12 gauge 304 stainless steel.

Note: stack is freestanding, supported only by anchor bolts & concrete foundation. No guy wires needed.

Stack responsibilities:

Project structural engineer:

- Design concrete stack foundation,
- Specify stack anchor bolts to be imbedded in foundation.

General Contractor:

- Provide & imbed stack anchor bolts specified by structural engineer,
- Construct the concrete stack foundation designed by the structural engineer,

Messersmith:

- Provide turning moment & weight from stack vendor
- Provide the template for placement of the stack anchors in the concrete foundation and a drawing showing correct orientation of the template,
- Provide and install a 26" x 65' painted stack,
- Grout the stack after it has been installed.

11. Installation (including biomass system electrical permit) includes:
    - Freight to site,
    - Setup of Equipment,
    - Startup.
12. Three (3) Operation Manuals (one hard copy & two digital) and as built drawings.
13. 12-Month warranty from startup.
14. Training of maintenance staff.
15. Spare parts.
16. Additional boiler equipment:

a. Blow down equipment

- Blowdown valves
- Blowdown separator for both boilers with aftercooler, temperature regulator, thermometer, strainer, check valve
- Surface blowdown

b. Feed water equipment

- Feedwater Stop & Check Valve,
- Feedwater valve,
- Three valve bypass,
- LWCO w/proportional level control, 0-135 ohm.

c. Supply valves

- Main steam valve,
- Stop/check valve,
- Spool piece.

d. Miscellaneous

- Drip pan elbows for relief valves,
- 1/2" Chem. Feed Quill w/ball check.

Messersmith will provide complete installation of the Messersmith system, from the control panels to the chip bin, including electrical wiring. The system will be guaranteed to produce 11.69 MMBTU of heat total output from the two boilers with a system efficiency rate of at least 75% when burning green hardwood chips, at 45% moisture content or less (wet basis).

Our price is based on Messersmith being able to place its equipment inside the boiler room prior to the roof going on the boiler room building. There will be an additional rigging cost if this condition is not met.

Typical Installation Schedule:

Site Visit # 1: (Messersmith installation crew on site about 5 days)

When? **1**. After completion of housekeeping pad, boiler room and chip bin concrete.
2. After backfilling of boiler room and chip bin foundation.
3. Before roof construction of boiler room **or** chip bin.

To Install: Wall, beam, traveling augers, combustors, boilers, metering bin, compressor, breeching, draft fan, ESP, and stack.
Note: Messersmith supplies the crane when needed for installation.

Site Visit # 2: (Messersmith crew, including electrician, on site about 20 days)

When? **1**. After boiler room ceiling & walls are completed.
2. After pipefitters are done in the boiler room.
3. After project electrician wires the boiler room.
4. After boiler room & conveyor alley floors are cleared of other trades' tools & materials.

To Install: Conveyors, touch-up paint, fire suppression, ash augers, VFD and control panels.
Note: Messersmith supplies the electrician for connections from control panels to components. No conduit to run under concrete.

Site Visit # 3: (Messersmith technician on site about 5 days)

When? **1**. After system is wired by Messersmith electrician.
2. After boiler is cleaned and pressure tested by Mechanical.
3. After all boiler feed water electrical connections are completed.
4. Concurrent with chip delivery.

To Complete: Start-up and Operator Training.

WORK TO BE DONE BY OTHERS:

ELECTRICAL:

Three phase power and Main Disconnect to feed these circuits:

1. 30 amp, 480 volt, 3-phase to Messersmith control panel for boiler #1;
2. 20 amp, 115 volt, single phase brought to control panel for boiler #1;
3. 30 amp, 480 volt, 3-phase to Messersmith control panel for boiler #2;
4. 20 amp, 115 volt, single phase brought to control panel for boiler #2;
5. 30 amp, 480 volt, 3-phase for Messersmith Fuel Handling control panel;
6. 40 amp, 480 volt, 3-phase for customer supplied VFD disconnect;
7. 20 amp, 480 volt, 3-phase for customer supplied air compressor disconnect;
8. 63 amp, 480 volt, 3-phase for customer supplied ESP disconnect.

Also needed are:

- A 115 volt outlet for the automatic tank drain of the air compressor.
- Ethernet connection with dedicated IP address for the Messersmith control panel.

MECHANICAL:

1. Water connected to boiler and ½" water line brought to back of boilers for fire suppression system;
2. Supply necessary pipe and fittings and make connections to valves (supplied by Messersmith) for boiler mud drum steam injection preheaters.
3. Install Messersmith supplied boiler trim (see item #2 on page 1) and additional equipment (see item #16 on page e);
   Supply necessary pipe and fittings, including isolation valves for each of these items:
   Pressuretrol Manual reset
   Pressuretrol Automatic reset
   Pressure transducer
   Pressure gauge
   In order to assure smooth, stable operation of this high pressure steam boiler, Messersmith strongly recommends the use of a properly sized, continuously running feedwater pump and a modulating feedwater valve. On/off operation of the feedwater pump and valve will cause uneven performance of the boiler and steam pressure swings.
4. Supply and install pipe from relief valve(s) to designated discharge point;
5. Supply and install all interconnections between the wood boilers, and the oil boiler;
6. After Messersmith installs sensors in boilers, mechanical contractor can begin cleaning, boil-out, filling and hydrostatic testing the boilers and piping; Messersmith will supply a technician for up to two days to operate biomass furnace to provide heat for boil out process if needed.
7. Air piping (125 psi max, pressure regulator is part of compressor) from Messersmith compressor to each (2) boiler tube cleaner:
   - Start at compressor shut off valve (1-1/2” NPT female), installed by Messersmith;

- Run 1-1/2” black pipe;
- End at boiler tube cleaner manifold (1-1/2” NPT female), installed by Messersmith.

8. Include Messersmith in the communication loop so that drawing changes that affect the biomass system are made available to Messersmith.

OTHER:

1. The GC will be responsible for any lighting for boiler room, chip bin and chip alleyway, as well as overhead sprinklers in the boiler and chip room.
2. The GC will provide a housekeeping pad (3.5” above the floor) for the boiler/combustors. The housekeeping pads should allow 6" on all sides of the combustor.
3. The GC will be responsible to supply and embed 3” x 3” x ¼” angle iron into the chip bin floor concrete located according to Messersmith supplied drawing.
4. The GC will be responsible for the breeching opening in the wall, including thimble and weatherproofing.
5. Others will also be responsible for insulating all breeching in the boiler room.
6. The GC will be responsible for supplying and installing facility platforms not supplied by Messersmith.
7. The GC will be responsible for any permits, except biomass system electrical permit will be provided by Messersmith.
8. The GC will be responsible for supplying to Messersmith an actual wall to wall inside dimension for beam length after the concrete chip bin walls have been poured.

Littleton Regional Hospital
MOTOR LIST

Motor Function	HP Rating	Voltage	Phase	Use	Amps
Traveling auger #1	5	480	3	Intermittent	6.20
Travel motor #1	0.25	480	3	Intermittent	0.70
Traveling auger #2	5	480	3	Intermittent	6.20
Travel motor #2	0.25	480	3	Intermittent	0.70
Belt conveyor #1	1	480	3	Intermittent	1.83
Belt conveyor #2	1	480	3	Intermittent	1.83
Induced draft fan	25	480	3	Continuous	29.60
Air compressor	10	480	3	Continuous	12.30
Boiler #1					
Metering auger	0.5	90	DC	Continuous	5.50
Stoker auger	1	480	3	Continuous	1.83
Overfire air #1	1	480	3	Continuous	1.83
Overfire air #2	1	480	3	Continuous	1.83
Underfire air #1	0.33	480	3	Continuous	0.70
Underfire air #2	0.33	480	3	Continuous	0.70
Underfire air #3	0.33	480	3	Continuous	0.70
Ash auger in combustor	0.5	480	3	Intermittent	0.80
Ash auger to barrel	0.75	480	3	Intermittent	1.40
Boiler #2					

Metering auger	0.5	90	DC	Continuous	5.50
Stoker auger	2	480	3	Continuous	2.60
Overfire air #1	2	480	3	Continuous	2.60
Overfire air #2	2	480	3	Continuous	2.60
Underfire air #1	0.33	480	3	Continuous	0.70
Underfire air #2	0.33	480	3	Continuous	0.70
Underfire air #3	0.33	480	3	Continuous	0.70
Underfire air #4	0.33	480	3	Continuous	0.70
Ash auger in combustor	0.5	480	3	Intermittent	0.80
Ash auger to barrel	0.75	480	3	Intermittent	1.40
Totals	**62.31**				**92.95**

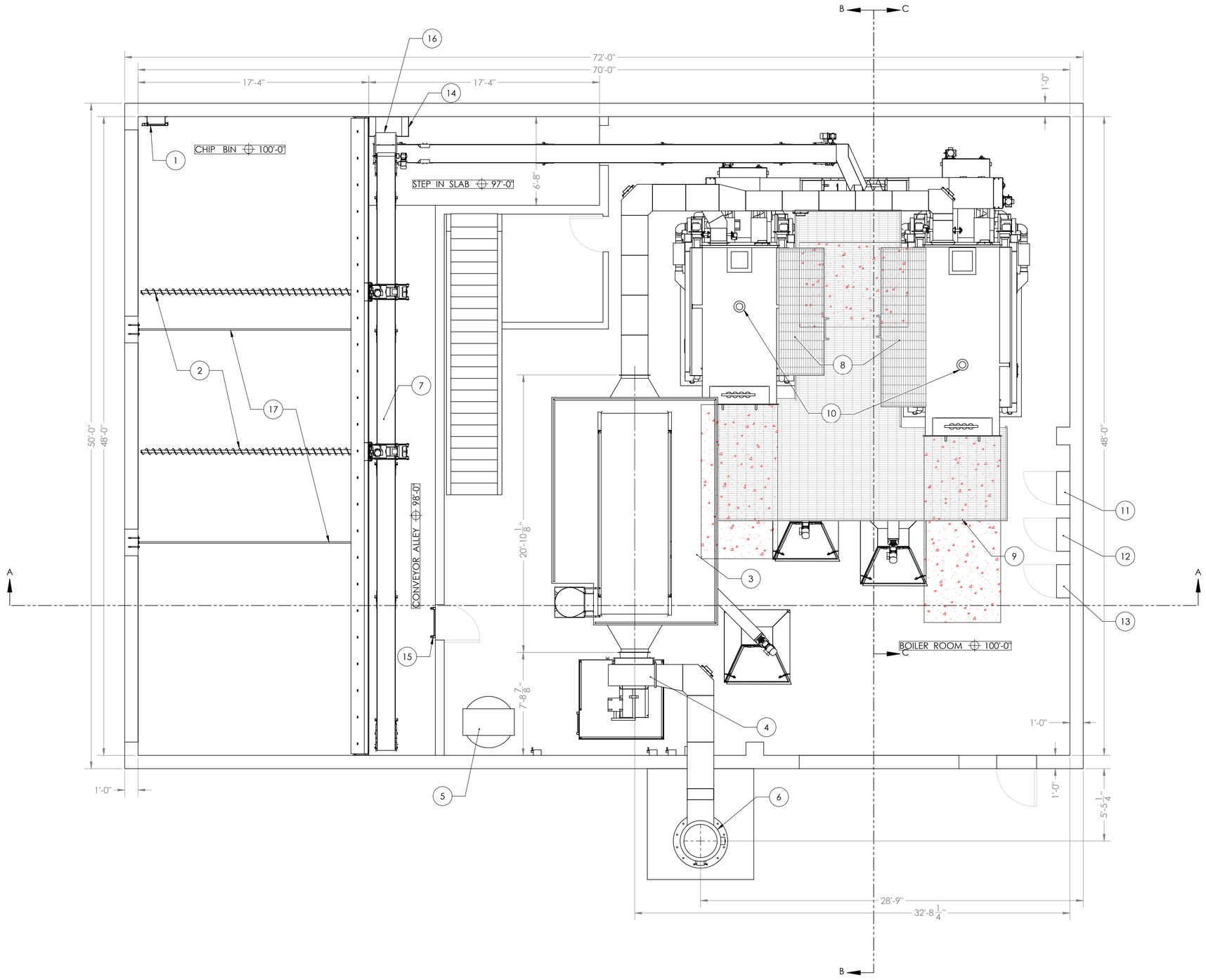
Continuous use means the motor runs continuously for 15 minutes or longer during normal operation.

HT-transformer units:

Number of aggregates	1
Peak voltage	70 kV
Secondary current	100 mA arithm

Energy consumption:

HT transformer unit	**approx. 2 kW**
Drivers for rapping	**0,04 kW**
Drivers for dust removal	**0,6 kW**
Trace Heating	**1,4 kW**
Back Fuse Size	**63 Amps**



ITEM	DESCRIPTION
1	Ladder for chip bin access - By MMI
2	Traveling Augers
3	ESP
4	ID fan with 25 hp motor
5	10hp 120 gal compressor
6	Ø 26" I.D. x 65' Painted Stack
7	16" Wide conveyor belt
8	Upper boiler maintenance platform - By MMI
9	Lower boiler maintenance platform - By others
10	4" 300 psi supply flanges
11	Boiler motor control center
12	Fuel system motor control center
13	Control panel
14	Oversized chip container
15	Ladder for conveyor alley access - By others
16	Chip screen
17	Bin wall stiffener - By MMI

MAINTENANCE AREA
KEEP CLEAR

Messersmith
Manufacturing Inc.
2612 F Road
Bark River, Mi 49807
Office (906) 466-9010
Fax (906) 466-2843

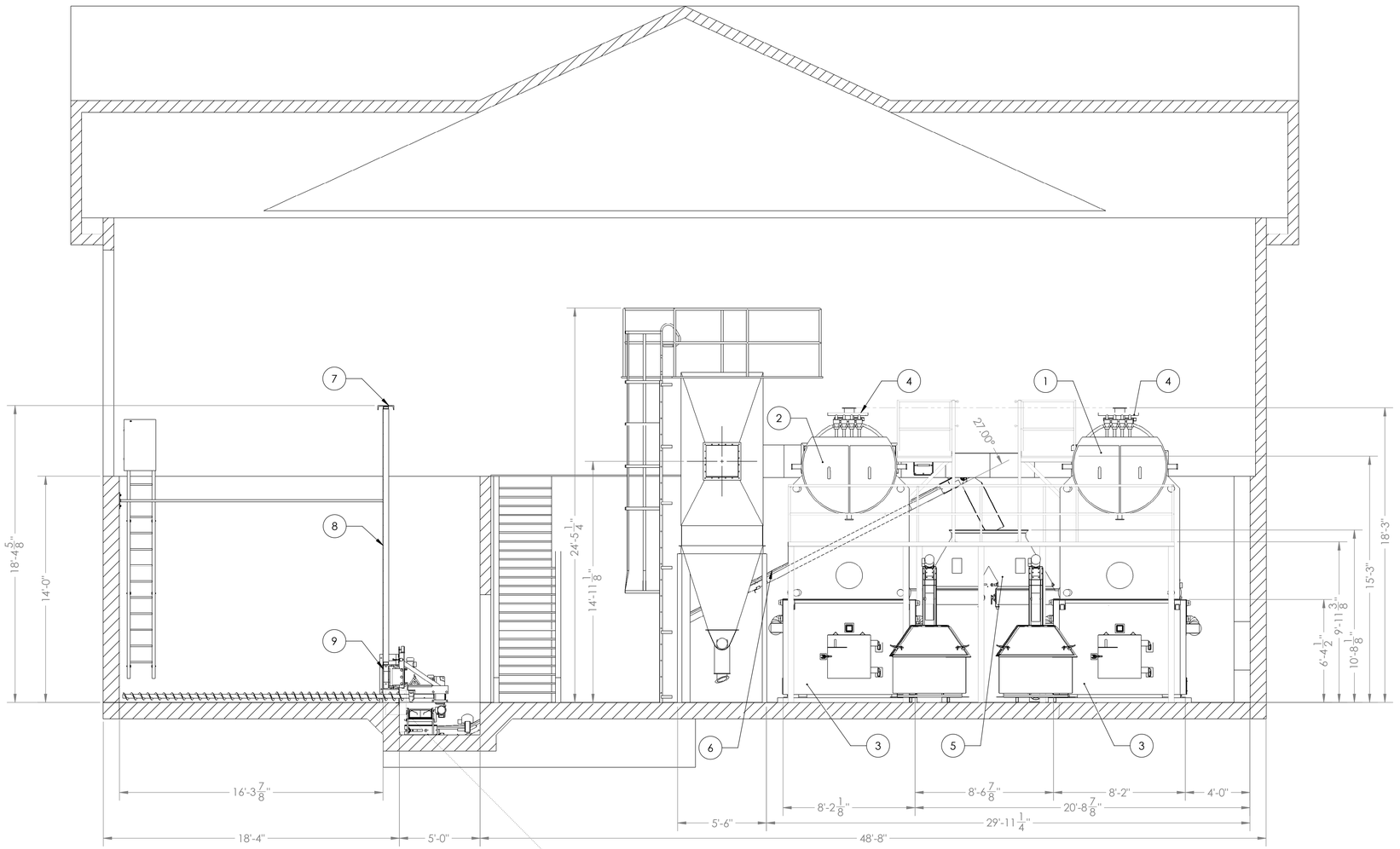
NORTH

PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF MESSESMITH MANUFACTURING, INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF MESSERSMITH MANUFACTURING, INC. IS PROHIBITED.

Littleton Boiler Room

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	Updated electrical information	5/15/2013	

PROJECT PHASE:	Installation
DATE:	3/6/2013
DRAWN BY:	JP
CHECKED BY:	
PROJECT NO.	929
SCALE:	1/4"=1'
REVISION:	A



SECTION A-A

DETAIL D
SCALE 1 : 16

Messersmith
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Fax (906) 466-2843

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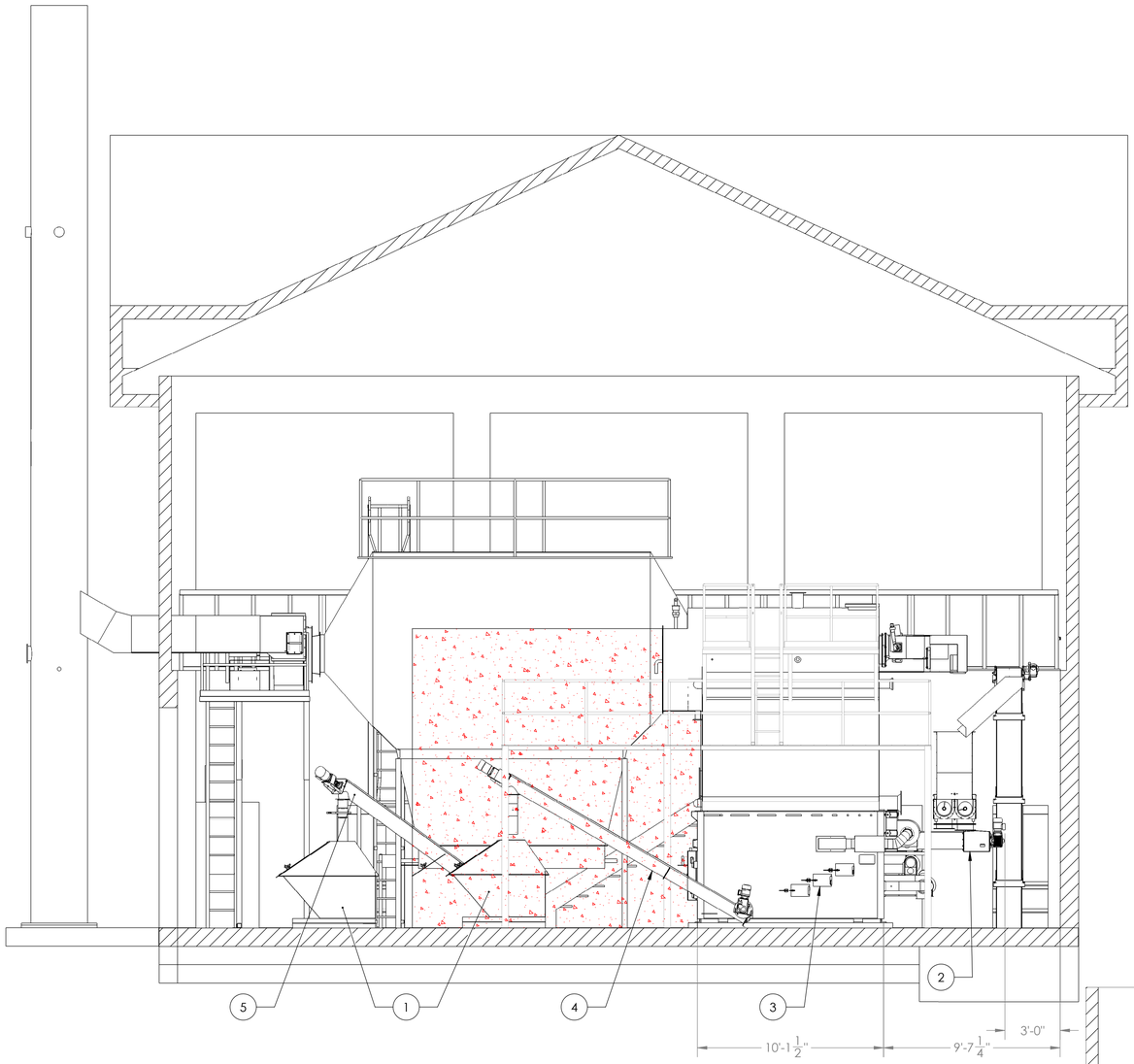
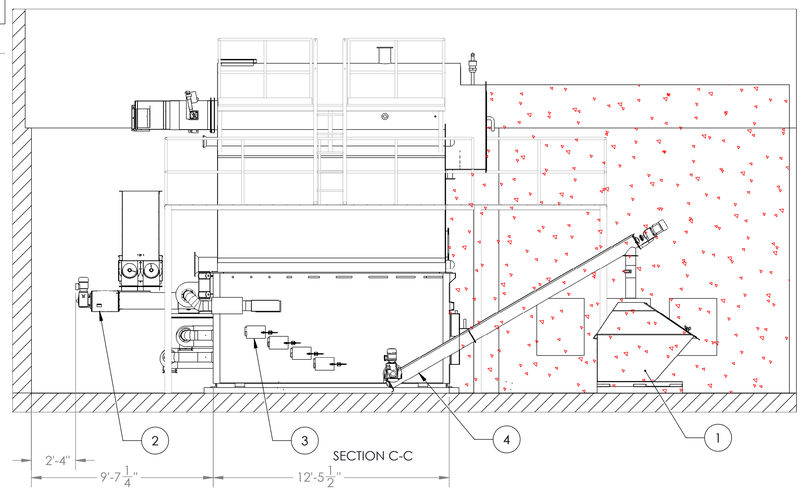
ITEM	DESCRIPTION
1	Boiler #1: Hurst N65-1300, 150 psi steam boiler
2	Boiler #2: Hurst N65-975, 150 psi steam boiler
3	Messersmith combustion base
4	Tube cleaner (min Ø1 1/2" pipe to compressor)
5	Metering Bin
6	Inclined conveyor
7	C12 x 25 Wall stabilizer
8	16' Steel chip bin wall
9	Beam for traveling auger

Littleton Boiler Room

PROJECT PHASE:	Installation
DATE:	3/6/2013
DRAWN BY:	JP
CHECKED BY:	
PROJECT NO.	929
SCALE:	1/4"=1'
REVISION:	A



SECTION B-B



SECTION C-C

Messersmith
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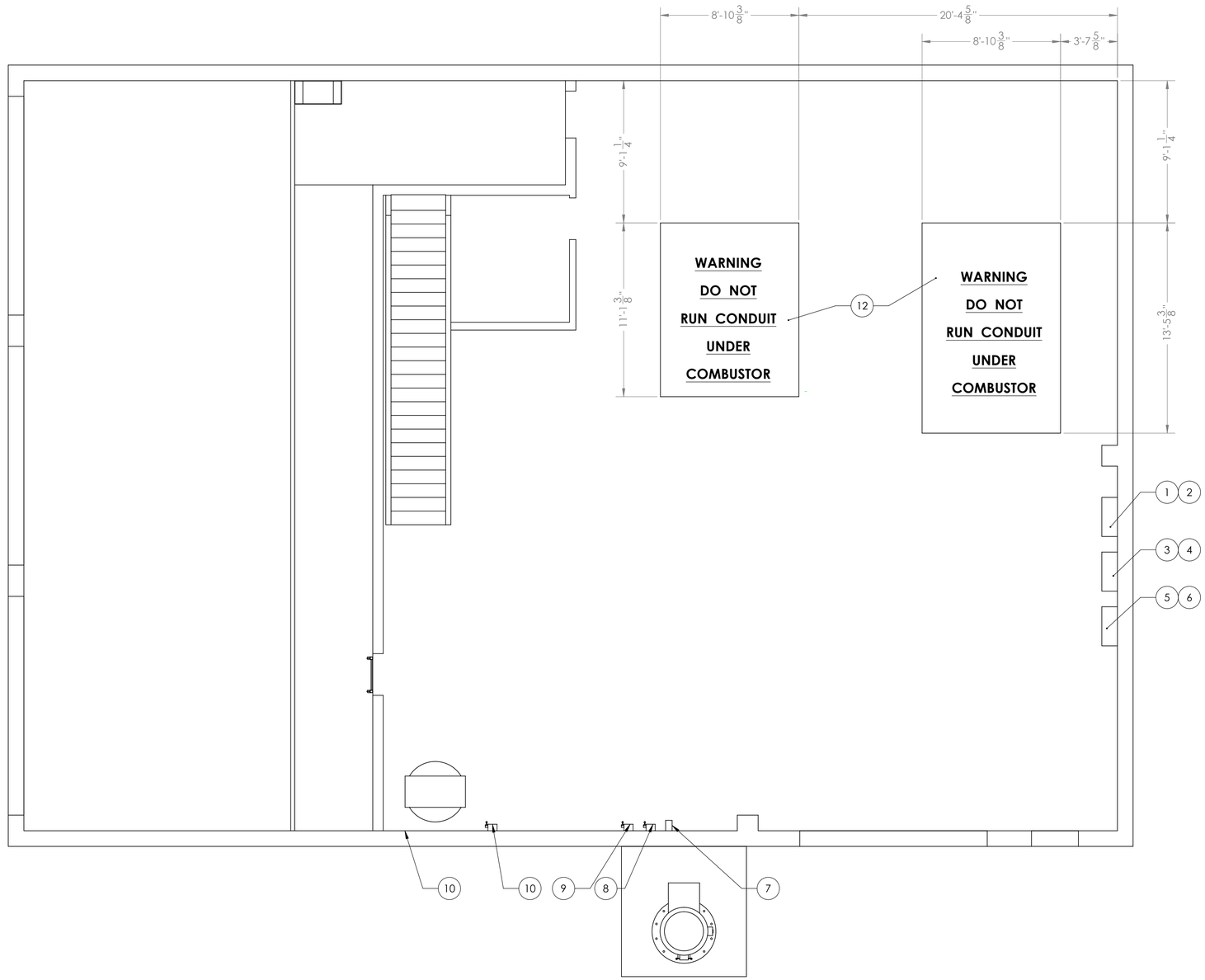
ITEM	DESCRIPTION
1	1.5 yd fly ash dumpster - By customer
2	Stoker auger
3	Undergrate ash cleanout
4	Auger for removal of combustor ash
5	Auger for removal of ESP ash

Littleton Boiler Room

PROJECT PHASE:	Installation
DATE:	3/6/2013
DRAWN BY:	JP
CHECKED BY:	
PROJECT NO.	929
SCALE:	1/4"=1'
REVISION:	A



Littleton Boiler Room

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ITEM	DESCRIPTION
1	Boiler #1control panel.
2	**Ciruit 1**: 480 V 30 A 3Ø - By Others **Circuit 2**:120 V 20 A 1 Ø - By others
3	Fuel delivery control panel
4	**Ciruit 3**: 480 V 30 A 3Ø - By Others **Circuit 4**:120 V 20 A 1 Ø - By others
5	Boiler #2 control panel
6	**Ciruit 5**: 480 V 30 A 3Ø - By Others **Circuit 6**:120 V 20 A 1 Ø - By others
7	VFD Drive - By Messersmith
8	**Circuit 7**: 480 V 40 A 3Ø VFD disconnect - By Others
9	**Circuit 8**: 480 V 63 A 3Ø ESP disconnect - By Others
10	**Circuit 9**: 480 V 20 A 3Ø Compressor disconnect - By Others
11	**Circuit 10**: 120 V 15 A 1Ø Tank drain outlet
12	4" Thick boiler pad

PROJECT PHASE:	Installation
DATE:	3/6/2013
DRAWN BY:	JP
CHECKED BY:	
PROJECT NO.	929
SCALE:	1/4"=1'
REVISION:	A

MESSERSMITH WOOD CHIP COMBUSTION SYSTEM

The Combustion System includes a Hurst Boiler, and a Messersmith Combustor/Furnace Base for the boiler.

The Hurst Boiler is a three-pass firebox boiler that is designed, constructed and stamped in accordance with the requirements of the ASME Boiler Code. It is also inspected and registered with National Board of Boiler & Pressure Vessel Inspectors. The boiler is of wet back construction. It is factory insulated, jacketed and painted. It is complete with the operating controls and relief valves.

The Messersmith Combustor/Base is a reinforced 0.25" steel combustion chamber which also is the base for the boiler. Please refer to the Messersmith submittal drawing for dimensions.

The base is lined with 4" of ceramic fiber insulation, rated for 1900 degrees F and at least 6" of refractory, rated at 3200 degrees F. Access doors are provided to allow the maintenance personnel to remove ash from under the grates. Ashes on top of the grates can be pulled down and removed from the combustor. A sight glass allows for observation of the combustion process.

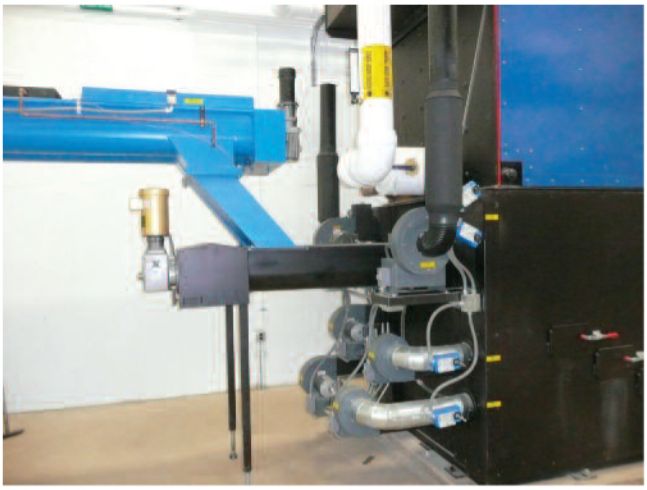
The grates are installed inside the combustor on a steel frame. Underfire air and overfire air are preheated by being drawn through the jacket of the base.

Messersmith

Industrial Biomass Boiler System

Industrial Biomass Boiler System

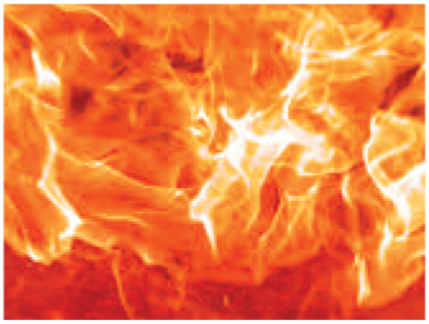
An automated biomass system that is custom designed for your unique needs.



Save over 50% of fuel cost while investing in your local economy

Fuel is emptied, by the delivery truck, into a large storage bin. The traveling auger pulls the fuel forward onto a belt conveyor. The belt conveyor then carries the fuel to the metering bin.

The metering auger conveys fuel from this bin. The speed of the metering auger varies to control the heat output of the boiler. The stoker auger quickly moves the fuel onto the specially designed grates in the combustor.



You can burn biomass fuels such as wood chips, sawdust or other clean biomass. The maximum allowable fuel moisture content is 45%. High combustion temperatures and computer control of combustion air result in clean, efficient combustion with low Carbon Monoxide (less than 100 PPM) and only a small quantity of ash.

The Heat You Can Afford
The Technology You Need
The Reliability You Deserve

The Messersmith control panel automatically:

- Responds to the heat load on the boiler by varying fuel feed and combustion air supply.
- Maintains a pilot burn when there is little or no heat load.
- Monitors the operation of fuel handling equipment.
- Protects motors from overload and boiler from low water conditions.
- Communicates with building Direct Digital Control systems.
- Allows Messersmith technicians to remotely troubleshoot your system.

Biomass System Safety features:

- Non-electric thermostatic valve fire suppression system
- Stoker auger continues running until empty

Factory Installation, Startup and Operator Training:

- Available BTU outputs from 1,000,000 to 20,000,000
- Our factory craftsmen that build your system will also install it
- Startup by factory technicians ensures clean, efficient combustion and well trained local operators

Messersmith Manufacturing, Inc.
Bark River, MI 49807
906-466-9010 • Fax 906-466-2843
www.burnchips.com

Messersmith

Industrial Biomass Boiler System

CALL TODAY
and start heating
the inexpensive way

You'll start saving immediately with your new, efficient Messersmith Industrial Biomass Boiler System. Our customers usually experience at least a 50% savings in their fuel cost.

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Patz®

Partners in Progress Since 1948!

Trough Slider-Bed Belt Conveyors

Models 8912, 8916, 1608

For economical conveying of light-to-medium-density bulk materials.

(Unit shown with optional decline and stands.)

Model 8912

(Unit shown with optional incline and stands.)

Model 8916

Choose from a wide variety of:

- ***conveyor lengths***
- ***belt widths***
- ***belt speeds***
- ***full load capacities***

High Gloss Polyester Powder Coated

(Unit shown with optional stands.)

Model 1608

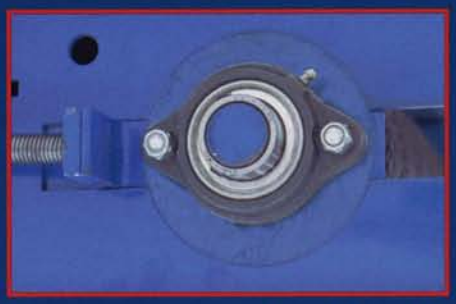
FLEXIBLE PAYMENT PLANS AVAILABLE. ASK FOR DETAILS.

Standard Features...

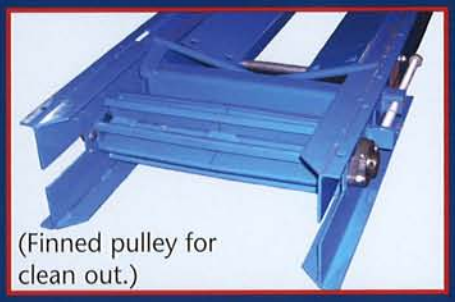
that benefit you day after day.

Open pan design provides trough for extra capacity and reduces belt friction for lower power requirements.

Return wheels carry belt on return bottom to reduce friction for longer belt life and less strain on the drive system.



Bearings are precision, long-life, sealed and greaseable for trouble-free, continuous duty.



(Finned pulley for clean out.)

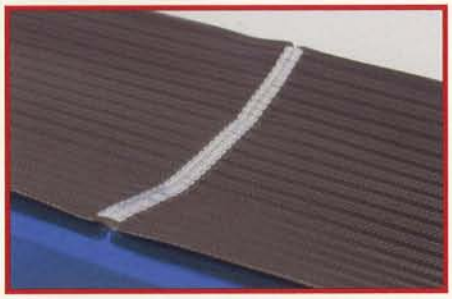
Note convenient adjustment for belt tension and tracking. 5/8" screw provides up to 20-inches of belt take-up.

High gloss polyester powder coated steel, bolt-together conveyor sections resist rust. The rugged, formed frame is heavy-gauge steel for durability.

Optional Features...

for extra versatility.

An optional wiper or powered brush (shown) belt wiper cleans the top surface of non-cleated belting.



Belts are available with a textured or smooth surface. A cleated belt is available for Model 8916. The alligator or clipper splice is stainless steel.

Covers available to protect material and conveyor from wind, rain and other contaminants.

Elevate 0°-30° and then convey level with an adjustable decline. Belt stays concave when passing over the elbow for maximum capacity.

Loading hopper controls material loading and prevents spillage.

Adjustable incline permits horizontal conveying with maximum 30° incline. Available on Model 8916 and 1608 Conveyors only.

Patz Model 8916

Move your materials where you want at the speed you need!

Specification Table

Overall Lengths ft.	Overall Lengths m	Bed Lengths ft.	Bed Lengths m
12′ 5″	3.785	10′	3.048
22′ 5″	6.833	20′	6.096
32′ 5″	9.881	30′	9.144
42′ 5″	12.929	40′	12.192
52′ 5″	15.977	50′	15.240
62′ 5″	19.025	60′	18.288
72′ 5″	22.073	70′	21.336
82′ 5″	25.121	80′	24.384
92′ 5″	28.169	90′	27.432
102′ 5″	31.217	100′	30.480
112′ 5″	34.265	110′	33.528
122′ 5″	37.313	120′	36.576

Weights available upon request.

Note: Sections can be field cut to exact lengths for custom fit.

Heavy-duty crowned, rubber lagged steel drive pulley is 5″ (127 mm) diameter, for positive nonslip traction.

(Unit shown with optional V-belt drive incline and stands.)

(Shown ▲ with optional belt wiper.)

- *Move material exactly where you want with one-way or two-way conveying, adjustable elbow or straight-line conveying and plowoff.*
- *Move material at your choice of 4 belt speeds. (Shown with various options installed).*

Belt Width: 16″ (406 mm)

Belt Speed:

- V-Belt Drive: 370 RPM
- Direct Drive: 260, 130 or 65 RPM

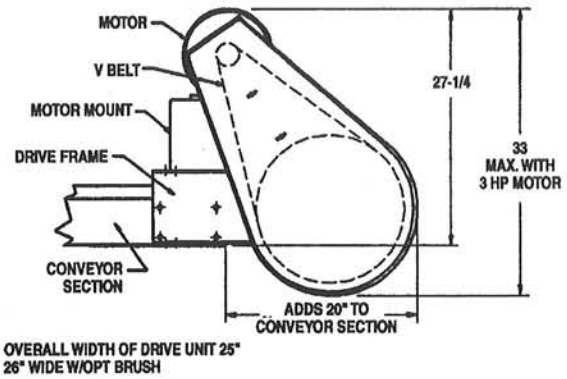
Overall Lengths: 4′ to 120′ (1.219 m to 36.576 m)

Note: 10′ sections standard. Can field cut to exact length for custom fit.

Full Load Capacity:

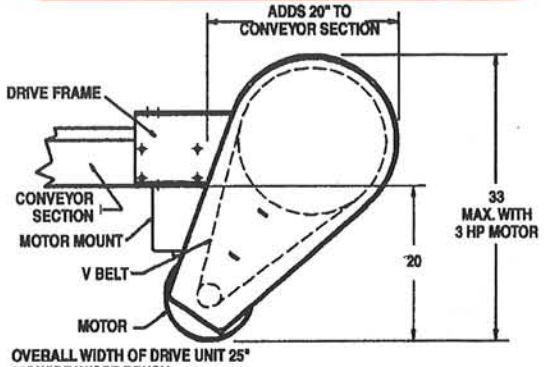
- Up to 90 ft³/min (2.55 m³/min) or
- Up to 3,700 lbs/min (1678 kg/min)

V-BELT DRIVE Motor on Top (RH or LH) - Side View



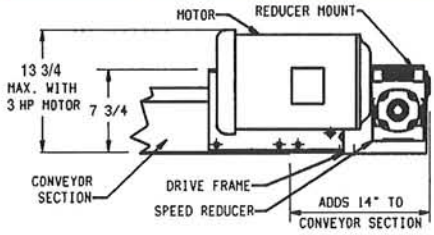
OVERALL WIDTH OF DRIVE UNIT 25" 26" WIDE W/OPT BRUSH

V-BELT DRIVE Motor on Bottom (RH or LH) - Side View

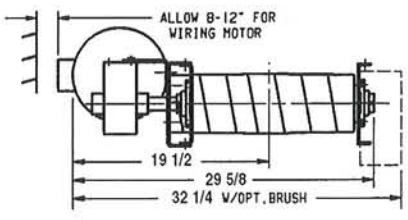


OVERALL WIDTH OF DRIVE UNIT 25" 26" WIDE W/OPT BRUSH

DIRECT DRIVE (RH or LH) - Side View



DIRECT DRIVE (RH or LH) - End View



STANDARD Equipment		8912	8916	1608
Overall Lengths	10′ (3.048) to 120′ (48.768 m) in 10′ (3.048 m) increments.		■	
	10′ (3.048) to 160′ (48.768 m) in 10′ (3.048 m) increments.	■		
	10′ (3.048) to 200′ (60.960 m) in 10′ (3.048 m) increments.			■
	Maximum length of individual bed section is 10′ (3.048 m); modular sections bolt together for lengths beyond 10′ (3.048 m).	■	■	■
Frame	Concave open bed, formed 16 ga. powder coated steel.	■	■	■
	6 1/2″ (165 mm) depth, 12 7/8″ (327 mm) width.	■		
	6 1/2″ (165 mm) depth, 17 1/8″ (435 mm) width.		■	■
Belt Width	12″ (305 mm).	■		
	16″ (406 mm).		■	■
Belt	Choose from varous belt choices to match environment and material conveyed.	■	■	■
Belt Speed	370 ft/min (112.8 m/min), 260 ft/min (79.2 m/min), 130 ft/min (39.6 m/min). or 65 ft/min (19.8 m/min), depending on drive selected.	■	■	
	390 ft/min (118.9 m/min), 260 ft/min (79.2 m/min), depending on drive selected.			■
Drive Pulley	5″ (127 mm) dia., crowned, steel, rubber lagged.	■	■	
	8″ (127 mm) dia., crowned, steel, rubber lagged.			■
Tail Pulley	5″ (127 mm) dia., finned, steel.	■	■	■
Bearings	Long-life, sealed, prelubricated, greasable.			
	1 1/4" bearing on idler and drive end.	■	■	
	1 1/4" bearing on idler; 1 1/2" bearing on drive end.			■
Belt Take-up	Screw-type take-up at tail pulley.	■	■	■
Load Capacity	Up to 56 ft³/min (1.58 m³/min), 3,700 lbs/min (1678 kg/min).	■		
	Up to 90 ft³/min (2.55 m³/min), 3,700 lbs/min (1678 kg/min).		■	
	Up to 95 ft³/min (2.69 m³/min), 3,900 lbs/min (1769 kg/min).			■
Span	Up to 20′ (6.096 m) between supports.	■	■	■
Color	Blue high gloss polyester powder coat.	■	■	■
Electrical Controls	Customer supplied, except optional equipment.	■	■	■
Assembly	Conveyor supplied unassembled.	■	■	■

OPTIONAL Equipment		8912	8916	1608
Overall Lengths	Conveyor lengths from 4′ (1.219 m) to 200′ (60.960 m) are possible.*			■
	Conveyor lengths from 4′ (1.219 m) to 160′ (48.768 m) are possible.*	■		
	Conveyor lengths from 4′ (1.219 m) to 120′ (36.576 m) are possible.* *Intermediate lengths are possible by field cutting.*		■	
Belt	Black, P.V.C. 120 COS, smooth or textured, standard & cold temp. Other belts available on request.	■	■	■
	Black, P.V.C. 120 COS, cleated for 10′ (3.048 m) to 40; (12.192 m).		■	
Drive Mount	Mount in various positions to match installation requirements.	■	■	■
Drive Motors	1 to 3 HP, 1 Ph. or 3 Ph. electric motor drive; hydraulic motor drive also available.	■	■	■
	3 HP or 5 HP, 1 Ph. or 3 Ph. electric motor drive.			■
Conveyor Supports	Supports and mounting hardware available.	■	■	■
Covers	20 ga. powder coated in 10′ (3.048 m) lengths.	■	■	■
Loading Hoppers	Funnels material into conveyor trough.	■	■	■
End Spout	Directs material discharge.	■	■	■
Belt Wipers	Blade or brush types for cleaning top of belts.	■	■	■
Magnets	Remove ferrous metals as the material slides over magnets.	■	■	■
Adjustable Decline	Adjust 0° to 30°.	■	■	■
Adjustable Incline	Adjust 0° to 30°.		■	■
Convey Sides	Positions material and helps seal edges to prevent material under belt.	■	■	■
Plow-Off	Locate anywhere along the conveyor to plow off in one direction.		■	■
Electrical Control	Reversing drum switch.		■	

Patz®

CAUTION: Never operate Patz equipment without all shields and guards in place. Safety is no accident. Before operating any piece of equipment, be sure to read and understand the operator's manual. This manual should be kept with the machine at all times. Additionally, make sure all safety shields and devices are functioning properly and are securely in place.

For some photos in this brochure, guards were removed for photographic purposes only to allow viewing of the equipment features. Before operating equipment, all guards must be in place. Because Patz continually improves and updates products, Patz reserves the right to change the construction of machines or attachments or any part thereof without incurring any obligation to make like changes on Patz machines, or attachments previously delivered.

Specifications and prices subject to change without notice.

Performance Strong as Steel

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DW

929

Littleton Regional Hospital

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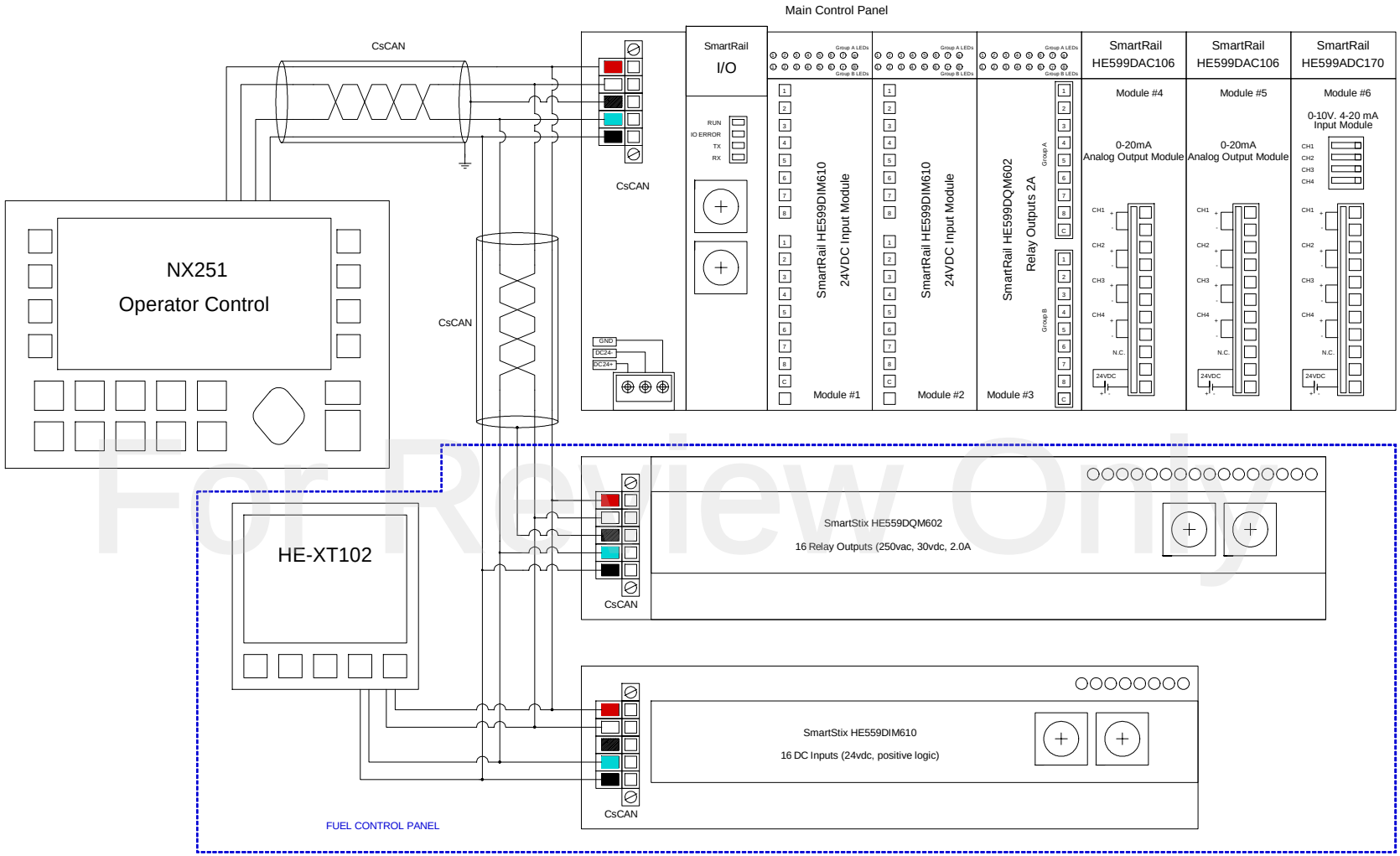
For Review Only

Boiler Control and Fuel Control Drawings: ***(E1-E10 is the same for each boiler)***

E1 PLC Control System Overview
E2 Boiler Digital Inputs (24VDC)
E3 Boiler Digital Outputs (24VDC)
E4 Boiler Analog Outputs (4-20mA)
E5 Boiler Analog Inputs (4-20mA)
E6 Boiler Power Supply
E7 Induced Draft Fan
E8 Boiler Terminal Assignments
E9 Boiler Combustion Air Motors Control (480VAC)
E10 Boiler Stoker and Ash Motors Control (480VAC)
E11 Fuel Panel PLC Digital Inputs (24VDC)
E12 Fuel Panel PLC Digital Outputs (24VDC)
E13 Fuel Panel Motor Controls (480VAC)
E14 Fuel Panel Terminals Assignments
E15 Air Compressor



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Rev	Date	Description	CK

Project No. 929

E1

PLC Control System Overview

Scale NONE

Sheet 1 of 15

Date: 4/28/2013

File: E1.DCD

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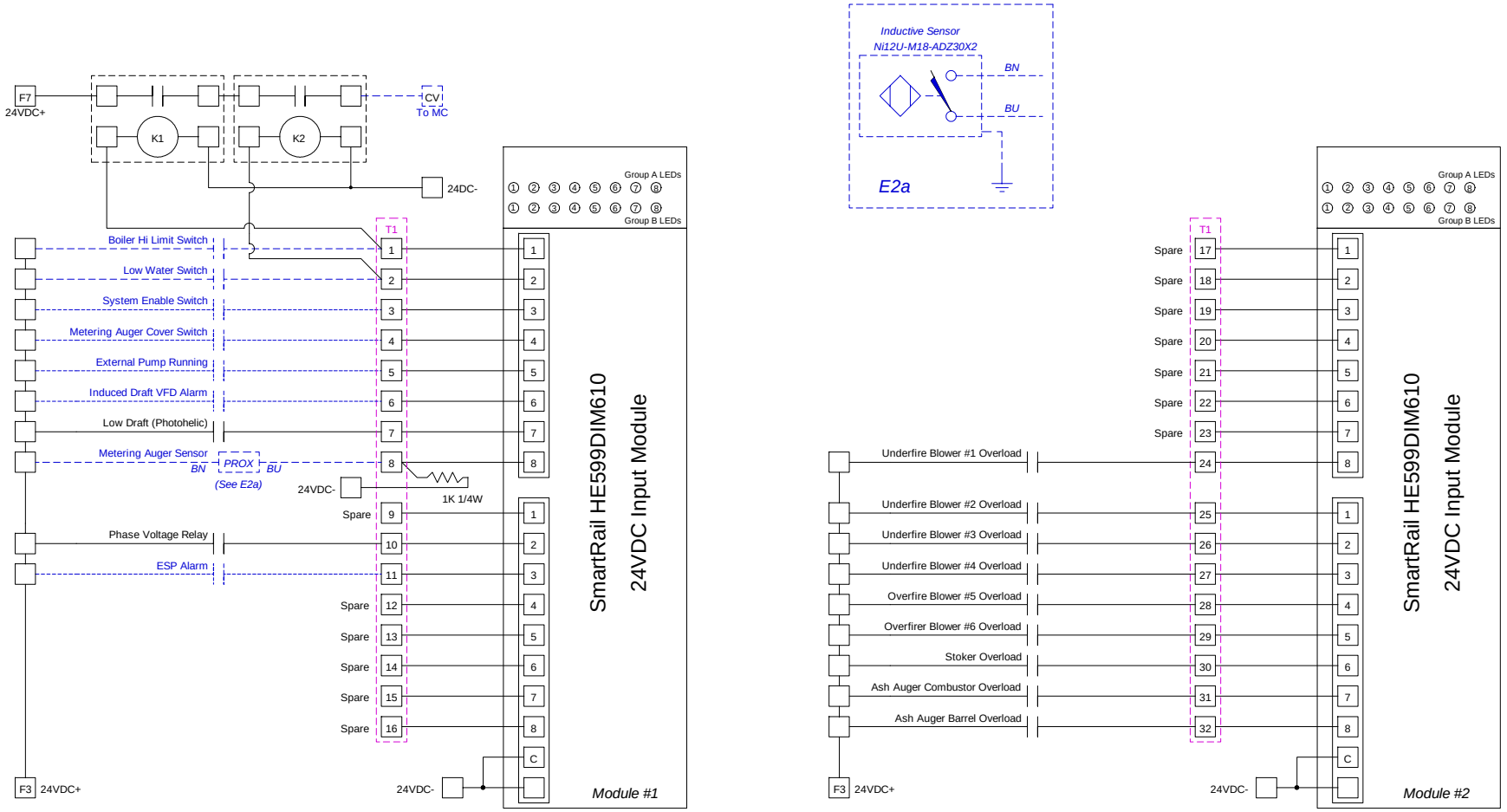

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Project No. 929

E2 — Boiler Digital Inputs

Scale NONE

Sheet 2 of 14

Date: 5/15/2013

File: E2.DCD

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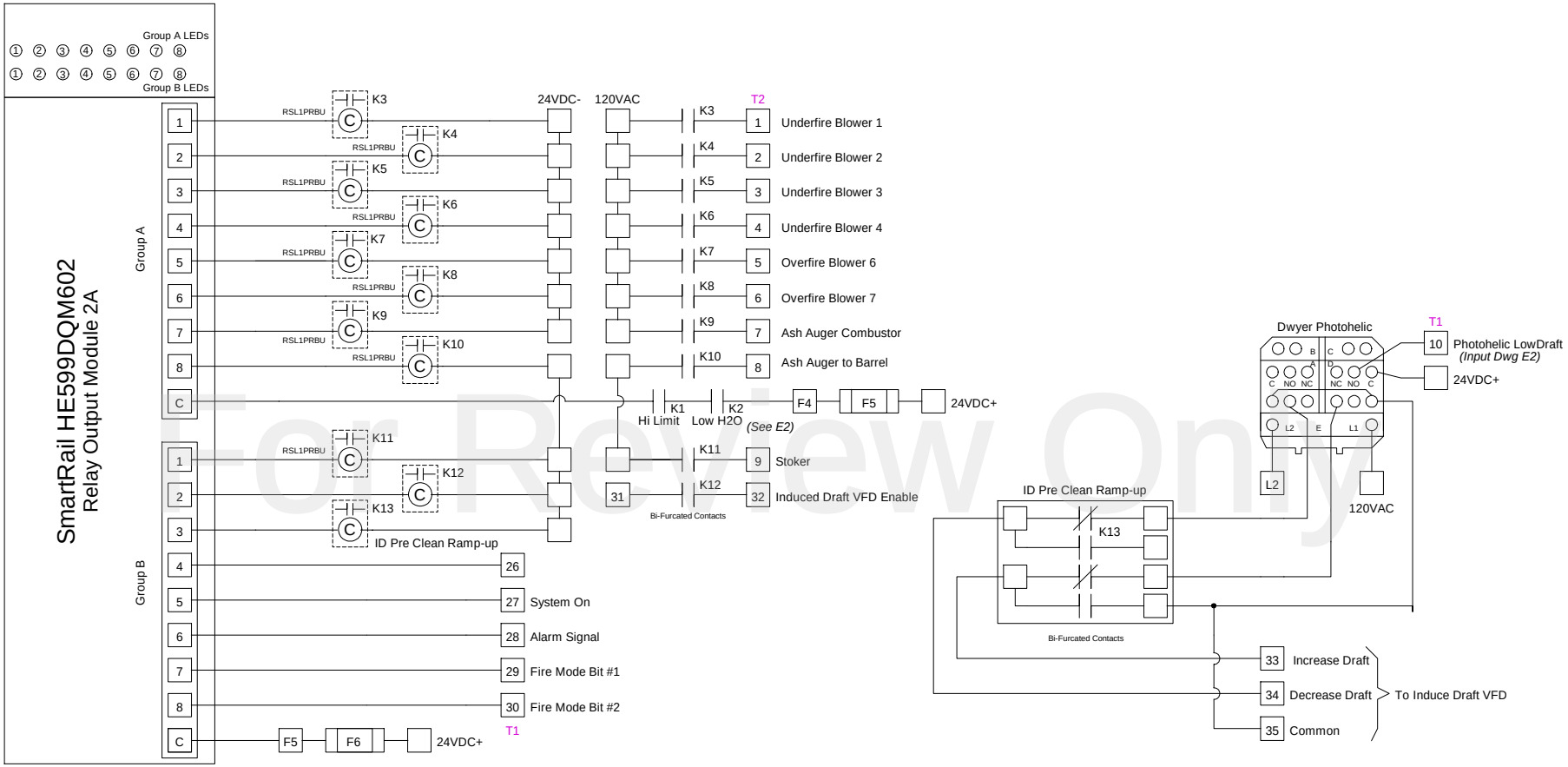

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Project No. 929

E3

Boiler
Digital Outputs

Scale NONE

Sheet 3 of 14

Date: 4/28/2013

File: E3.DCD

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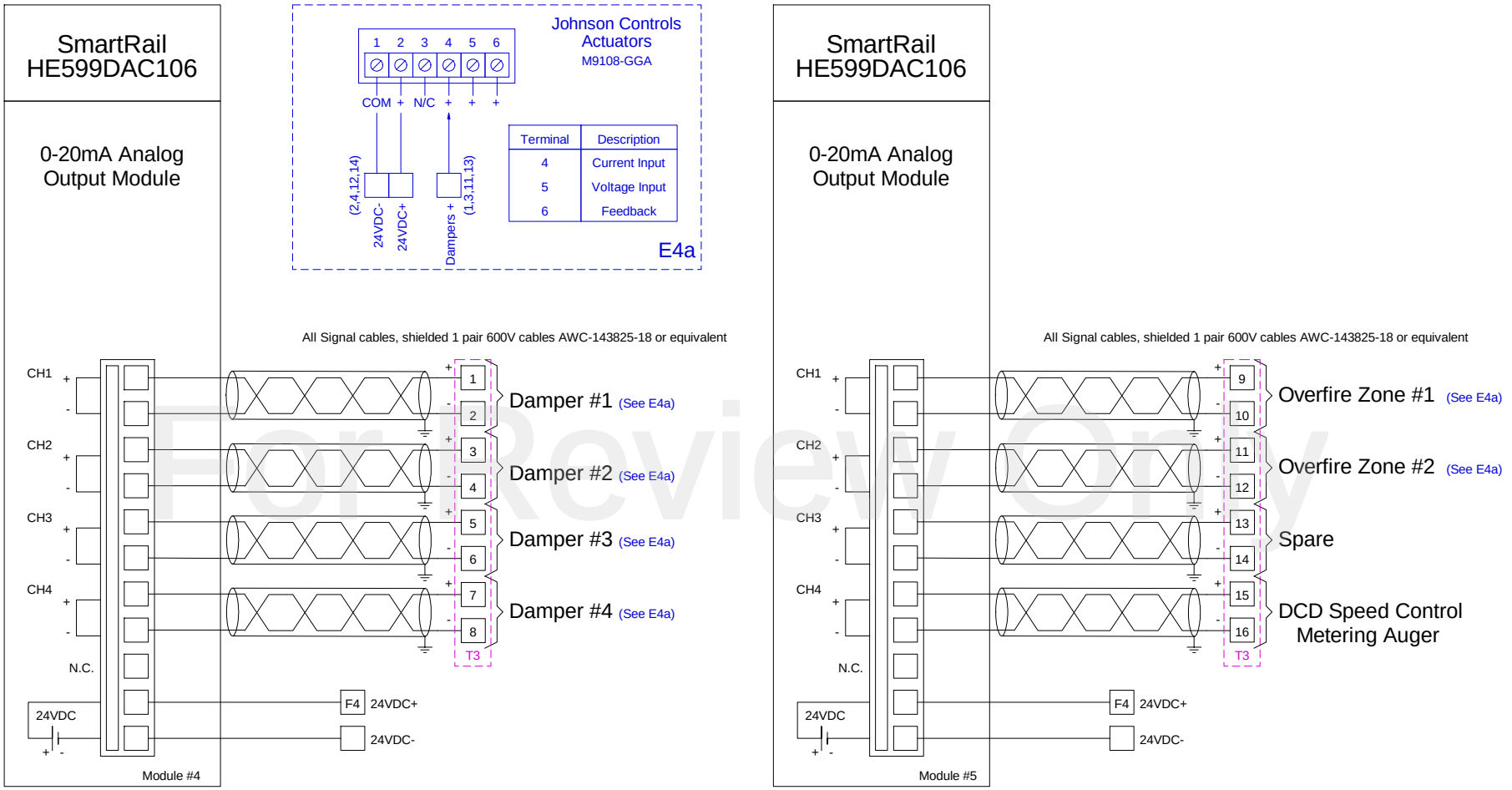

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Project No. 929

E4

Boiler
Anaolg Outputs

Scale NONE

Sheet 4 of 14

Date: 4/28/2013

File: E4.DCD

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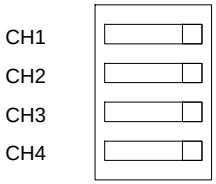
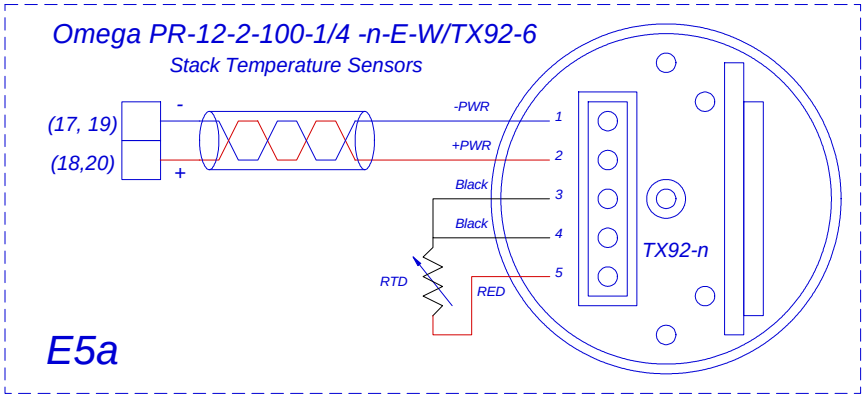
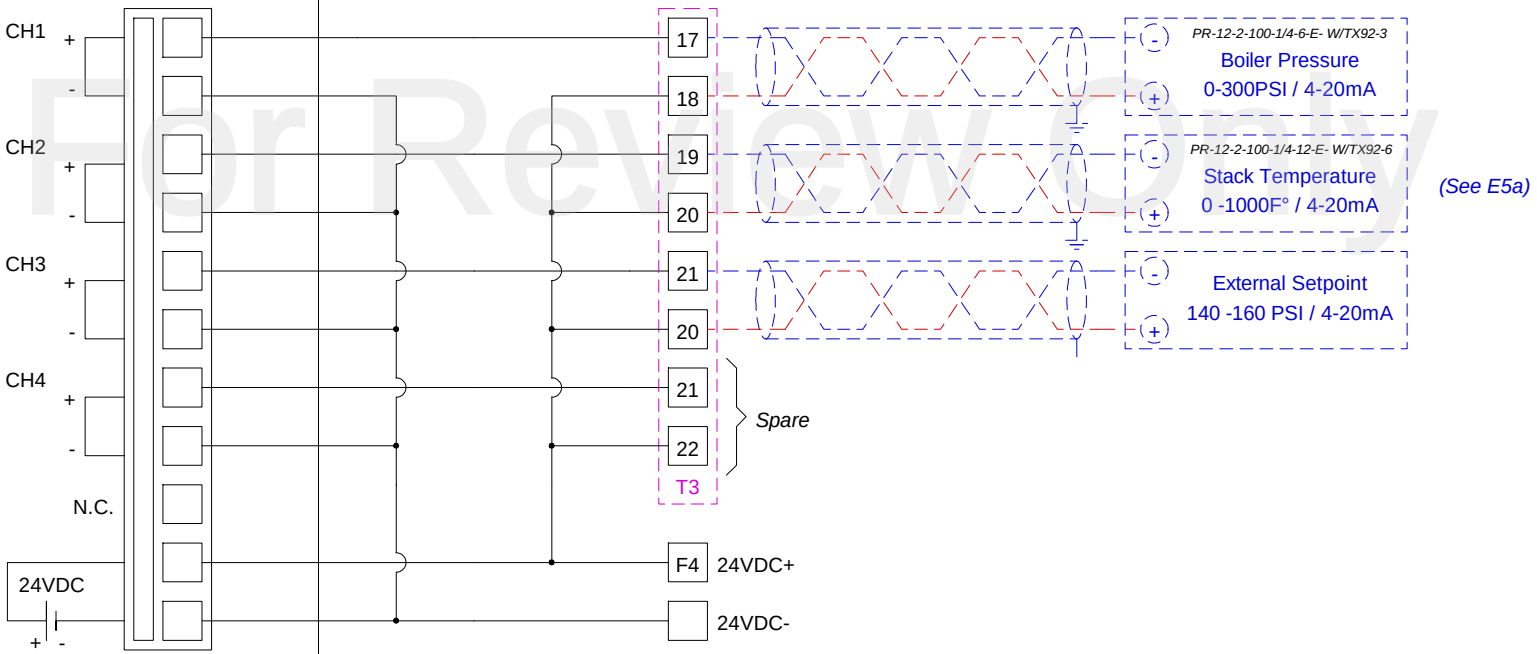
SmartRail HE599ADC170

0-10V, 4-20mA Input Module





All signal cables, shielded 1 pair 600V cables AWC-143825-18 or equivalent



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Project No. 929

E5 — Boiler Analog Inputs

Scale NONE

Sheet 5 of 14

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File: E5.DCD

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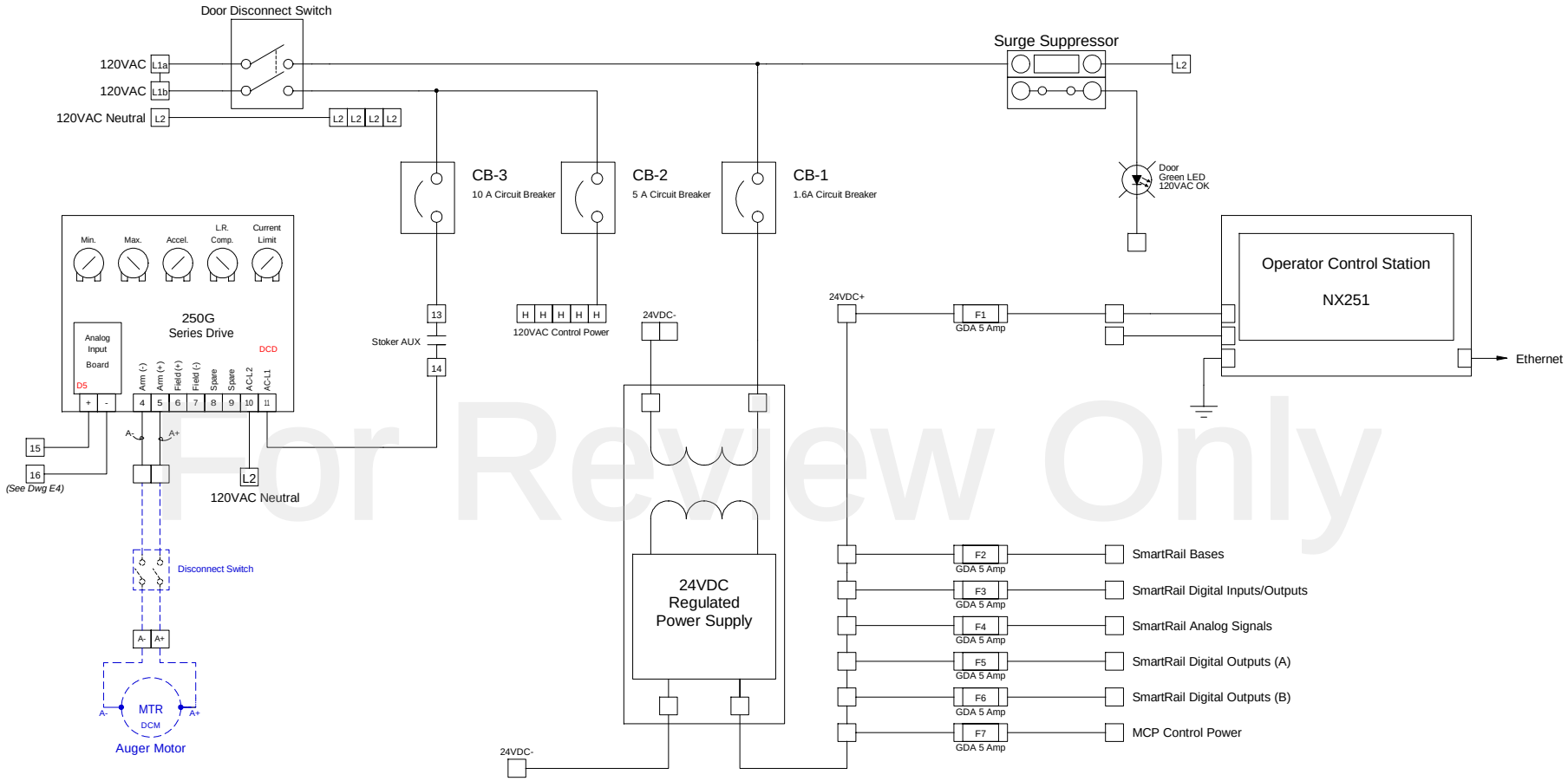

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Project No. 929

E6

Boiler
Power Supply

Scale NONE

Sheet 6 of 14

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File: E6.DCD

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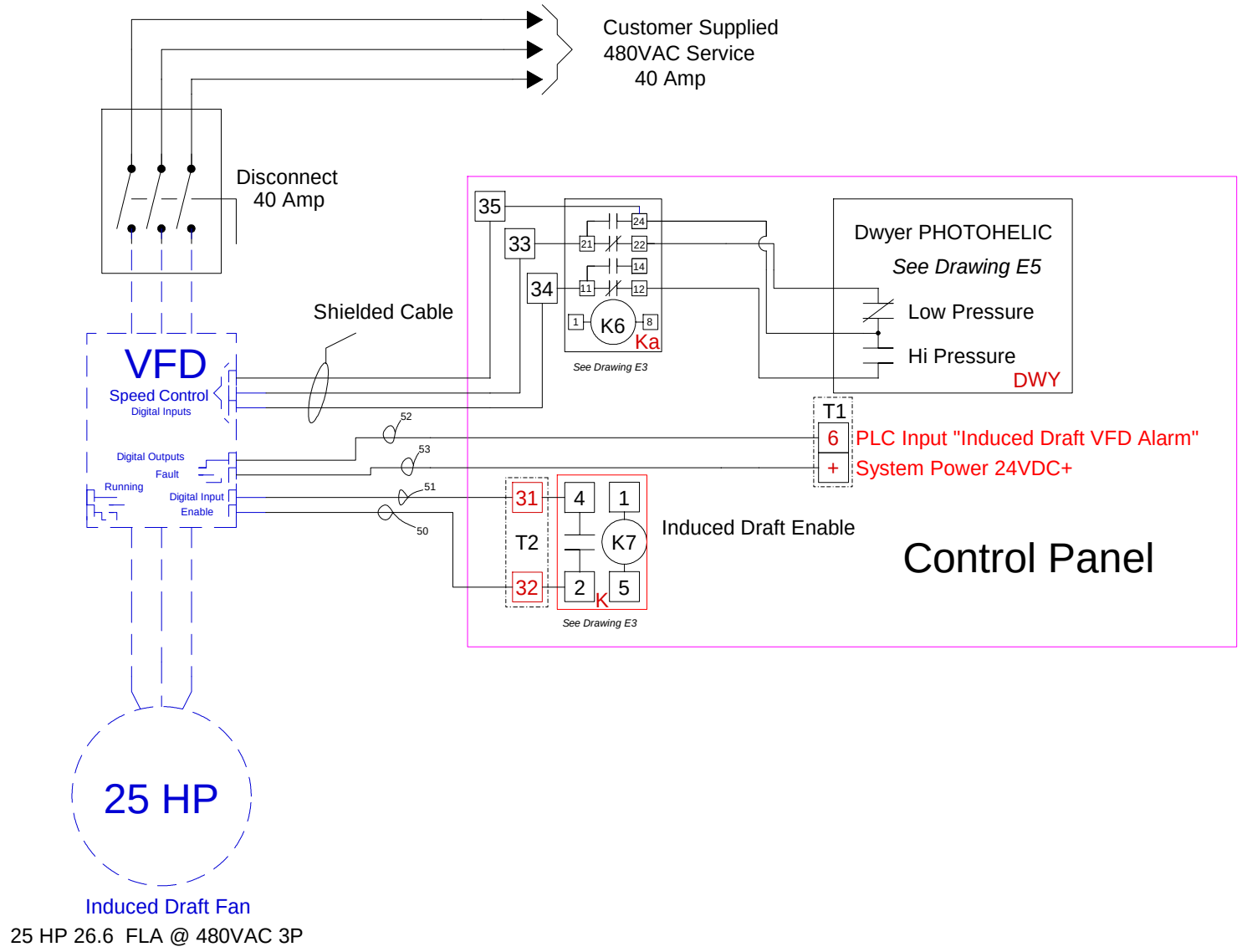

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Rev	Date	Description	CK

E7 — Induced Draft Fan

Scale: NONE

Sheet 7 of 14

Project No. 929

Date: 5/15/2013

File: E7.DCD

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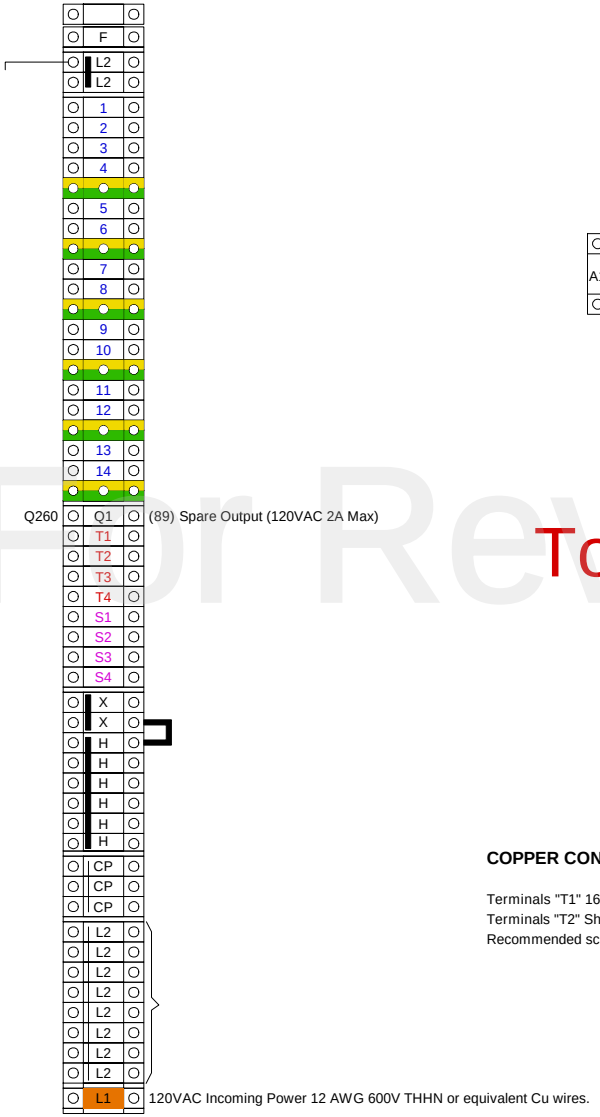
Terminals T1

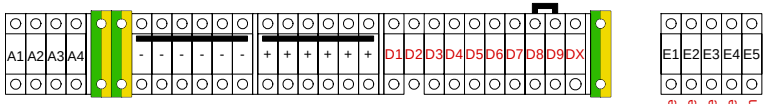
(90VDC)

A+ A+ (68) Metering Auger DC Motor ARM +
A- A- (69) Metering Auger DC Motor ARM - } 12AWG Cu Wire THHN 600V

(120VAC)



Terminals T2 (24VDC)



For Review Only

To Be Determined

COPPER CONDUCTORS ONLY

Terminals "T1" 16-12 AWG 600V THHN or equivalent Cu wires Only except where noted.
Terminals "T2" Shielded 20 AWG Cu twisted pairs cables only.
Recommended screw tightening torque: 7-8 lbf-in, 0.8-0.9 N-m

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E8 — Boiler Terminals

Scale NONE
Sheet 8 of 14

Project No. 929
Date: 3/19/2013
File: E8.DCD

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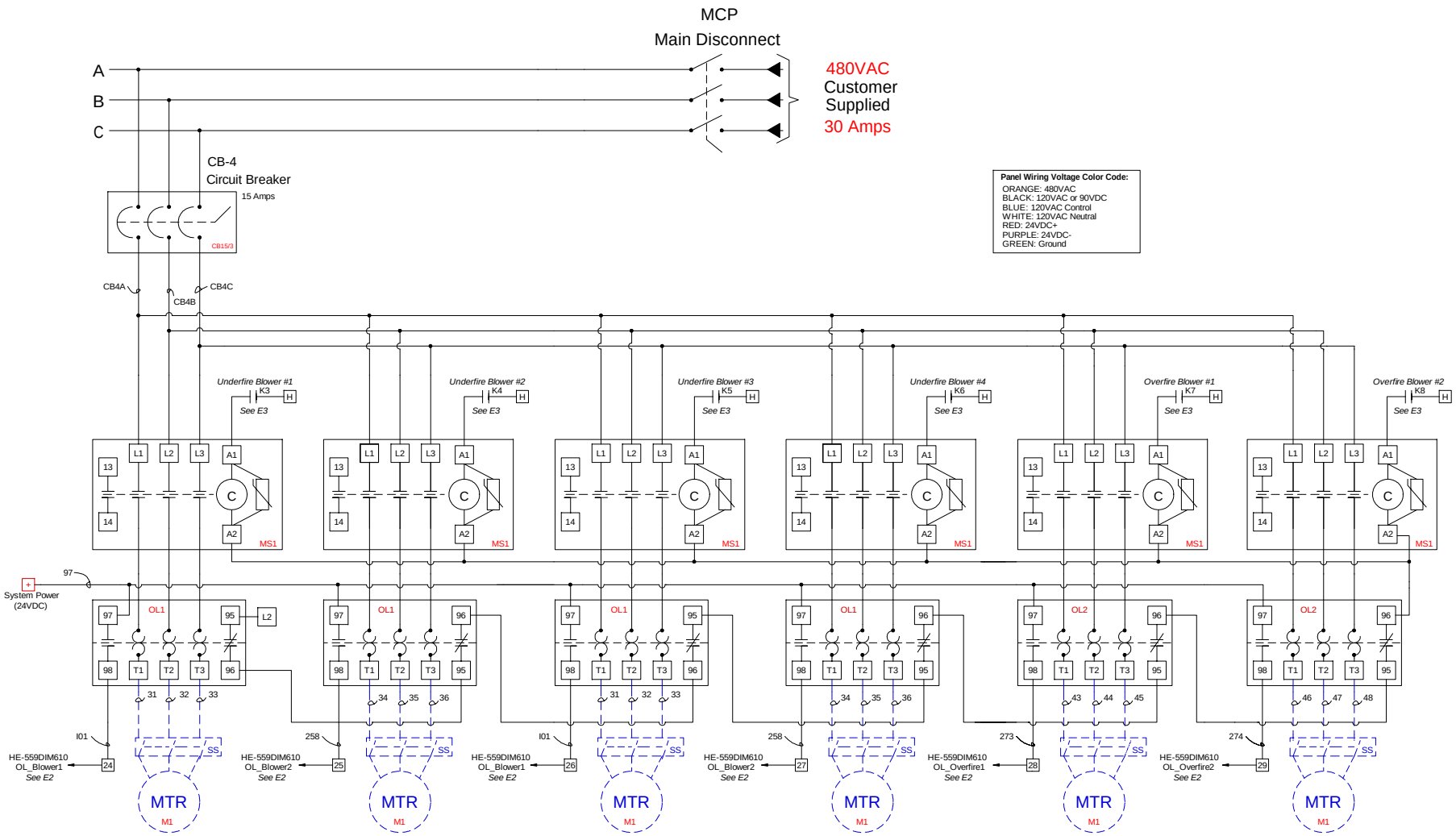

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Rev	Date	Description	CK

Project No. 929

E9

Boiler
Combustion Air Motor

Scale NONE

Sheet 9 or 15

Date: 5/15/2013

File: E9.DCD

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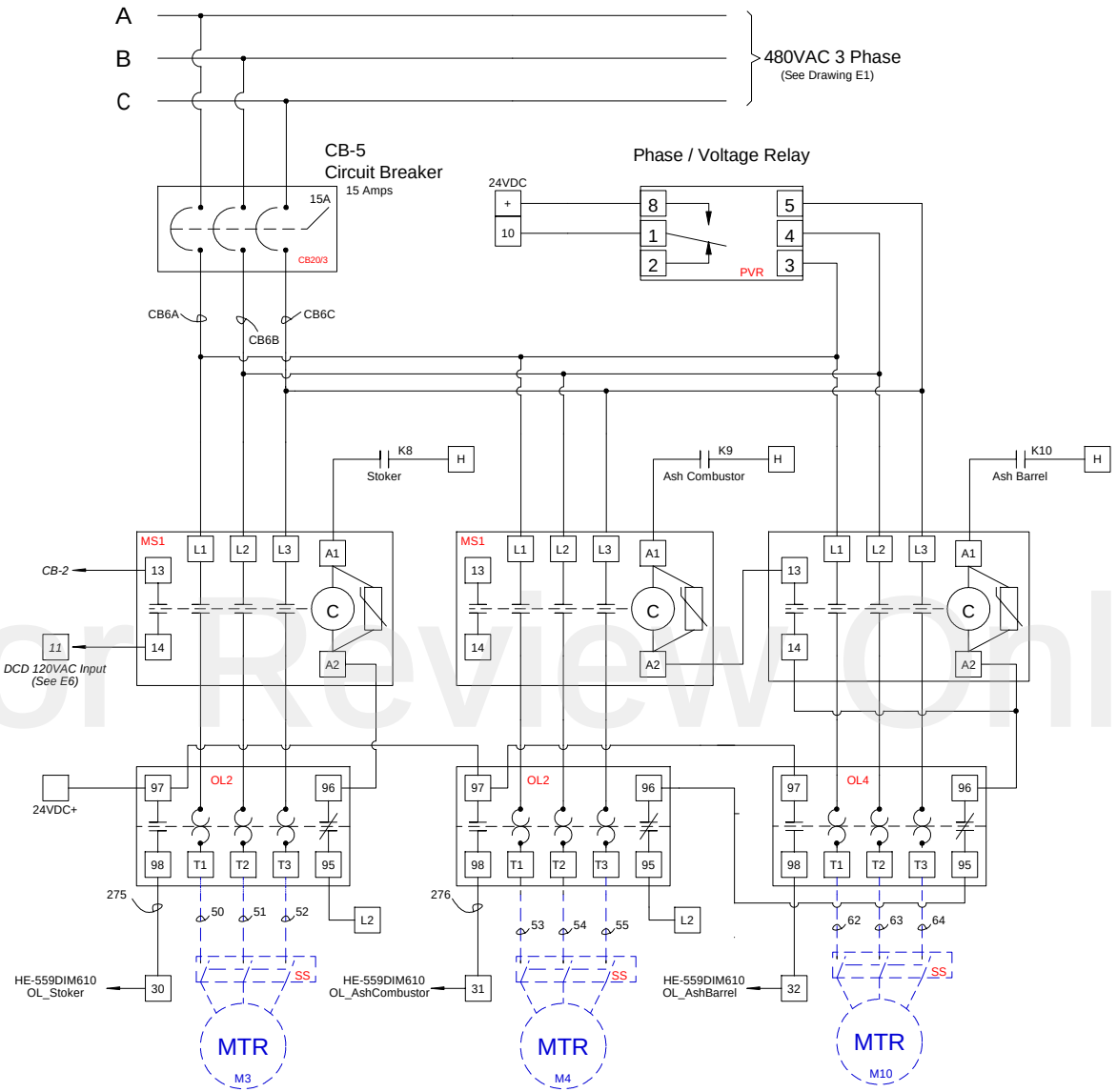

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Rev	Date	Description	CK

Project No. 929

E10 — Boiler Stoker & Ash Motors

Scale: NONE

Sheet 10 of 15

Date: 4/28/2013

File: E10.DCD

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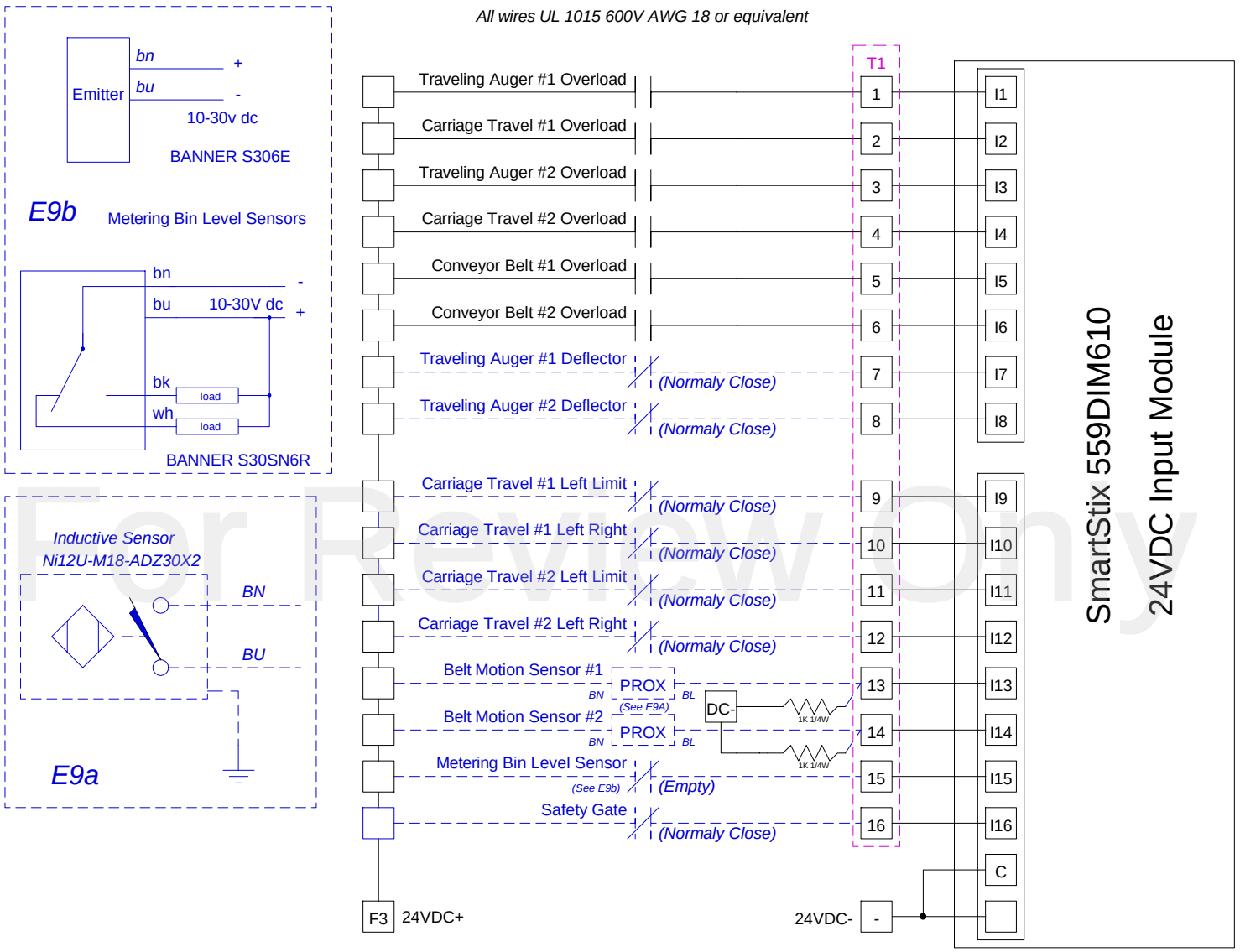
All wires UL 1015 600V AWG 18 or equivalent



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Project No. 929

E11 — Fuel Panel PLC Digital Inputs

Scale NONE

Sheet 11 of 15

Date: 5/06/2013

File: E11.DCD

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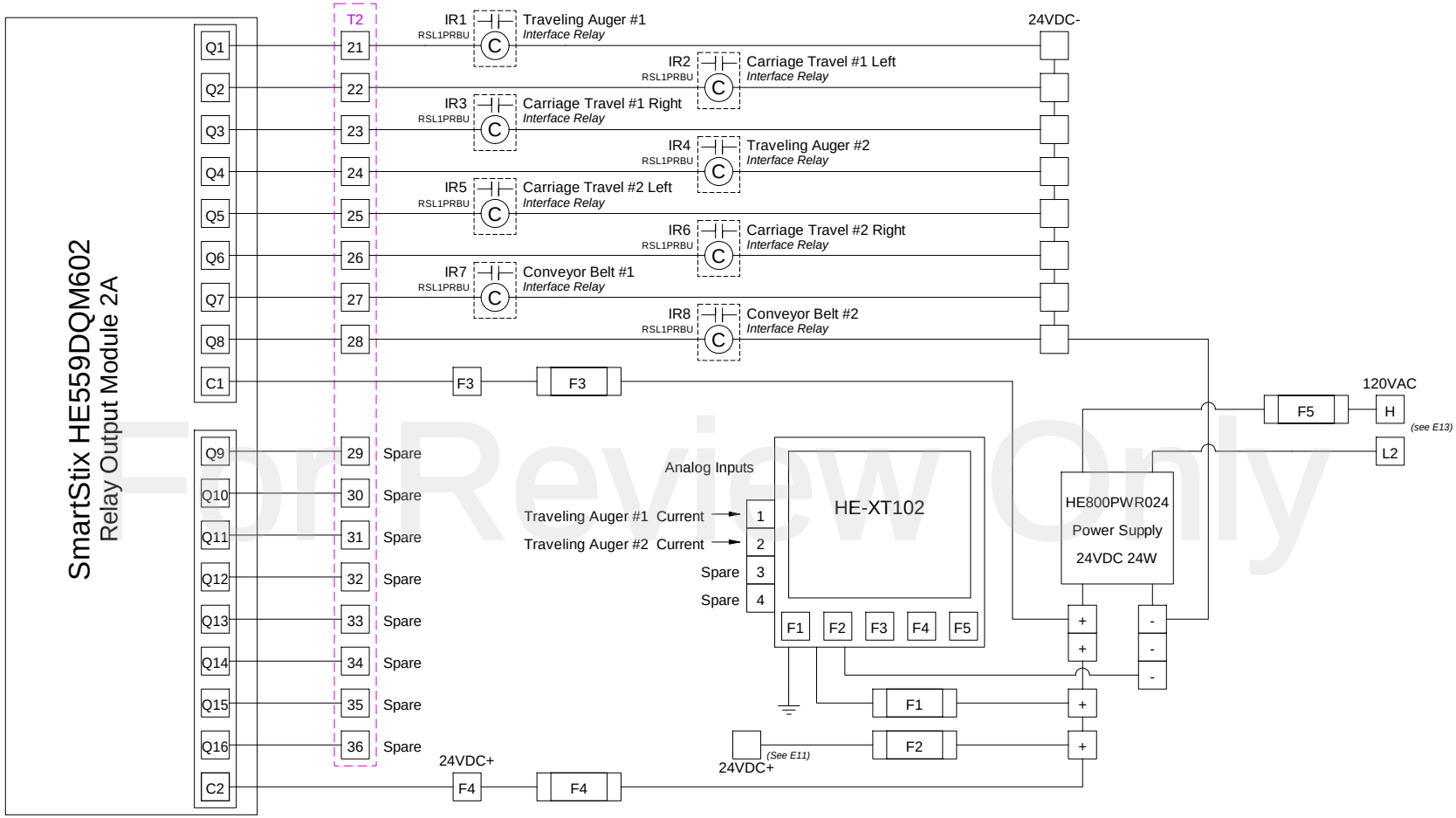
Email: sales@burnchips.com

All wires are UL 1015 600V AWG 18 or equivalent



Notes: Interface Relays, Schneider RSL1PRBU or equivalent

For Review Only

DASHED LINES / BLUE = Field wired by Messersmith Manufacturing, Inc.

Components are supplied and field installed by Messersmith Manufacturing, Inc.

ONLY MESSERSMITH TRAINED PERSONNEL ARE TO WORK ON THE CONTROL PANEL

Rev	Date	Description	CK

Project No. 929

E12 — Fuel Panel PLC & Digital I/O

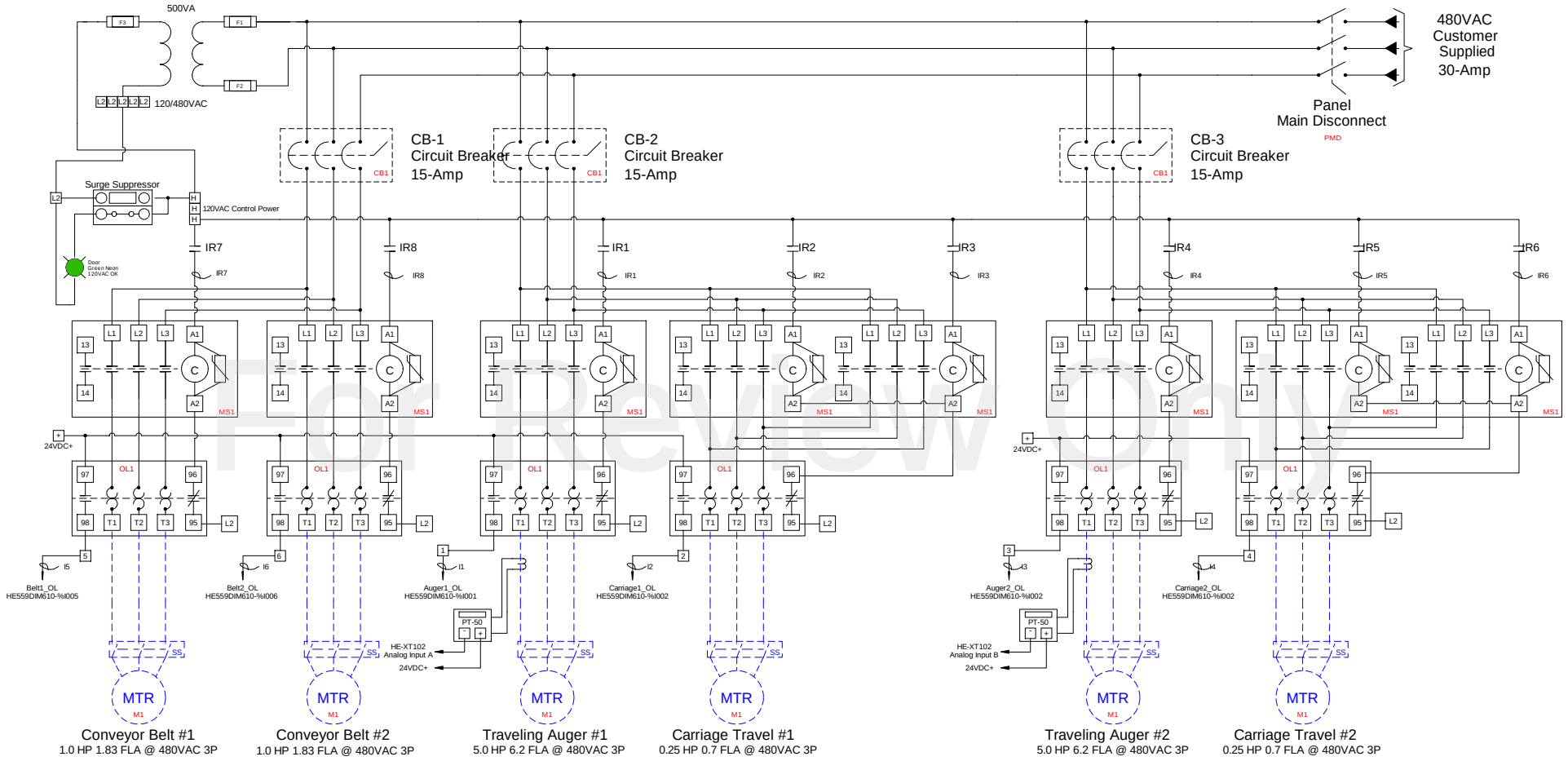
Scale NONE

Sheet 12 of 15

Date: 5/06/2013

File: E12.DCD

Messersmith Manufacturing, Inc
2612 F Road
Bark River, MI 49807
Telephone (906) 466-9010
Fax (906) 466-2843
Email: sales@burnchips.com



For Review Only

DASHED LINES / BLUE = Wired by Others

Components are supplied and field installed by Messersmith Manufacturing, Inc.

ONLY MESSERSMITH TRAINED PERSONNEL ARE TO WORK ON THE CONTROL PANEL

Rev	Date	Description	CK

E13	Fuel Panel Motor Control	Scale NONE	Project No. 929
		Sheet 13 of 15	Date: 5/06/2013
			File: E13.DCD

Messersmith Manufacturing, Inc
2612 F Road
Bark River, MI 49807
Telephone (906) 466-9010
Fax (906) 466-2843
Email: sales@burnchips.com

Terminals T1

(90VDC)

A+ A+ (68) Metering Auger DC Motor ARM +
A- A- (69) Metering Auger DC Motor ARM - } 12AWG Cu Wire THHN 600V

(120VAC)

F
L2
L2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Q260 Q1 (89) Spare Output (120VAC 2A Max)
T1
T2
T3
T4
S1
S2
S3
S4
X
X
H
H
H
H
H
H
CP
CP
CP
L2
L2
L2
L2
L2
L2
L2
L2
L1 120VAC Incoming Power 12 AWG 600V THHN or equivalent Cu wires.

Terminals T2 (24VDC)

A1 A2 A3 A4 | - - - - - | + + + + + | D1 D2 D3 D4 D5 D6 D7 D8 D9 DX

E1 E2 E3 E4 E5

Induce Draft Enable
Induce Draft Enable
Induce Draft Increase
Induce Draft Decrease
Induce Draft Speed Common

For Review Only

To Be Determined

COPPER CONDUCTORS ONLY

Terminals "T1" 16-12 AWG 600V THHN or equivalent Cu wires Only except where noted.
Terminals "T2" Shielded 20 AWG Cu twisted pairs cables only.
Recommended screw tightening torque: 7-8 lbf-in, 0.8-0.9 N-m

DASHED LINES / BLUE = Field wired by Messersmith Manufacturing, Inc.

Components are supplied and field installed by Messersmith Manufacturing, Inc.

ONLY MESSERSMITH TRAINED PERSONNEL ARE TO WORK ON THE CONTROL PANEL

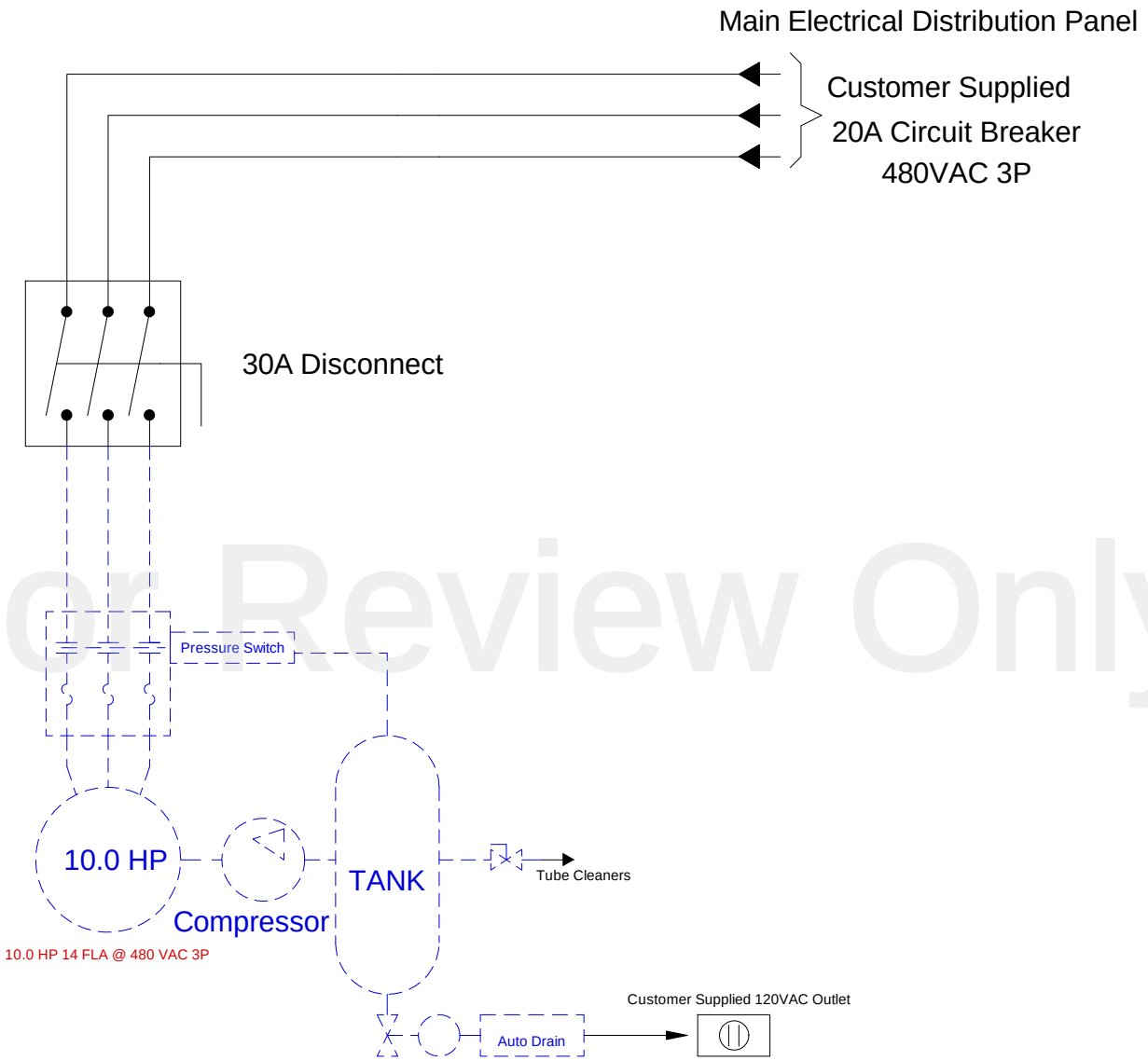
Rev	Date	Description	CK

E14 — Fuel Panel Terminals

Scale NONE
Sheet 14 of 15

Project No. 929
Date: 5/06/2013
File: E14.DCD

Messersmith Manufacturing, Inc
2612 F Road
Bark River, MI 49807
Telephone (906) 466-9010
Fax (906) 466-2843
Email: sales@burnchips.com



For Review Only

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Components are supplied and field installed by Messersmith Manufacturing, Inc.

ONLY MESSERSMITH TRAINED PERSONNEL ARE TO WORK ON THE CONTROL PANEL

Rev	Date	Description	CK

Project No. 929

E15 — Air Compressor

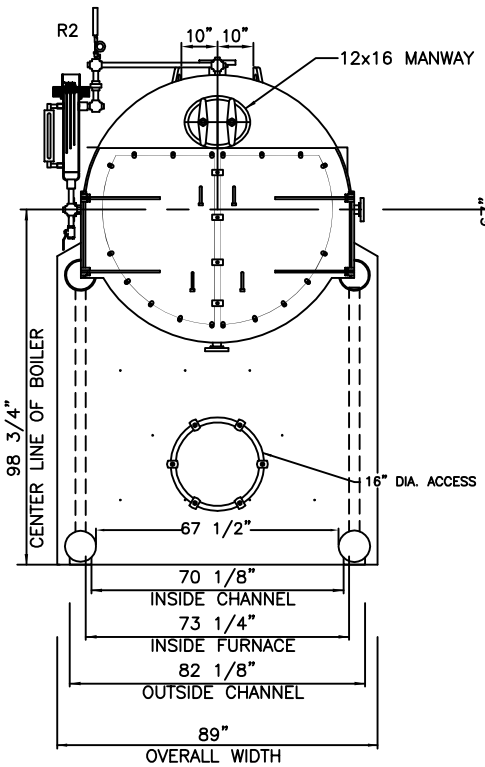
Scale NONE

Sheet 15 of 15

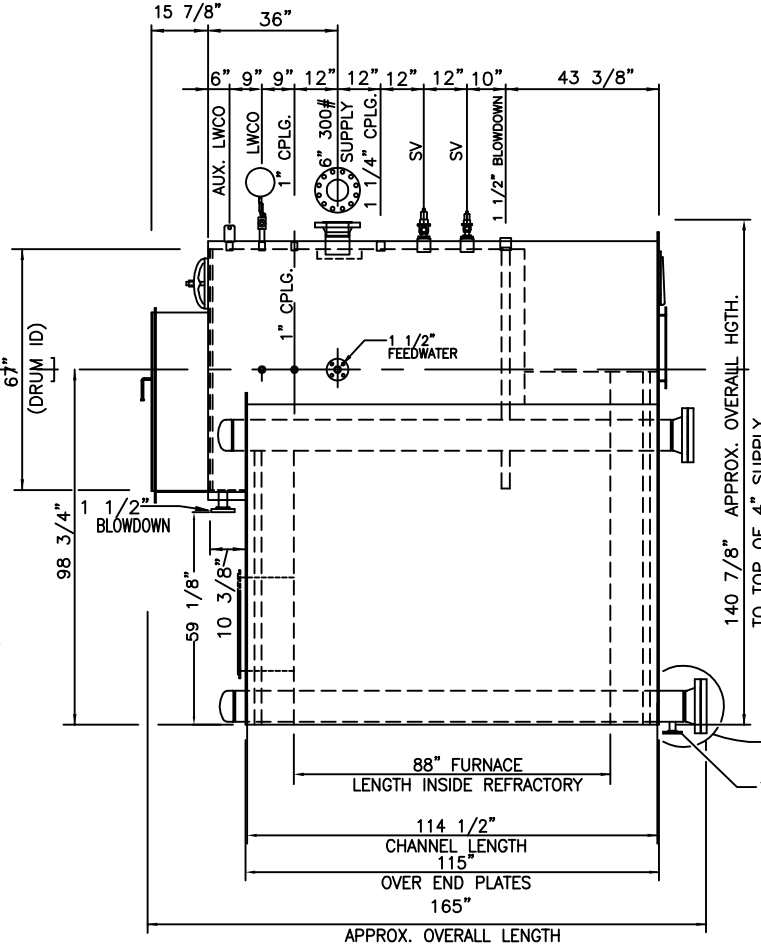
Date: 5/06/2013

File: E15.DCD

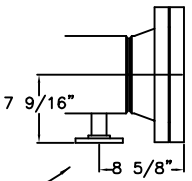
Messersmith Manufacturing, Inc
2612 F Road
Bark River, MI 49807
Telephone (906) 466-9010
Fax (906) 466-2843
Email: sales@burnchips.com

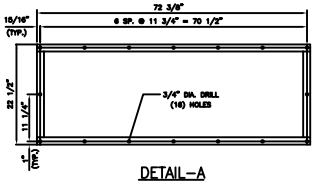


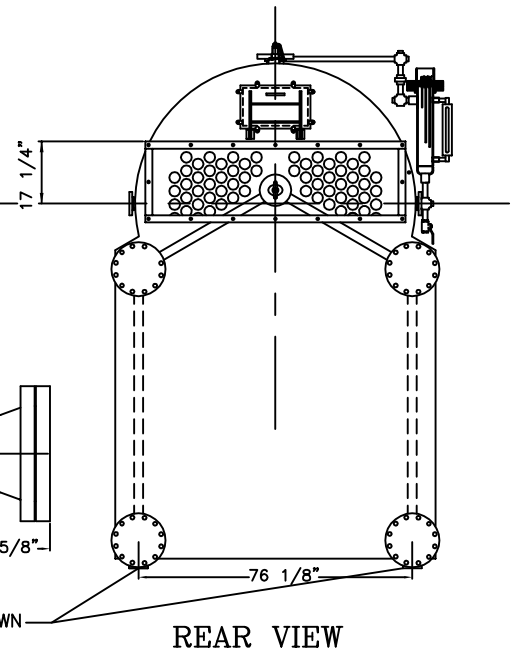
FRONT VIEW



SIDE VIEW







REAR VIEW

HURST BOILER and WELDING CO., INC.
N65 FIREBOX BOILER DETAILS
975 SQ. FT. HIGH PRESS. FIREBOX BOILER–150 PSI

BOILER SPECIFICATIONS	
BUILT TO ASME CODE SECTION 1 FOR:	150 PSI STEAM
HEATING SURFACE	1,000 SQ. FT.
FURNANCE VOLUME	288.6 CU. FT.
SHIPPING WEIGHT	22,000 LBS.

R	BY:	DATE:	CHK'D.	REASON FOR CHANGE

to:

for:

THIS DRAWING IS THE PROPERTY OF HURST BOILER AND WELDING CO., INC. AND MAY NOT BE COPIED OR REPRODUCED IN ANY WAY UNLESS AUTHORIZED IN WRITING BY HURST BOILER AND WELDING CO., AND MUST BE RETURNED UPON REQUEST

SCALE:	DWN. BY:	DATE:	CHK'D. BY:	DRAWING NO.:	R
NTS 24	JGF	4.23.13	JWT	10013A161	

Class 250 Iron Body Automatic Stop Check Valves

Bolted Bonnet • Angle Pattern • Renewable Seat and Disc* • Bronze Mounted

250 PSI/17.2 Bar Saturated Steam to 406º F/207º C
500 PSI/34.5 Bar Non-Shock Cold Working Pressure to -20º F to 150º F/-29º C to 66º C◆

CONFORMS TO MSS SP-85

MATERIAL LIST

	PART	SPECIFICATION
1.	Handwheel Nut	Steel ASTM A 307
2.	Identification Plate	Aluminum
3.	Handwheel	Cast Iron ASTM A 126 Class B
4.	Stem	Brass ASTM B 16 Alloy C36000
5.	Yoke Bushing	Cast Bronze ASTM B 584 Alloy C84400
6.	Bonnet	Cast Iron ASTM A 126 Class B
7.	Gland Follower Stud	Steel ASTM A 307 (not shown)
8.	Gland Follower Nut	Brass ASTM F 467 Alloy C27000 (not shown)
9.	Gland Follower	Ductile Iron ASTM A 536
10.	Packing Gland	Zinc Plated Powdered Iron ASTM B 783 or Brass ASTM B 16
11.	Packing	TFE Braided
12. [1]	Butterfly Handle Nut	Steel ASTM A 307
13. [1]	Butterfly Handle	Cast bronze ASTM B 584 Alloy C84400
14. [1]	Control Valve Stem	Bronze ASTM B 371 Alloy C69400
15. [1]	Control Valve Pack Nut	Cast Bronze ASTM B 584 Alloy C84400
16. [1]	Control Valve Pack Gland	Brass ASTM B 16 Alloy C36000
17. [1]	Control Valve Packing	Synthetic Fibers with Graphite
18. [1]	Control Valve Body	Cast Bronze ASTM B 584 Alloy C84400
19.	Hex Head Cap Screw	Steel ASTM A 307
20.	Body Gasket	Reinforced Graphite
21. [1]	Dashpot Gasket	Reinforced Graphite
22. [1]	Dashpot	Cast Bronze ASTM B 584 Alloy C84400
23. [1]	Piston-Disc	Cast Iron ASTM A 126 Class B
24. [1]	Piston Ring (2)	TFE Composite Material
25. [1]	Disc Face Ring	Cast Bronze ASTM B 584 Alloy C84400
26. [1]	Seat Ring	Cast Bronze ASTM B 584 Alloy C84400
27.	Body	Cast Iron ASTM A 126 Class B
28. [2]	Piston Ring Collar	Brass ASTM B 16 Alloy C36000
29. [2]	Disc Cage	Bronze ASTM B 62 Alloy C83600
30. [2]	Teflon Disc	TFE
31. [2]	Disc Plate and Nut	Bronze ASTM B 62 Alloy C83600
32. [2]	Piston Rod Plug	Brass ASTM B 16 Alloy C36000
33. [2]	Piston Rod Plug Pin	Red Bronze ASTM B 140 Alloy C31400

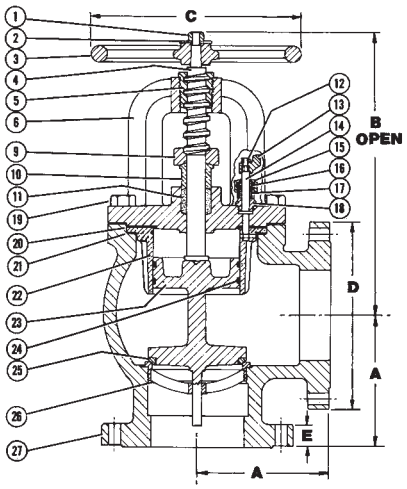
[1] 4" thru 8" size only. (4" thru 8" have Cast Iron Disc with Bronze Disc Face Ring.)
[2] 2½" and 3" size only. (2½" and 3" have Teflon Disc Ring (-Y series).)

DIMENSIONS—WEIGHTS—QUANTITIES

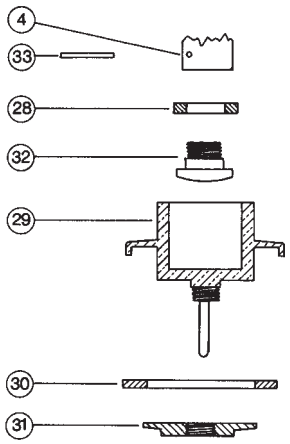
Size		Dimensions A		B		C		D		E		Weight	
In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	Lbs.	Kg.
2½	65	5.75	146	12.63	321	8	203	7.50	191	1.00	25	80	36
3	80	6.25	159	14.00	356	10	254	8.25	210	1.13	29	102	46
4	100	7.00	178	16.50	419	10	254	10.00	254	1.25	32	168	76
6	150	8.75	222	20.75	527	14	356	12.50	318	1.44	37	311	141
8	200	10.50	267	23.81	605	16	406	15.00	381	1.63	41	520	236

*** With proper machining facilities available.**

F-869-B
Flanged
Series D



F-869-B
Flg x Flg



Freezing Weather Precaution – Subsequent to testing a piping system, valves should be in an open position to allow complete drainage.

◆ For detailed Operating Pressure, refer to Pressure Temperature Chart on page 110.

NIBCO INC. WORLD HEADQUARTERS • 1516 MIDDLEBURY ST. • ELKHART, IN 46516-4740 • USA • PH: 1.800.234.0227
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NIBCO
AHEAD OF THE FLOW

Automatic Stop Check Valves F-869-B

OVERSIZING OFTEN THE CULPRIT BEHIND MALFUNCTIONING AUTOMATIC STOP CHECK VALVES

By Glenn Pauley
Technical Service Senior Engineer

When an automatic stop check valve in a multiple-boiler system appears to be malfunctioning, it may seem logical to replace the valve and return the system to service. But in many cases, the problem lies not in the valve itself but in an error that commonly occurs during the design stage when valves for multiple-boiler systems are specified. More often than not, troublesome valves are oversized for the actual demand because of sizing error or to accommodate pipe size for future facility expansion. While thinking to the future may seem like a good idea, over-sizing the valves will cause improper operation, resulting in excessive seat wear, valve leaks, or even complete failure.

Use of an automatic steam stop check valve in a multiple-boiler system comes about because it is recommended by industry standard. ANSI/ASME B31.1 Power Piping Code requires two stop valves or a stop valve and an automatic stop check on top of each boiler in a multiple-boiler installation, when the output feeds a common header. This code gives preference to the automatic stop check valve.

With the question of the type of valve to be used settled, the issue then becomes proper sizing for the application. This is, in fact, the most important issue because improper sizing creates the bulk of the problems encountered with automatic steam stop check valve malfunctions. Typically, a stop check valve is selected to handle the boiler system's maximum output, ignoring the current needs that may be significantly less. Seasonal fluctuations in heat demand and computer controlled boiler modulation with high turn down ratios create a similar situation. The result is the valve is oversized if you consider the everyday low demand. This causes the valve to perform poorly and wear prematurely.

A typical scenario runs like this: A new hospital is being planned. The sequence starts on the drawing board, where the required steam supply line size is specified by calculating the maximum demand. It is decided that a three-boiler installation feeding a common header will work best.

The boiler manufacturer typically sizes the discharge nozzle from the boiler for maximum output. Let's say the discharge nozzle that comes with the boiler is 6", based on maximum rated output. An automatic steam check valve is placed on top of each boiler. Each valve is piped to the common header, all in 6" size following the boiler manufacturer's lead with the 6" discharge nozzle.

Unfortunately, this does not mean that 6" is the proper size for the automatic steam check valve based on actual steam demand to be used. As we said, the boiler outlet nozzles sized by the manufacturer at 6" is merely to provide for the maximum achievable output of the boiler. Maximum output may have been calculated by the design engineer to include a building expansion planned in five years. What all this means is for those five years the valve will be

oversized for the system's actual requirements no matter what minor corrective actions are taken. There is simply too much valve for too little steam demand.

The project progresses, the construction follows the drawings and instructions from the design engineer. The job is completed and turned over to the hospital. Now the operating people working for the hospital start to have trouble.

We have taken a look at how it was done, so let's take a look at how it should be done. The hospital equipment, taking into consideration in establishing the operating requirements, might include such items as steam tables in the cafeteria, heating equipment, laundry facilities, and sterilizing equipment to name a few. When the equipment is totaled up, the theoretical demand is 12,000 pounds per hour at peak demand. The operating pressure is 120 psi based on equipment selected. The boilers are rated 250 horsepower (ultimate) each, based on calculated maximum demand. Sooner or later in the piping process, we need to convert out steam supply and demand to pounds per hour. To convert horsepower to pounds per hour, multiply 250 (boiler horsepower) by 34.5 to arrive at a maximum steam output of 8,625 pounds per hour, per boiler. The combined total supply for three boilers then results in about 26,000 pounds of steam per hour.

We now have a total boiler capacity of 26,000 lbs/hr, far in excess of the 12,000 lbs/hr actual demand. Although a single boiler's output is less than actual demand, generally there will be two boilers on-line and one standby. In order to prevent steam from backing up into the second on-line boiler, the valve's disc continually opens and closes. A "chattering" sound is caused by the disc as it repeatedly rises and falls. This chattering is more than an annoyance; it is the first hint of operating trouble. Over time, the rising and falling action causes damage to the seat and disc. Leakage past the seat is the eventual result allowing steam to re-enter the boiler when it should not. If not corrected soon, the result is an unusable waterlogged boiler.

There is only one way to properly size an automatic steam stop check valve. We must go all the way back to the design stage. This is done by calculating the actual steam load that goes through the valve in pounds per hour. Current needs should be the basis of these calculations, even if the demand is likely to change later. Anything other than current actual demand values must be ignored.

The solution is simple. Select a valve with the correct operating range from the manufacturer's sizing information. A dampening adjustment can significantly lessen the wear caused by impact against the valve seat. This could eliminate the need to employ a single-stage parallel reduction station, the only other viable solution to the problem of over-sizing. This expensive method uses two different sized valves to meet both minimum and maximum demand periods. In this situation a smaller valve is sized to handle one-third of the maximum output of the system, and the other is sized to handle the remaining two-thirds of the maximum load. Although this method is effective, it is much more complicated and expensive than using a single valve with adequate range of operation.

NIBCO's F-869-B automatic steam stop check valve is quality designed and built. It has an external dampening control valve for easy adjustment to control the rate of disc rise and fall. The use of NIBCO automatic steam stop check valves cannot entirely eliminate over-sizing errors that occur. But with its modern materials, tight manufacturing tolerances, and reliable control damper, it will help to reduce some common sizing errors.

NIBCO
AHEAD OF THE FLOW

Automatic Stop Check Valves F-869-B

EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT TECHNICAL BULLETIN

Stop check valves are as essential to the safe operation of a multi-boiler plant as any other safety device that is attached to a boiler, and have four very important functions in the steam piping system.

1. To act as an automatic non-return valve by preventing the backflow of steam from the header to the boiler in the event of failure in the boiler.
2. To assist in cutting a boiler out of the steam system when it ceases to fire. In this case the disc automatically closes and prevents the pressure in the header from entering the boiler.
3. To assist in bringing a boiler into service after a shutdown. This operation requires considerable care when preformed manually, but is accomplished automatically by a stop check valve without pressure fluctuations or disturbance of water level.
4. To act as a "safety first" valve by preventing back-flow of the steam from the header to the boiler that has been shut down for inspection should the valve be opened accidentally.

There are three basic questions regarding the NIBCO automatic stop check valve.

1. What is an automatic stop check valve?
2. Where is it used?
3. How does it work?

Question #1 – What is an automatic stop check valve?

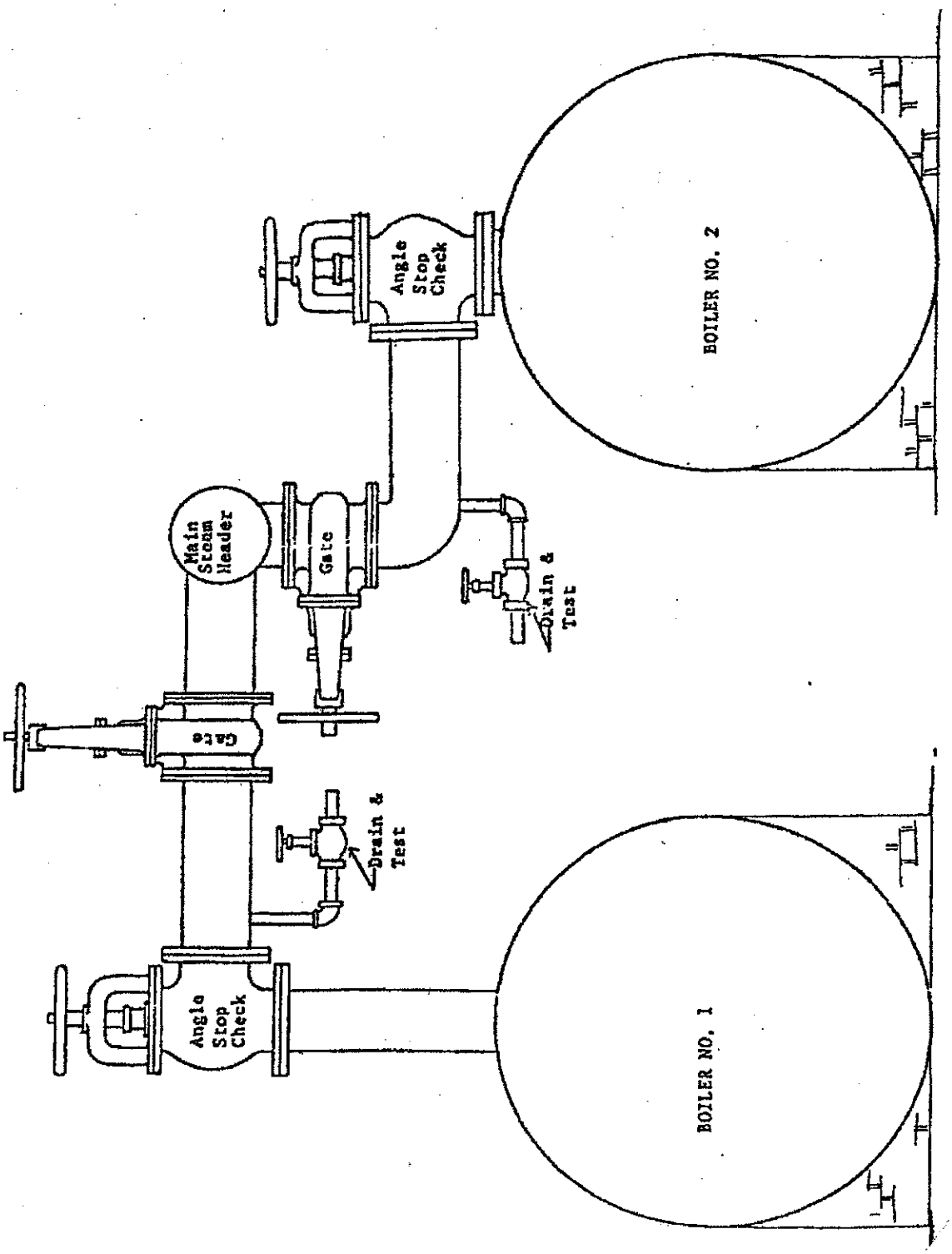
The location of a stop check valve is predominantly in the steam line at the boiler riser. It allows steam to pass through it from the boiler to the main header, but in case the boiler steam delivery is interrupted, the stop check valve will automatically prevent steam from flowing back into the boiler. The stop check valve is a back-flow preventer. Its function is the same as the swing or lift check valve in that it allows flow in one direction but not in the opposite direction.

An automatic stop check valve can also function as a stop and throttling valve the same way as a globe pattern valve.

Question #2 – Where is it used?

The automatic stop check valve is designed to be used between the boiler steam exit and the steam header in a multiple boiler plant to serve as a back-flow preventer and a stop valve.

Generally, there are two valves between the boiler and the header. One valve is a stop check valve and the other is a stop valve, either gate, angle, or globe type. The two valves are used to make maintenance more convenient and in most cases, are required by code for the inspectors safety while inspecting the boiler. (See sketch on page 2)



TYPICAL BOILER SYSTEM SKETCH

Question #3 – How does it work?

As stated in the answer to question #1, the automatic stop check valve in principle works like a lift check valve but with two very important additional features.

1. A method is provided to control the rate of ascent and descent of the disc.
2. A means is provided to close the disc positively so that fluids may not flow in either direction regardless of pressure differential.

Various manufactures provide different methods of controlling disc movement. Basically the two methods are by spring tension or dashpot arrangement.

Lunkenheimer was the only manufacturer that produced a valve with an external spring tension adjustment to control disc movement. Other manufacturers, including NIBCO, use the less complicated dashpot arrangement. NIBCO is the only manufacturer who supplies a valve with external control of the dashpot. All other manufacturer's valves must be disassembled so that the piston rings may be added or removed to respectively slow down or speed up automatic disc movement.

Generally all manufacturers provide OS&Y stem arrangement to positively close the disc. This stem merely pushes down on the disc through the linkage on the Lunkenheimer valve, or the dashpot piston on other valves. (See sketch on page 4)

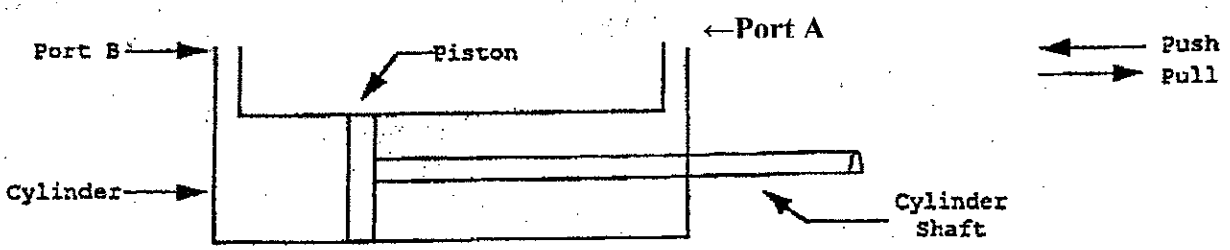
The purpose of the dashpot is to control the rate of ascent and decent of the disc so that the disc does not slam and chatter in the line. Since valves are connected to a network of pipes in the system, this would mean that the noise of a slamming and chattering disc could be transmitted through the piping system. This noise is distracting in office buildings, hospitals, ect. where concentration is essential. Moreover, the slam and chatter is extremely harmful to the disc and seat. It should also be noted that slam and chatter of the disc causes pulsations within the steam line which makes it very difficult for automatic steam regulators and other steam equipment to function properly. Therefore, the disc must be controlled by some means of dampening which, in most cases, is the dashpot.

The disc has a tendency to slam and chatter at various times. Usually the slam and chatter will be obvious when the boiler is coming up to operating pressure. At this time the steam is tending to lift the disc, and as it does the pressure in the boiler drops allowing disc to fall and make noise. Sometimes this is in the form of a slam, or it can take the form of a chatter if it occurs several times per minute. The disc can also make noise at periods when the boiler is at peak delivery. Here the disc can rise rapidly banging up against the stem end or the dashpot housing to cause noise.

We cannot stop the disc from coming into contact with the seat or stem, but we can and do control the rate of impact to prevent loud noises in the piping system.

Finally, we come to the questions: How is this done? How does the dashpot work? How are adjustments made?

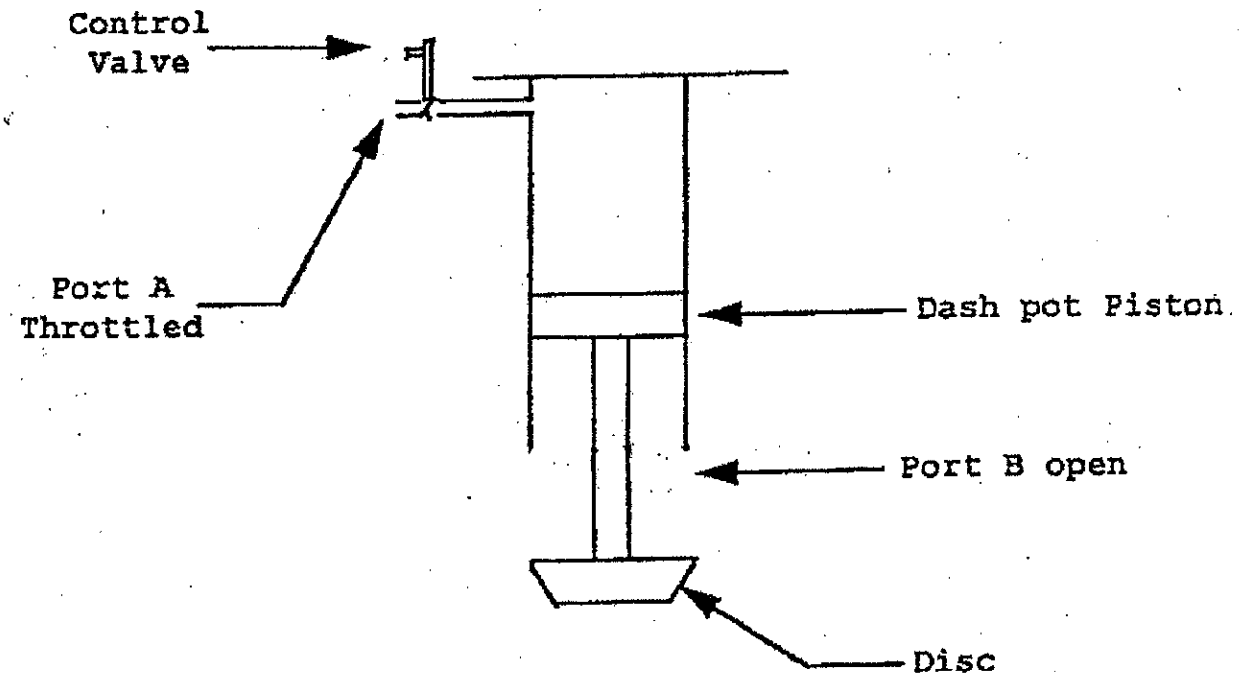
The dashpot is the same in principle as a shock absorber on an automobile. It does not prevent, but controls the rate of movement. The dashpot must have fluid to displace. In the case of the stop check valve, this fluid is the fluid within the piping system, namely steam. All dashpots are very similar to an air cylinder.



TYPICAL AIR CYLINDER

If one tries to push the cylinder shaft into the cylinder, air will come out of port B and flow into port A. Pulling the shaft out will cause the opposite to happen. Now if a throttle valve is put on port A and throttled very closely, the same amount of force applied to push in the shaft will allow a greatly reduced rate of movement. Hence, when the shaft bottoms out there will only be a small click heard instead of a loud bang. If we put the throttling valve on port B and take it off port A and push the shaft in the same direction, the very same result will be obtained as when the throttle valve was on port A. Having throttle valves on both ports would not change function at all. The rate of travel will be controlled by the throttle valve being closed the most. Since one throttle valve does the same job as two, the NIBCO automatic stop check valve has but one control valve.

We have now developed the principle on which the NIBCO automatic stop check valve was designed, only now we add the principle of gravity and turn the air cylinder in the vertical direction and attach a disc to have the following:

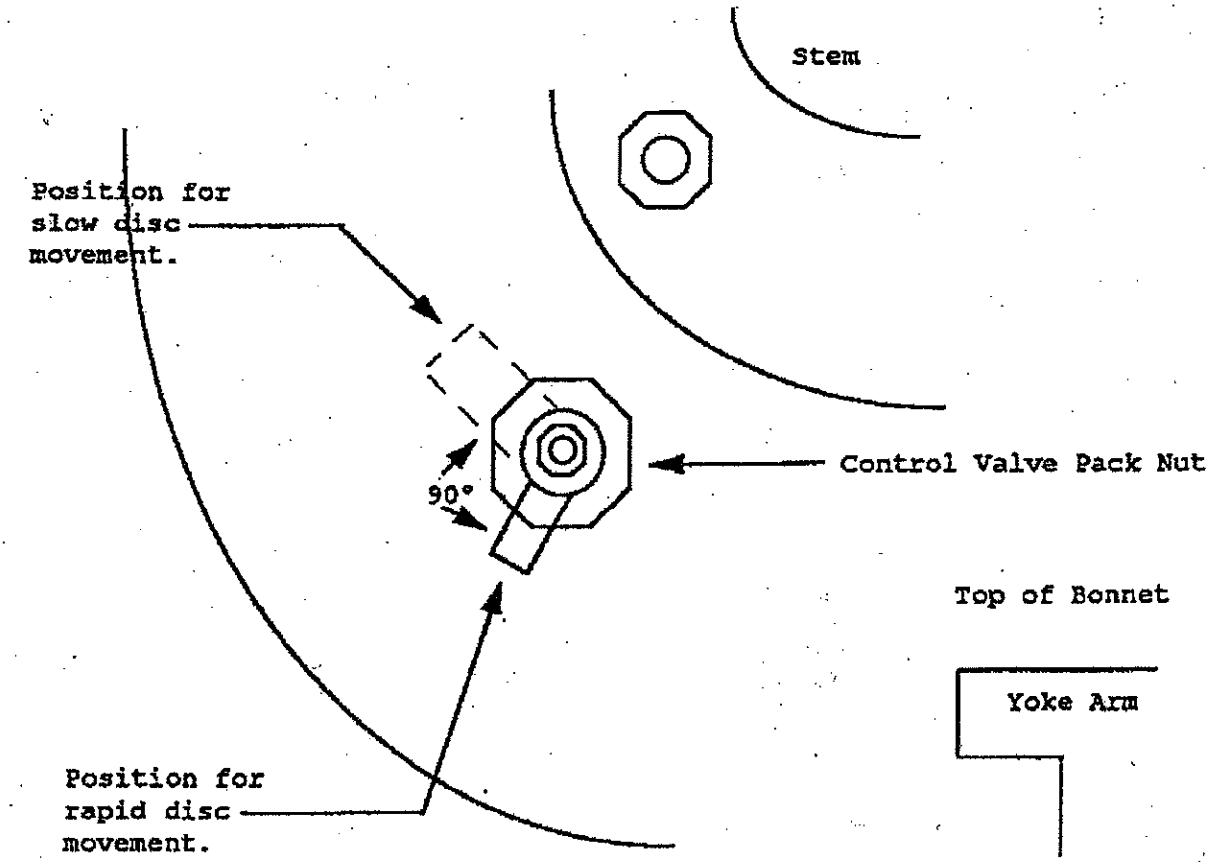


NIBCO DASHPOT / DISC CONTROL SYSTEM

Note that port B is merely an opening at the bottom of the dashpot which allows steam to enter and exit freely. Port A has a control valve which can be throttled to allow steam to enter the chamber above the piston, either rapidly for quick decent or slowly for slow decent of disc. This is the function of the dashpot arrangement. It should be pointed out that the stop check valve must always be in an upright position with the handwheel on top of the valve. If this is not done there is no way that the valve will work properly.

ADJUSTING THE NIBCO F-869-B AUTOMATIC STOP CHECK VALVE

The external control valve near the packing gland requires only a quarter turn to allow the disc to rise / descend rapidly or slowly. (See sketch below)



TOP VIEW OF NIBCO VALVE

If slam or chatter exists in the piping line, the small control valve should be adjusted by turning clockwise until noise is greatly reduced. After adjustment of control valve, the control valve packing nut should be tightened to assure valve does not move from its new setting.

If a noise problem is still present and steam delivery from the boiler is at a minimal demand operating range, the delivery may have fallen below the range the valve was designed for. This may be corrected by partially closing or "throttling" the automatic steam check valve by turning handwheel clockwise. It is important to remember the valve must be fully opened again if steam demand is increased. If the steam delivery demand is changed to any great degree, the adjustment procedure may need to be repeated.

NOTE: 2½" and 3" F-869-Y automatic stop check valves do not have an external disc control valve. The disc control setting is made during valve manufacturing and is permanently fixed.

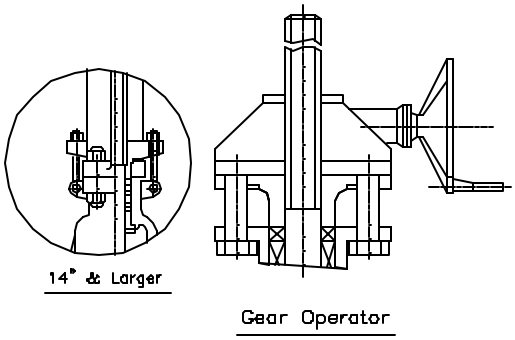
In the event that a boiler shuts down the stop check must prevent backflow into the boiler. The weight of the disc and dashpot, through force of gravity, promotes rapid sealing so steam and condensate cannot backflow into the boiler even at low pressures. In the NIBCO design stop checks, you will note that the disc and dashpot are one piece to allow positive sealing eliminating any misalignment due to assembly or uneven heat expansion. This feature also permits field repair of the valve seat without fear of misassembly by field mechanics.

It takes about ¾ psi steam pressure to lift disc from seat for all sizes of NIBCO automatic stop check valves.

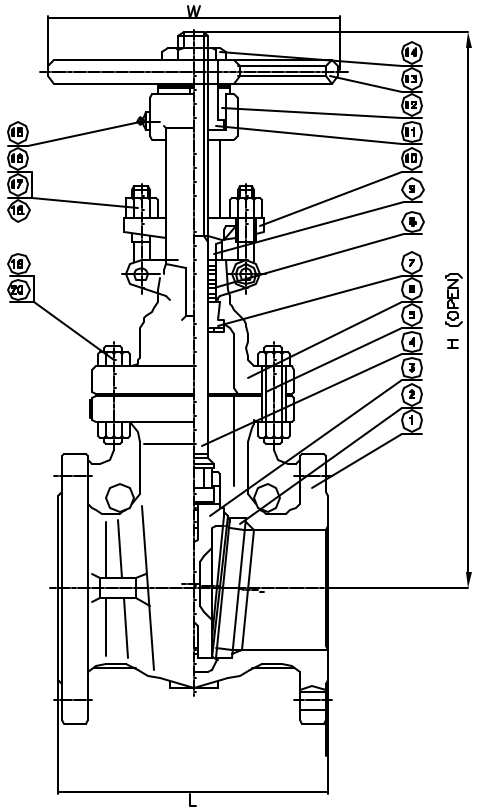
Cast Steel Gate Valve

Class 150 Flanged (2" to 36") - 15FGAW

Class 150 Butt Weld (2" to 36") - 15BGAW



NO.	PART NAME	MATERIAL
1	BODY	A216 WCB
2	SEAT	A105+HF
3	WEDGE	WCB+F6
4	STEM	A182 F6
5	GASKET	Spiral Wound SS/Graphite
6	BONNET	A216 WCB
7	BACK SEAT	A276 410
8	PACKING	Graphite
9	PACKING GLAND	A276 410
10	GLAND	A216 WCB
11	STEM NUT	D-2 Ductile Iron
12	GLAND NUT	1035 Steel
13	HANDWHEEL	Ductile Iron
14	LOCK NUT	A29 1035 Steel
15	GREASE FITTING	Steel
16	EYE BOLT	A193 B7 Steel
17	EYE BOLT NUT	A194 2H Steel
18	EYEBOLT PIN	A29 1035 Steel
19	BOLT	A193 B7 Steel
20	NUT	A194 2H Steel



Davis cast steel valves comply with the following applicable specifications: ANSI B16.10, ANSI B16.5, API 600: Tested to API 598

Working Pressure: 285 WOG Body Testing Pressure: 428 psi
Seat Testing Pressure: 314 psi Air Testing Pressure: 80 psi

NPS		2	2-1/2	3	4	5	6	8	10	12	14	16	18	20	24	30	36
d	mm	51	64	76	102	127	152	203	254	305	337	387	438	489	591	743	915
L	in	7	7.5	8	9	10	10.5	11.5	13	14	15	16	17	18	20	24	28
(RF)	mm	178	190	203	229	254	267	292	330	356	381	406	432	457	508	610	711
L	in	8.50	9.50	11.14	12.00	15.00	15.88	16.50	18.00	19.76	22.50	24.00	26.00	28.00	32.00	36	40
(BW)	mm	216	241	283	305	381	403	419	457	502	572	610	660	711	813	914	1016
H	in	15.20	17.13	19.02	23.11	26.50	30.20	37.60	45.12	52.28	59.80	67.76	74.80	83.31	97.64	134.5	161.8
(open)	mm	386	435	483	587	673	767	955	1146	1328	1519	1721	1900	2116	2480	3417	4109
W	in	7.87	7.87	9.84	9.84	11.81	11.81	13.78	17.72	19.69	18.11	18.11	18.11	24.02	24.02	Gear	Gear
	mm	200	200	250	250	300	300	350	450	500	460*	460*	460*	610*	610*		
WT	RF	44	66	79	117	157	187	300	485	712	853	1219	1455	1786	2756	4343	7070
(Lbs)	BW	37	57	64	101	146	170	256	445	648	772	1116	1268	1587	2491	4482	7209

Davis Valve

70-100 Series
Bronze Ball Valve

Threaded, 600 psig WOG, Cold Non-Shock. 150 psig Saturated Steam. (See referenced P/T charts)
Vacuum Service to 29 inches Hg.
Federal Specification: WW-V-35C, Type: II, Composition: BZ, Style: 3.
MSS SP-110; Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

FEATURES

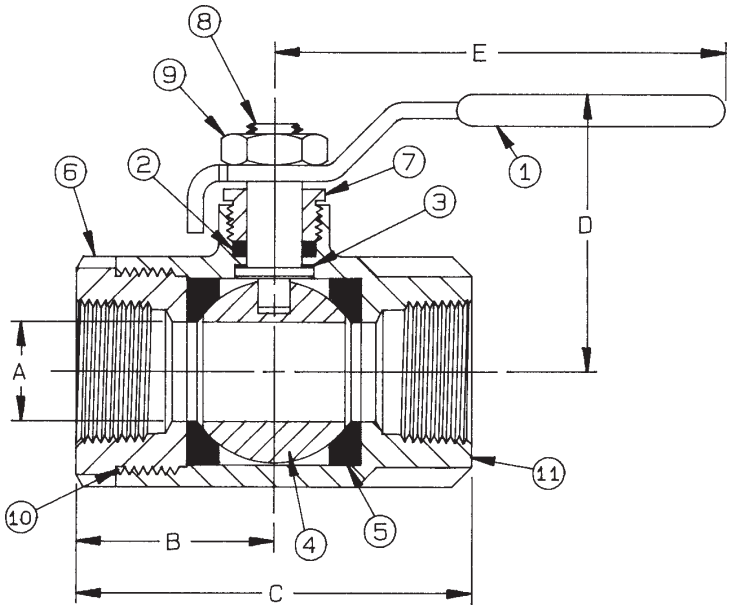
- Two-piece body
- Reinforced seats
- Blow-out-proof stem design
- Adjustable packing gland

STANDARD MATERIAL LIST

1. Lever and grip	Steel, zinc plated w/vinyl	7. Gland nut	B16
2. Stem packing	MPTFE	8. Stem	B16
3. Stem bearing	RPTFE	9. Lever nut	Steel, zinc plated
4. Ball	B16, chrome plated	10. Body seal (1-1/4" to 4")	PTFE
5. Seat (2)	RPTFE		
6. Retainer	B16 (1/4" to 1") B584-C84400 (1-1/4" to 4")	11. Body	B584-C84400

VARIATIONS AVAILABLE:

70-140 Series (316 SS Ball & Stem)
70-190 Series (Locked Retainer)



BRONZE BALL VALVE

NUMBER	SIZE	A	B	C	D	E	Wt.
70-101-01	1/4"	.37	1.03	2.06	1.75	3.87	.60
70-102-01	3/8"	.37	1.03	2.06	1.75	3.87	.56
70-103-01	1/2"	.50	1.12	2.25	1.75	3.87	.63
70-104-01	3/4"	.68	1.50	3.00	2.12	4.87	1.39
70-105-01	1"	.87	1.68	3.37	2.25	4.87	1.72
70-106-01	1-1/4"	1.00	2.00	4.00	2.62	5.50	3.26
70-107-01	1-1/2"	1.25	2.18	4.37	3.06	8.00	4.61
70-108-01	2"	1.50	2.34	4.68	3.25	8.00	6.06
70-109-01A	2-1/2"	2.00	3.12	6.25	3.72	8.00	17.25
70-100-01	3"	2.50	3.37	6.75	4.12	8.00	18.60
70-10A-01	4"	3.12	3.69	7.37	5.25	9.94	25.50

OPTIONS AVAILABLE:

(SUFFIX)	OPTION	SIZES
-02-	Stem Grounded	1/4" to 4"
-04-	2-1/4" CS Stem Extension	1/4" to 3"
-05-	Plain Ball	1/4" to 3"
-07-	Steel Tee Handle	1/4" to 2"
-08-	90° Reversed Stem	1/4" to 3"
-10-	SS Lever & Nut	1/4" to 3"
-11-	Therma-Seal™ Insulating Tee Handle	1/4" to 2"
-14-	Side Vented Ball (Uni-Directional)	1/4" to 4"
-15-	Wheel Handle, Steel	1/4" to 2"
-16-	Chain Lever - Vertical	3/4" to 2"
-17-	Rough Chrome Plated - Bronze Valves	1/4" to 3"
-21-	UHMWPE Trim (Non-PTFE)	1/4" to 3"
-24-	Graphite Packing	1/4" to 3"
-27-	SS Latch-Lock Lever & Nut	1/4" to 3"
-30-	Cam-Lock and Grounded	1/4" to 2"
-32-	SS Tee Handle & Nut	1/4" to 2"
-35-	VTFE Trim	1/4" to 3"
-36-	SS Hi-Rise Round Handle, SS Nut	1/4" to 2"
-39-	SS Hi-Rise Locking Wheel Handle, SS Nut	1/4" to 2"
-40-	Cyl-Loc and Grounded	1/4" to 2"
-41-	Automatic Drain (Bronze Valves Only) see page J-8	1/4" to 2"
-45-	Less Lever & Nut	1/4" to 3"
-46-	Latch Lock Lever - Lock in Closed Position Only	1/4" to 3"
-47-	SS Oval Latch-Lock Handle & Nut	1/4" to 1"
-48-	SS Oval Handle (No Latch) & Nut	1/4" to 2"
-49-	Assembled Dry	1/4" to 4"
-50-	2-1/4" CS Locking Stem Extension	1/4" to 3"
-56-	Multifill Seats & Packing	1/4" to 3"
-57-	Oxygen Cleaned	1/4" to 4"
-58-	Chain Lever - Horizontal	3/4" to 2"
-60-	Static Grounded Ball & Stem	1/4" to 3"
-63-	NPT x Solder/Socket Weld	3/8" to 4"
-64-	250# Steam Trim	1/4" to 3"
-92-	Balancing Stop	1/4" to 3"
-HC-	Hose Cap & Chain	1/2" to 1"
-P01-	BSPP (Parallel) Thread Connection	1/4" to 3"
-T01-	BSPT (Tapered) Thread Connection	1/4" to 3"

For Pressure/Temperature Ratings, Refer to Page M-8, Graph No. 4

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FLOW DATA

For Apollo® Ball Valves

The listed Cv "factors" are derived from actual flow testing, in the Apollo® Ball Valve Division, Conbraco Industries, Inc., Pageland, South Carolina. These tests were completed using standard "off the shelf" valves with no special preparation and utilizing standard schedule 40 pipe. It should be understood that these factors are for the valve only and also include the connection configuration. The flow testing is done utilizing water as a fluid media and is a direct statement of the gallons of water flowed per minute with a 1 psig pressure differential across the valve/connection unit. Line pressure is not a factor. Because the Cv is a factor, the formula can be used to estimate flow of most media for valve sizing.

Flow of Liquid

$$Q = Cv\sqrt{\frac{\Delta P}{SpGr}}$$

or $$\Delta P = \frac{(Q)^2\ (SpGr)}{(Cv)^2}$$

Where:
Q = flow in US gpm
ΔP = pressure drop (psig)
SpGr = specific gravity at flowing temperature
Cv = valve constant

Flow of Gas

$$Q = 1360\ Cv\sqrt{\frac{(\Delta P)\ (P_1)}{(SpGr)\ (T)}}$$

or $$\Delta P = \frac{5.4 \times 10^{-7}\ (SpGr)\ (T)\ (Q)^2}{(Cv)^2\ (P_2)}$$

Where:
Q = flow in SCFH
ΔP = pressure drop (psig)
SpGr = specific gravity (based on air = 1.0)
P_2 = outlet pressure–psia (psig + 14.7)
T = (temp. °F + 460)
Cv = valve constant

Cv FACTORS FOR APOLLO VALVES

Valve Size (inches)	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10	12
Ball Valves															
32-100/200 Series	5.1	6.6	8	24	30	45	55	95	--	--	--	--	--	--	--
64-100/200 Series	6	7	19	34	50	104	268	309	629	1018	1622	--	--	--	--
64W Series	--	--	--	--	--	--	--	--	629	1018	1622	--	--	--	--
70B-140 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
70-100/200 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	---
70-300/400 Series	--	--	15	30	43	48	84	108	--	--	--	--	--	--	--
70-600 Series	2.3	4.5	5.4	12	14	21	34	47	--	--	--	--	--	--	--
70-800 Series	8.4	7.2	15	30	43	48	84	--	--	--	--	--	--	--	--
71AR Series	--	--	--	30	43	48	84	108	190	370	--	--	--	--	--
71-100/200 Series	--	--	--	30	43	48	84	108	190	370	--	--	--	--	--
72-100/900 Series	--	--	26	48	65	125	170	216	--	--	--	--	--	--	--
73A-100 Series	8.4	7.2	15	30	43	48	84	108	--	--	--	--	--	--	--
73-300/400 Series	--	--	26	48	65	125	170	216	--	--	--	--	--	--	--
74-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
75-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
76AR Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
76F-100 Series	8.1	15	15	51	68	125	177	389	--	--	--	--	--	--	--
76-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
76-300/400 Series	--	--	26	48	65	125	170	216	--	--	--	--	--	--	--
76-600 Series	2.3	4.5	5.4	12	14	21	34	47	--	--	--	--	--	--	--
7K-100 Series	--	--	15	51	68	125	177	389	503	--	--	--	--	--	--
77AR Series	8.1	15	15	51	68	125	177	389	--	--	--	--	--	--	--
77C-100/200 Series	4.5	7.2	16	36	68	125	177	389	503	--	--	--	--	--	--
77D-140 Series	4.5	7.2	16	36	68	125	177	389	--	--	--	--	--	--	--
77D-640 Series	--	--	--	11	24	35	--	--	--	--	--	--	--	--	--
77G-UL Series	4.5	7.2	16	36	68	125	177	389	503	--	--	--	--	--	--
77W Series	--	--	16	36	68	125	177	389	--	--	--	--	--	--	--
77X Series	--	--	16	36	68	--	--	--	--	--	--	--	--	--	--
77-100/200 Series	8.1	15	15	51	68	125	177	389	503	--	--	--	--	--	--

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Cv FACTORS FOR APOLLO VALVES

Valve Size (inches)	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10	12
Ball Valves															
79 Series	8.5	8.5	9.8	32	44	66	148	218	440	390	--	--	--	--	--
80/81 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
82-100/200 Series	8.1	14	26	51	68	120	170	376	510	996	1893	--	--	--	--
83A/83B Series	8.1	14	26	51	68	120	170	376	--	--	--	--	--	--	--
83R-100/200 Series	--	--	--	--	--	--	170	376	--	996	1893	--	--	--	--
86A/86B Series	8.1	14	26	51	68	120	170	376	--	--	--	--	--	--	--
86R-100/200 Series	--	--	--	--	--	--	170	376	--	996	1893	--	--	--	--
87A-100 Series	--	--	--	--	--	--	86	104	234	375	673	1099	1902	3890	--
87A-200 Series	--	--	15	19	75	--	195	410	545	1021	2016	4837	9250	15170	22390
87A-700 Series	--	--	--	--	--	--	86	104	234	375	673	1099	1902	3890	--
87A-900 Series	--	--	15	19	75	--	195	410	545	1021	2016	4837	9250	15170	22390
87B-100 Series	--	--	--	--	--	--	--	--	--	375	673	1099	1902	3890	--
88A-100 Series	--	--	--	--	--	--	86	104	234	375	673	1099	1902	3890	--
88A-200 Series	--	--	15	19	75	--	195	410	545	1021	2016	4837	9250	15170	22390
88A-700 Series	--	--	--	--	--	--	86	104	234	375	673	1099	1902	3890	--
88A-900 Series	--	--	15	19	75	--	195	410	545	1021	2016	4837	9250	15170	22390
88B-100 Series	--	--	--	--	--	--	--	--	--	375	673	1099	1902	3890	--
89-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
9A-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
91-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
92-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
93-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
94A-100/200 Series	6	7	19	34	50	104	268	309	629	1018	1622	--	--	--	--
95-100/200 Series	--	--	15	51	68	--	--	--	--	--	--	--	--	--	--
95A-300/400 Series	--	--	19	34	50	--	--	--	--	--	--	--	--	--	--
96-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
399-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
489-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--

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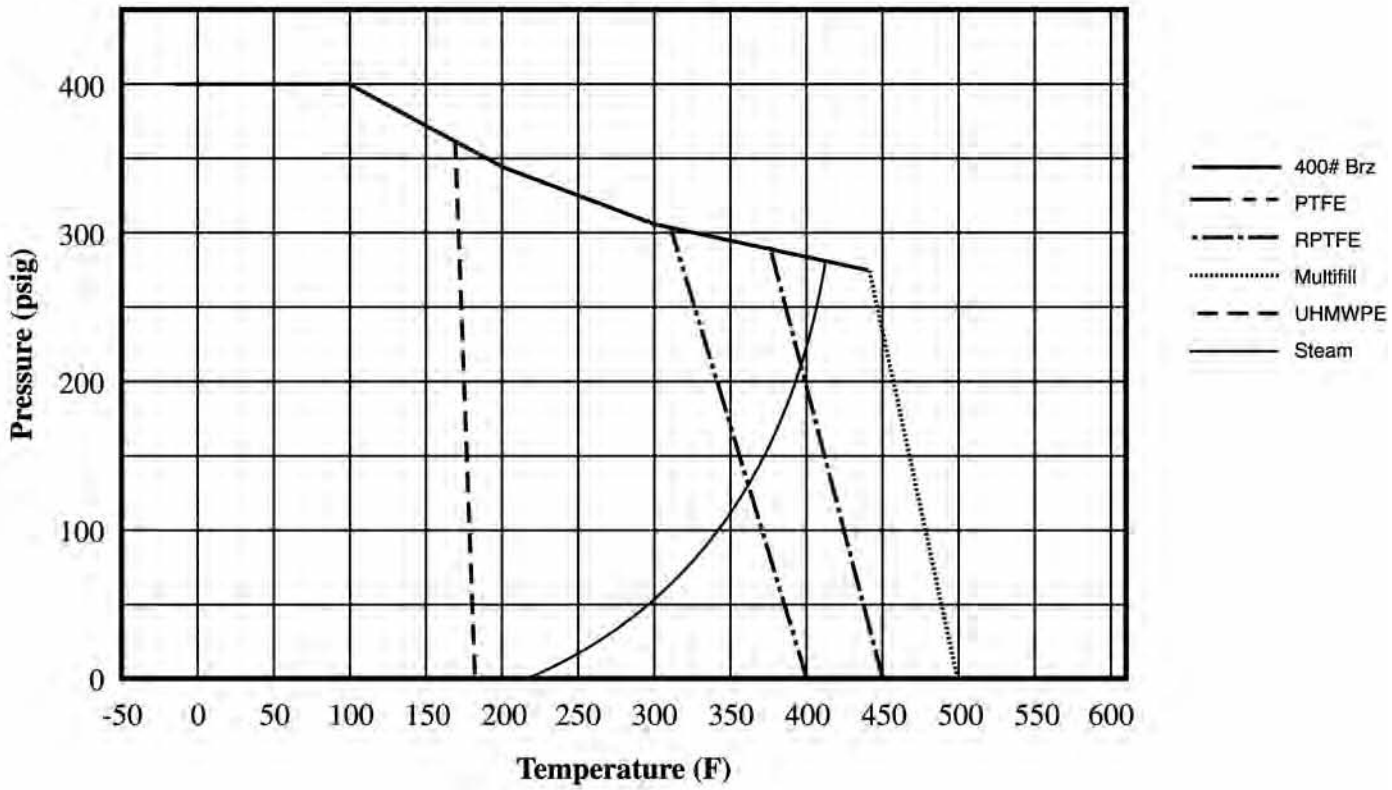
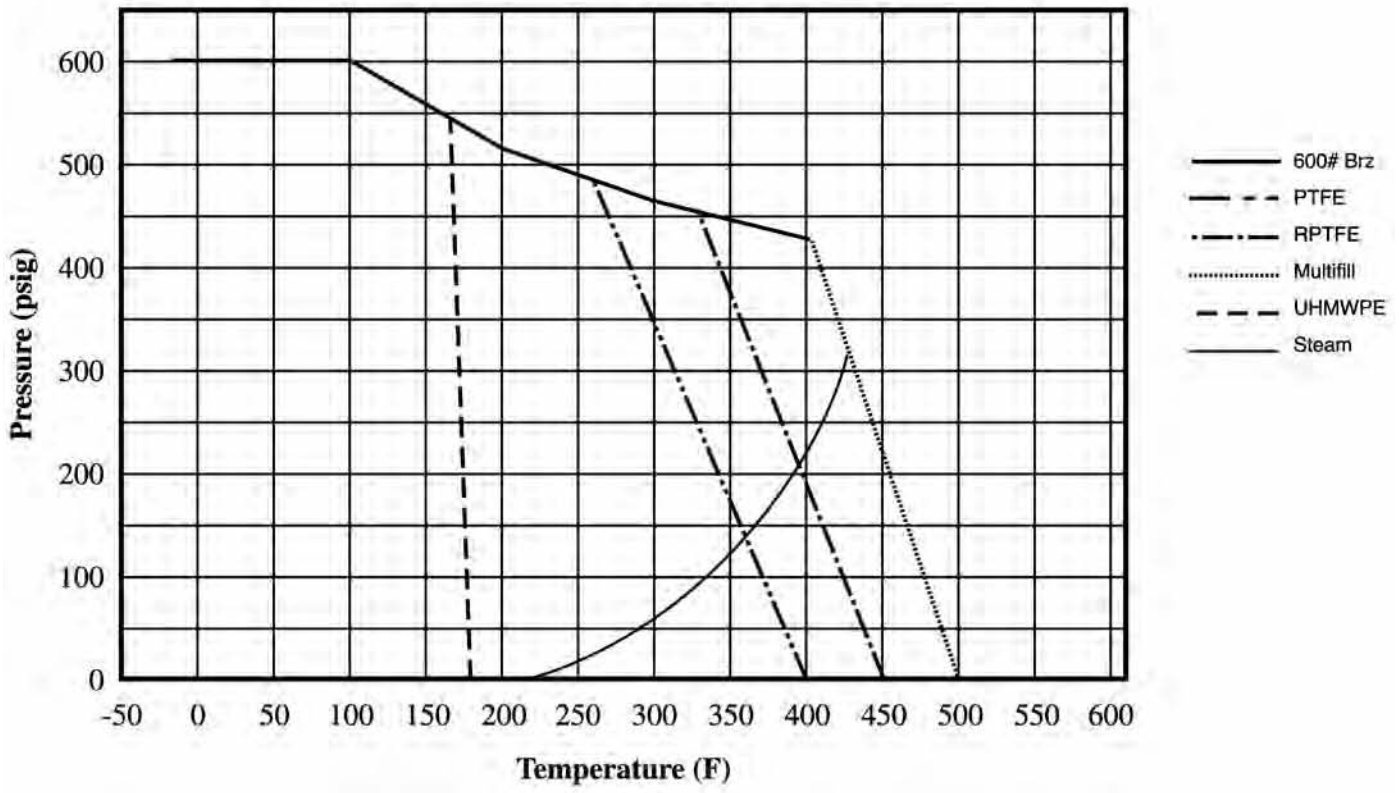
400# Bronze P-T Rating (Graph 3)



600# Bronze P-T Rating (Graph 4)



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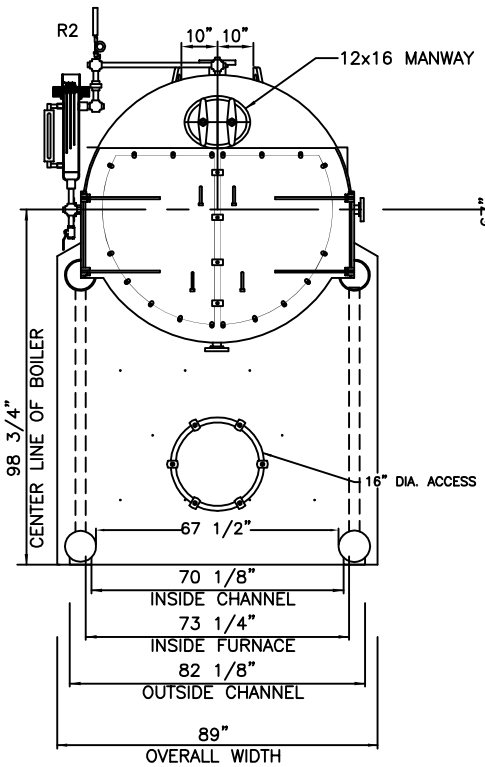
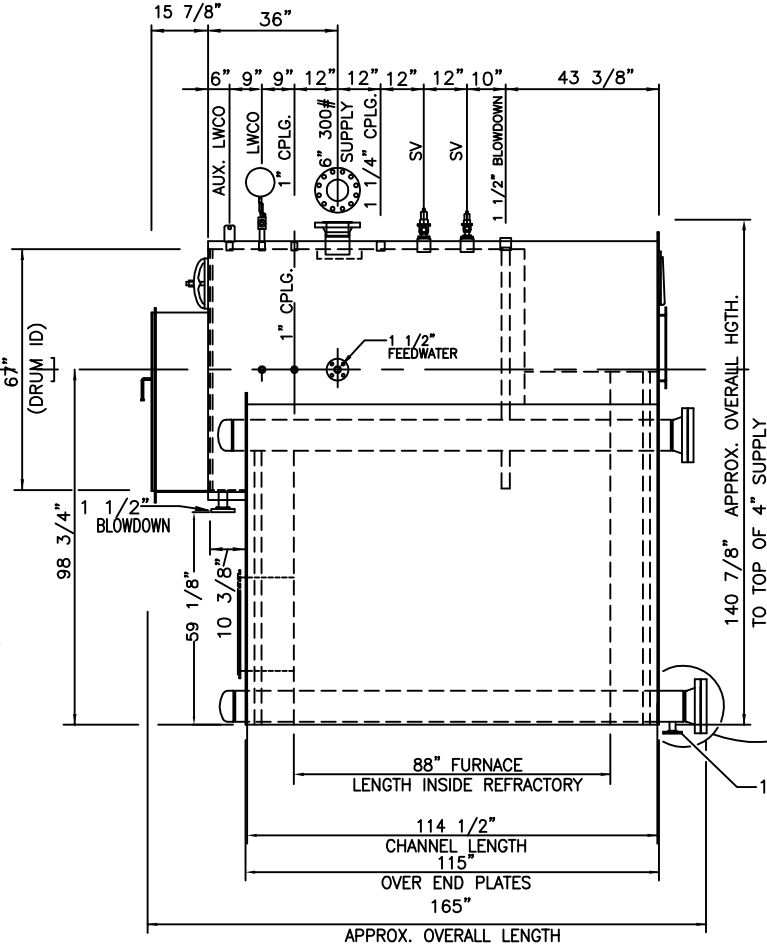
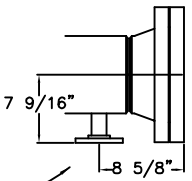
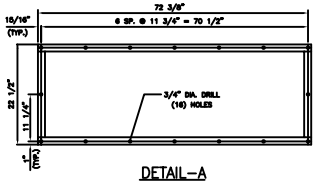


FRONT VIEW

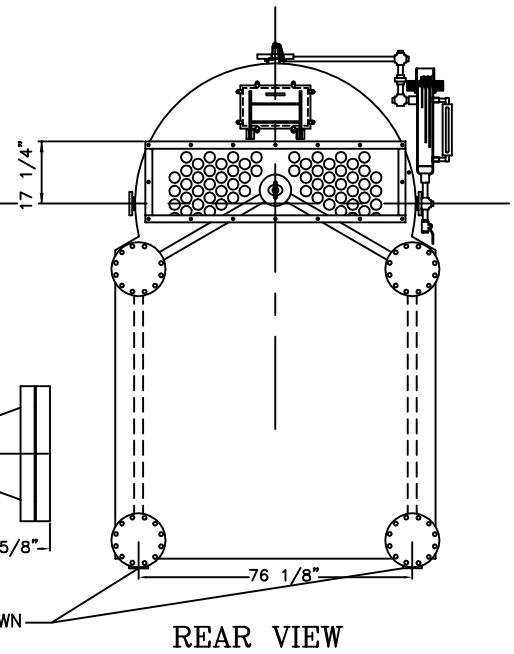


SIDE VIEW





DETAIL-A



REAR VIEW

HURST BOILER and WELDING CO., INC.
N65 FIREBOX BOILER DETAILS
975 SQ. FT. HIGH PRESS. FIREBOX BOILER–150 PSI

BOILER SPECIFICATIONS	
BUILT TO ASME CODE SECTION 1 FOR:	150 PSI STEAM
HEATING SURFACE	1,000 SQ. FT.
FURNANCE VOLUME	288.6 CU. FT.
SHIPPING WEIGHT	22,000 LBS.

R	BY:	DATE:	CHK'D.	REASON FOR CHANGE

to:

for:

THIS DRAWING IS THE PROPERTY OF HURST BOILER AND WELDING CO., INC. AND MAY NOT BE COPIED OR REPRODUCED IN ANY WAY UNLESS AUTHORIZED IN WRITING BY HURST BOILER AND WELDING CO., AND MUST BE RETURNED UPON REQUEST

SCALE:	DWN. BY:	DATE:	CHK'D. BY:	DRAWING NO.:	R
NTS 24	JGF	4.23.13	JWT	10013A161	

Class 250 Iron Body Automatic Stop Check Valves

Bolted Bonnet • Angle Pattern • Renewable Seat and Disc* • Bronze Mounted

250 PSI/17.2 Bar Saturated Steam to 406º F/207º C
500 PSI/34.5 Bar Non-Shock Cold Working Pressure to -20º F to 150º F/-29º C to 66º C◆

CONFORMS TO MSS SP-85

MATERIAL LIST

	PART	SPECIFICATION
1.	Handwheel Nut	Steel ASTM A 307
2.	Identification Plate	Aluminum
3.	Handwheel	Cast Iron ASTM A 126 Class B
4.	Stem	Brass ASTM B 16 Alloy C36000
5.	Yoke Bushing	Cast Bronze ASTM B 584 Alloy C84400
6.	Bonnet	Cast Iron ASTM A 126 Class B
7.	Gland Follower Stud	Steel ASTM A 307 (not shown)
8.	Gland Follower Nut	Brass ASTM F 467 Alloy C27000 (not shown)
9.	Gland Follower	Ductile Iron ASTM A 536
10.	Packing Gland	Zinc Plated Powdered Iron ASTM B 783 or Brass ASTM B 16
11.	Packing	TFE Braided
12. [1]	Butterfly Handle Nut	Steel ASTM A 307
13. [1]	Butterfly Handle	Cast bronze ASTM B 584 Alloy C84400
14. [1]	Control Valve Stem	Bronze ASTM B 371 Alloy C69400
15. [1]	Control Valve Pack Nut	Cast Bronze ASTM B 584 Alloy C84400
16. [1]	Control Valve Pack Gland	Brass ASTM B 16 Alloy C36000
17. [1]	Control Valve Packing	Synthetic Fibers with Graphite
18. [1]	Control Valve Body	Cast Bronze ASTM B 584 Alloy C84400
19.	Hex Head Cap Screw	Steel ASTM A 307
20.	Body Gasket	Reinforced Graphite
21. [1]	Dashpot Gasket	Reinforced Graphite
22. [1]	Dashpot	Cast Bronze ASTM B 584 Alloy C84400
23. [1]	Piston-Disc	Cast Iron ASTM A 126 Class B
24. [1]	Piston Ring (2)	TFE Composite Material
25. [1]	Disc Face Ring	Cast Bronze ASTM B 584 Alloy C84400
26. [1]	Seat Ring	Cast Bronze ASTM B 584 Alloy C84400
27.	Body	Cast Iron ASTM A 126 Class B
28. [2]	Piston Ring Collar	Brass ASTM B 16 Alloy C36000
29. [2]	Disc Cage	Bronze ASTM B 62 Alloy C83600
30. [2]	Teflon Disc	TFE
31. [2]	Disc Plate and Nut	Bronze ASTM B 62 Alloy C83600
32. [2]	Piston Rod Plug	Brass ASTM B 16 Alloy C36000
33. [2]	Piston Rod Plug Pin	Red Bronze ASTM B 140 Alloy C31400

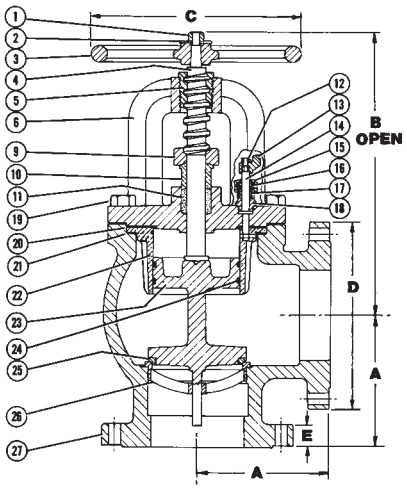
[1] 4" thru 8" size only. (4" thru 8" have Cast Iron Disc with Bronze Disc Face Ring.)
[2] 2½" and 3" size only. (2½" and 3" have Teflon Disc Ring (-Y series).)

DIMENSIONS—WEIGHTS—QUANTITIES

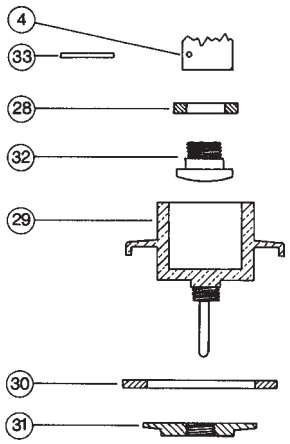
Size		Dimensions A		B		C		D		E		Weight	
In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	Lbs.	Kg.
2½	65	5.75	146	12.63	321	8	203	7.50	191	1.00	25	80	36
3	80	6.25	159	14.00	356	10	254	8.25	210	1.13	29	102	46
4	100	7.00	178	16.50	419	10	254	10.00	254	1.25	32	168	76
6	150	8.75	222	20.75	527	14	356	12.50	318	1.44	37	311	141
8	200	10.50	267	23.81	605	16	406	15.00	381	1.63	41	520	236

*** With proper machining facilities available.**

F-869-B
Flanged
Series D



F-869-B
Flg x Flg



Freezing Weather Precaution – Subsequent to testing a piping system, valves should be in an open position to allow complete drainage.

◆ For detailed Operating Pressure, refer to Pressure Temperature Chart on page 110.

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NIBCO
AHEAD OF THE FLOW

Automatic Stop Check Valves F-869-B

OVERSIZING OFTEN THE CULPRIT BEHIND MALFUNCTIONING AUTOMATIC STOP CHECK VALVES

By Glenn Pauley
Technical Service Senior Engineer

When an automatic stop check valve in a multiple-boiler system appears to be malfunctioning, it may seem logical to replace the valve and return the system to service. But in many cases, the problem lies not in the valve itself but in an error that commonly occurs during the design stage when valves for multiple-boiler systems are specified. More often than not, troublesome valves are oversized for the actual demand because of sizing error or to accommodate pipe size for future facility expansion. While thinking to the future may seem like a good idea, over-sizing the valves will cause improper operation, resulting in excessive seat wear, valve leaks, or even complete failure.

Use of an automatic steam stop check valve in a multiple-boiler system comes about because it is recommended by industry standard. ANSI/ASME B31.1 Power Piping Code requires two stop valves or a stop valve and an automatic stop check on top of each boiler in a multiple-boiler installation, when the output feeds a common header. This code gives preference to the automatic stop check valve.

With the question of the type of valve to be used settled, the issue then becomes proper sizing for the application. This is, in fact, the most important issue because improper sizing creates the bulk of the problems encountered with automatic steam stop check valve malfunctions. Typically, a stop check valve is selected to handle the boiler system's maximum output, ignoring the current needs that may be significantly less. Seasonal fluctuations in heat demand and computer controlled boiler modulation with high turn down ratios create a similar situation. The result is the valve is oversized if you consider the everyday low demand. This causes the valve to perform poorly and wear prematurely.

A typical scenario runs like this: A new hospital is being planned. The sequence starts on the drawing board, where the required steam supply line size is specified by calculating the maximum demand. It is decided that a three-boiler installation feeding a common header will work best.

The boiler manufacturer typically sizes the discharge nozzle from the boiler for maximum output. Let's say the discharge nozzle that comes with the boiler is 6", based on maximum rated output. An automatic steam check valve is placed on top of each boiler. Each valve is piped to the common header, all in 6" size following the boiler manufacturer's lead with the 6" discharge nozzle.

Unfortunately, this does not mean that 6" is the proper size for the automatic steam check valve based on actual steam demand to be used. As we said, the boiler outlet nozzles sized by the manufacturer at 6" is merely to provide for the maximum achievable output of the boiler. Maximum output may have been calculated by the design engineer to include a building expansion planned in five years. What all this means is for those five years the valve will be

oversized for the system's actual requirements no matter what minor corrective actions are taken. There is simply too much valve for too little steam demand.

The project progresses, the construction follows the drawings and instructions from the design engineer. The job is completed and turned over to the hospital. Now the operating people working for the hospital start to have trouble.

We have taken a look at how it was done, so let's take a look at how it should be done. The hospital equipment, taking into consideration in establishing the operating requirements, might include such items as steam tables in the cafeteria, heating equipment, laundry facilities, and sterilizing equipment to name a few. When the equipment is totaled up, the theoretical demand is 12,000 pounds per hour at peak demand. The operating pressure is 120 psi based on equipment selected. The boilers are rated 250 horsepower (ultimate) each, based on calculated maximum demand. Sooner or later in the piping process, we need to convert out steam supply and demand to pounds per hour. To convert horsepower to pounds per hour, multiply 250 (boiler horsepower) by 34.5 to arrive at a maximum steam output of 8,625 pounds per hour, per boiler. The combined total supply for three boilers then results in about 26,000 pounds of steam per hour.

We now have a total boiler capacity of 26,000 lbs/hr, far in excess of the 12,000 lbs/hr actual demand. Although a single boiler's output is less than actual demand, generally there will be two boilers on-line and one standby. In order to prevent steam from backing up into the second on-line boiler, the valve's disc continually opens and closes. A "chattering" sound is caused by the disc as it repeatedly rises and falls. This chattering is more than an annoyance; it is the first hint of operating trouble. Over time, the rising and falling action causes damage to the seat and disc. Leakage past the seat is the eventual result allowing steam to re-enter the boiler when it should not. If not corrected soon, the result is an unusable waterlogged boiler.

There is only one way to properly size an automatic steam stop check valve. We must go all the way back to the design stage. This is done by calculating the actual steam load that goes through the valve in pounds per hour. Current needs should be the basis of these calculations, even if the demand is likely to change later. Anything other than current actual demand values must be ignored.

The solution is simple. Select a valve with the correct operating range from the manufacturer's sizing information. A dampening adjustment can significantly lessen the wear caused by impact against the valve seat. This could eliminate the need to employ a single-stage parallel reduction station, the only other viable solution to the problem of over-sizing. This expensive method uses two different sized valves to meet both minimum and maximum demand periods. In this situation a smaller valve is sized to handle one-third of the maximum output of the system, and the other is sized to handle the remaining two-thirds of the maximum load. Although this method is effective, it is much more complicated and expensive than using a single valve with adequate range of operation.

NIBCO's F-869-B automatic steam stop check valve is quality designed and built. It has an external dampening control valve for easy adjustment to control the rate of disc rise and fall. The use of NIBCO automatic steam stop check valves cannot entirely eliminate over-sizing errors that occur. But with its modern materials, tight manufacturing tolerances, and reliable control damper, it will help to reduce some common sizing errors.

NIBCO
AHEAD OF THE FLOW

Automatic Stop Check Valves F-869-B

EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT TECHNICAL BULLETIN

Stop check valves are as essential to the safe operation of a multi-boiler plant as any other safety device that is attached to a boiler, and have four very important functions in the steam piping system.

1. To act as an automatic non-return valve by preventing the backflow of steam from the header to the boiler in the event of failure in the boiler.
2. To assist in cutting a boiler out of the steam system when it ceases to fire. In this case the disc automatically closes and prevents the pressure in the header from entering the boiler.
3. To assist in bringing a boiler into service after a shutdown. This operation requires considerable care when preformed manually, but is accomplished automatically by a stop check valve without pressure fluctuations or disturbance of water level.
4. To act as a "safety first" valve by preventing back-flow of the steam from the header to the boiler that has been shut down for inspection should the valve be opened accidentally.

There are three basic questions regarding the NIBCO automatic stop check valve.

1. What is an automatic stop check valve?
2. Where is it used?
3. How does it work?

Question #1 – What is an automatic stop check valve?

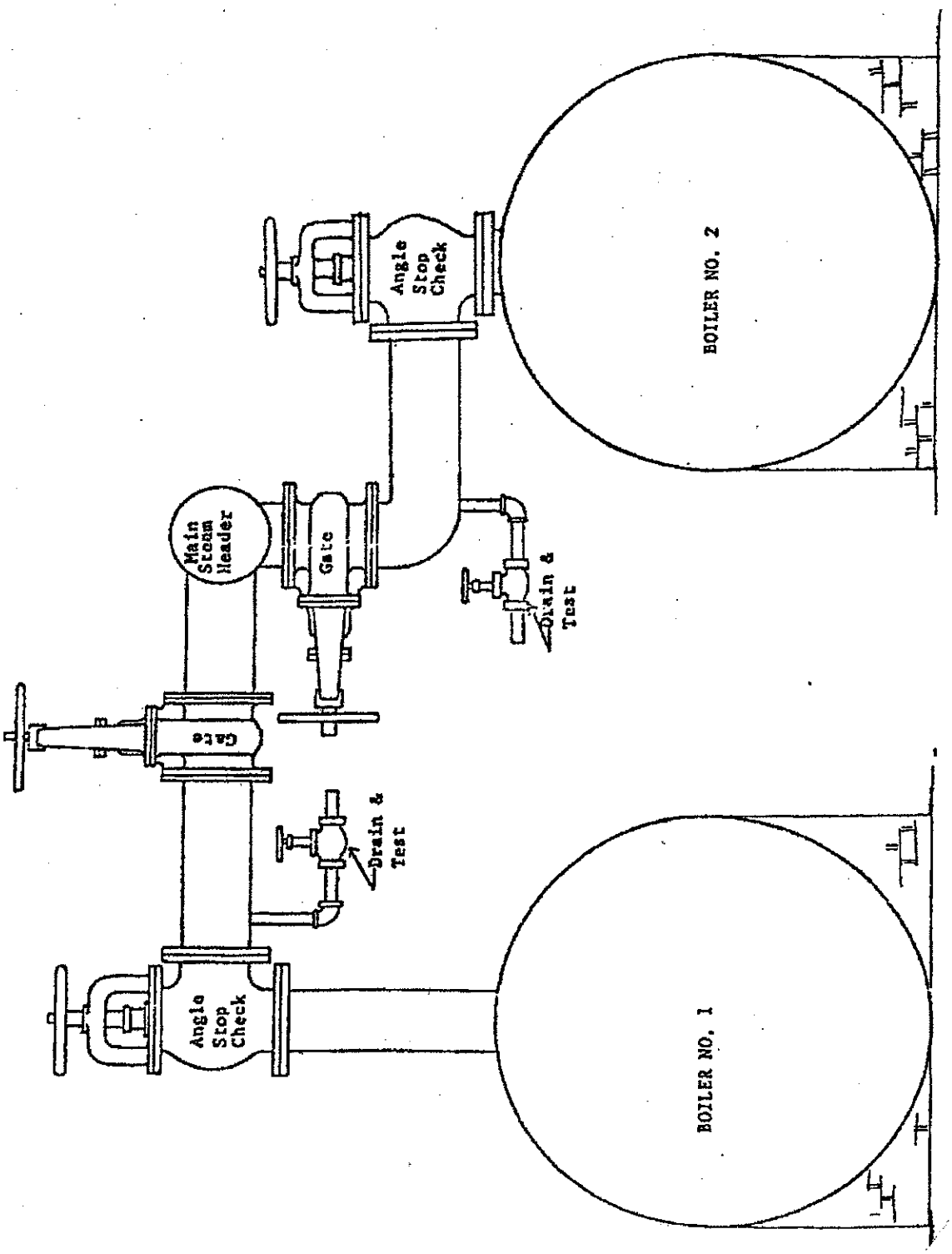
The location of a stop check valve is predominantly in the steam line at the boiler riser. It allows steam to pass through it from the boiler to the main header, but in case the boiler steam delivery is interrupted, the stop check valve will automatically prevent steam from flowing back into the boiler. The stop check valve is a back-flow preventer. Its function is the same as the swing or lift check valve in that it allows flow in one direction but not in the opposite direction.

An automatic stop check valve can also function as a stop and throttling valve the same way as a globe pattern valve.

Question #2 – Where is it used?

The automatic stop check valve is designed to be used between the boiler steam exit and the steam header in a multiple boiler plant to serve as a back-flow preventer and a stop valve.

Generally, there are two valves between the boiler and the header. One valve is a stop check valve and the other is a stop valve, either gate, angle, or globe type. The two valves are used to make maintenance more convenient and in most cases, are required by code for the inspectors safety while inspecting the boiler. (See sketch on page 2)



TYPICAL BOILER SYSTEM SKETCH

Question #3 – How does it work?

As stated in the answer to question #1, the automatic stop check valve in principle works like a lift check valve but with two very important additional features.

1. A method is provided to control the rate of ascent and descent of the disc.
2. A means is provided to close the disc positively so that fluids may not flow in either direction regardless of pressure differential.

Various manufactures provide different methods of controlling disc movement. Basically the two methods are by spring tension or dashpot arrangement.

Lunkenheimer was the only manufacturer that produced a valve with an external spring tension adjustment to control disc movement. Other manufacturers, including NIBCO, use the less complicated dashpot arrangement. NIBCO is the only manufacturer who supplies a valve with external control of the dashpot. All other manufacturer's valves must be disassembled so that the piston rings may be added or removed to respectively slow down or speed up automatic disc movement.

Generally all manufacturers provide OS&Y stem arrangement to positively close the disc. This stem merely pushes down on the disc through the linkage on the Lunkenheimer valve, or the dashpot piston on other valves. (See sketch on page 4)

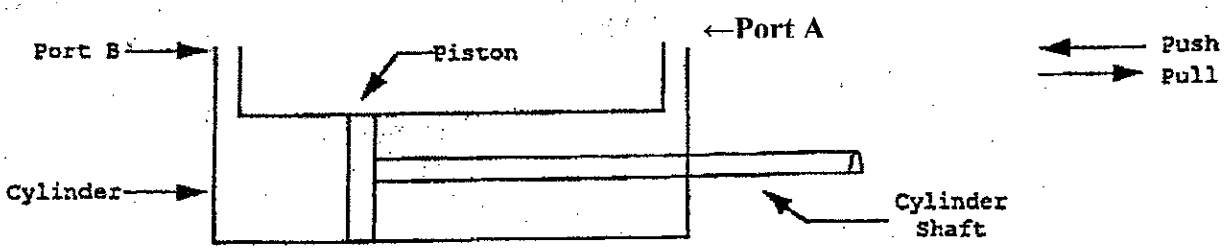
The purpose of the dashpot is to control the rate of ascent and decent of the disc so that the disc does not slam and chatter in the line. Since valves are connected to a network of pipes in the system, this would mean that the noise of a slamming and chattering disc could be transmitted through the piping system. This noise is distracting in office buildings, hospitals, ect. where concentration is essential. Moreover, the slam and chatter is extremely harmful to the disc and seat. It should also be noted that slam and chatter of the disc causes pulsations within the steam line which makes it very difficult for automatic steam regulators and other steam equipment to function properly. Therefore, the disc must be controlled by some means of dampening which, in most cases, is the dashpot.

The disc has a tendency to slam and chatter at various times. Usually the slam and chatter will be obvious when the boiler is coming up to operating pressure. At this time the steam is tending to lift the disc, and as it does the pressure in the boiler drops allowing disc to fall and make noise. Sometimes this is in the form of a slam, or it can take the form of a chatter if it occurs several times per minute. The disc can also make noise at periods when the boiler is at peak delivery. Here the disc can rise rapidly banging up against the stem end or the dashpot housing to cause noise.

We cannot stop the disc from coming into contact with the seat or stem, but we can and do control the rate of impact to prevent loud noises in the piping system.

Finally, we come to the questions: How is this done? How does the dashpot work? How are adjustments made?

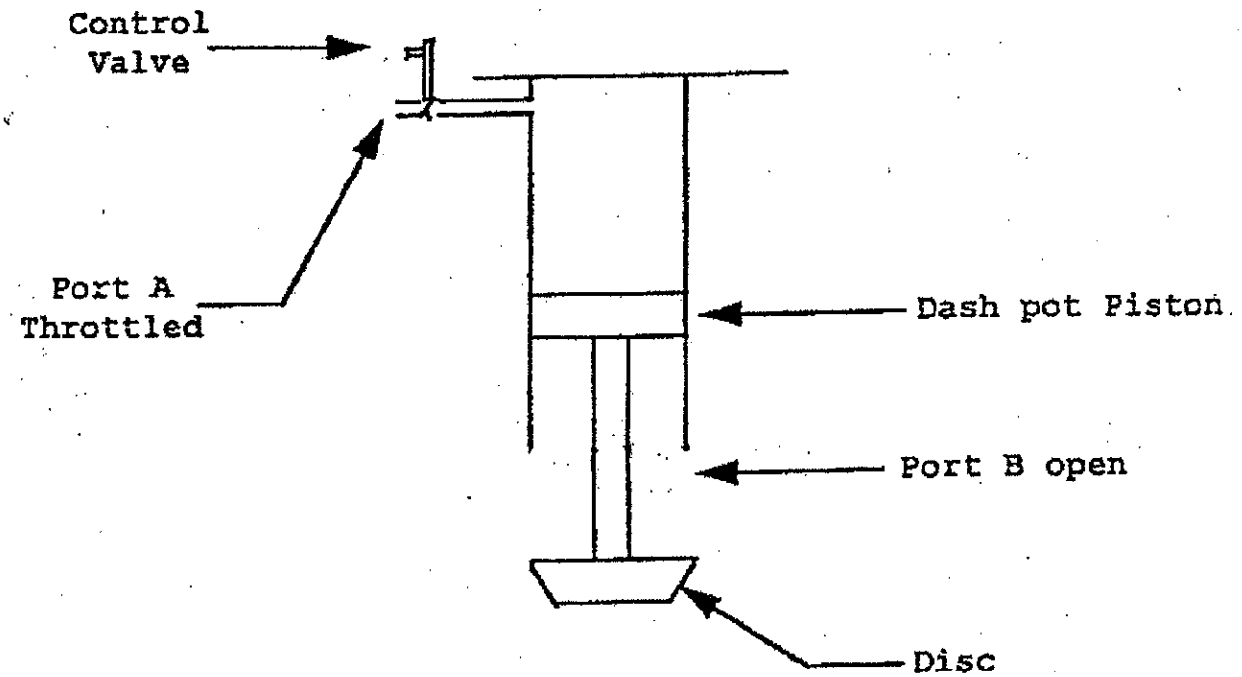
The dashpot is the same in principle as a shock absorber on an automobile. It does not prevent, but controls the rate of movement. The dashpot must have fluid to displace. In the case of the stop check valve, this fluid is the fluid within the piping system, namely steam. All dashpots are very similar to an air cylinder.



TYPICAL AIR CYLINDER

If one tries to push the cylinder shaft into the cylinder, air will come out of port B and flow into port A. Pulling the shaft out will cause the opposite to happen. Now if a throttle valve is put on port A and throttled very closely, the same amount of force applied to push in the shaft will allow a greatly reduced rate of movement. Hence, when the shaft bottoms out there will only be a small click heard instead of a loud bang. If we put the throttling valve on port B and take it off port A and push the shaft in the same direction, the very same result will be obtained as when the throttle valve was on port A. Having throttle valves on both ports would not change function at all. The rate of travel will be controlled by the throttle valve being closed the most. Since one throttle valve does the same job as two, the NIBCO automatic stop check valve has but one control valve.

We have now developed the principle on which the NIBCO automatic stop check valve was designed, only now we add the principle of gravity and turn the air cylinder in the vertical direction and attach a disc to have the following:

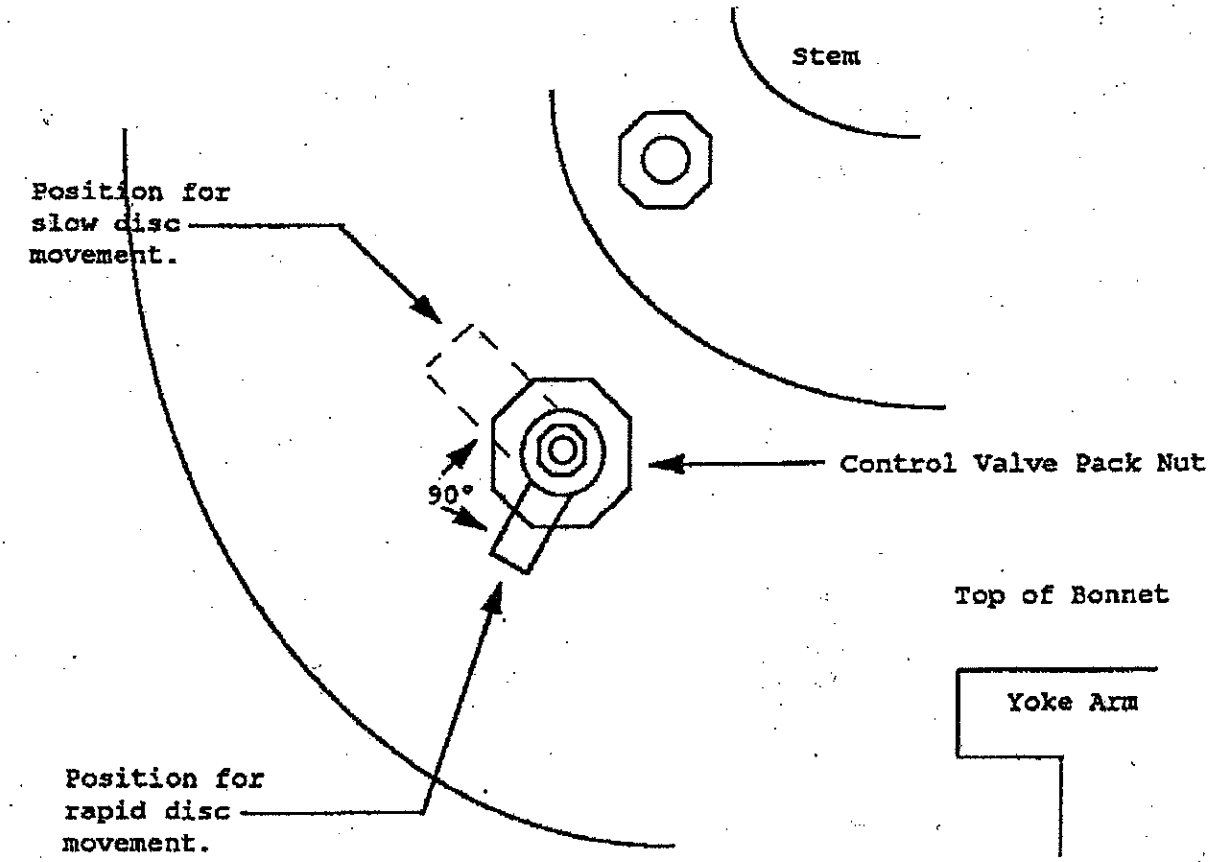


NIBCO DASHPOT / DISC CONTROL SYSTEM

Note that port B is merely an opening at the bottom of the dashpot which allows steam to enter and exit freely. Port A has a control valve which can be throttled to allow steam to enter the chamber above the piston, either rapidly for quick decent or slowly for slow decent of disc. This is the function of the dashpot arrangement. It should be pointed out that the stop check valve must always be in an upright position with the handwheel on top of the valve. If this is not done there is no way that the valve will work properly.

ADJUSTING THE NIBCO F-869-B AUTOMATIC STOP CHECK VALVE

The external control valve near the packing gland requires only a quarter turn to allow the disc to rise / descend rapidly or slowly. (See sketch below)



TOP VIEW OF NIBCO VALVE

If slam or chatter exists in the piping line, the small control valve should be adjusted by turning clockwise until noise is greatly reduced. After adjustment of control valve, the control valve packing nut should be tightened to assure valve does not move from its new setting.

If a noise problem is still present and steam delivery from the boiler is at a minimal demand operating range, the delivery may have fallen below the range the valve was designed for. This may be corrected by partially closing or "throttling" the automatic steam check valve by turning handwheel clockwise. It is important to remember the valve must be fully opened again if steam demand is increased. If the steam delivery demand is changed to any great degree, the adjustment procedure may need to be repeated.

NOTE: 2½" and 3" F-869-Y automatic stop check valves do not have an external disc control valve. The disc control setting is made during valve manufacturing and is permanently fixed.

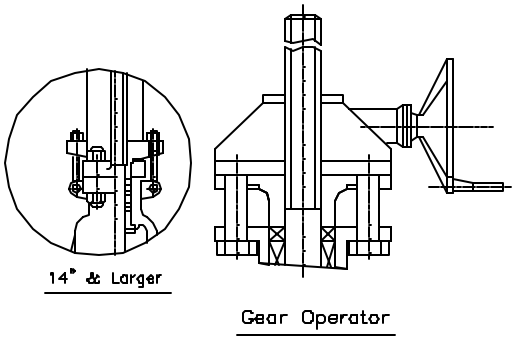
In the event that a boiler shuts down the stop check must prevent backflow into the boiler. The weight of the disc and dashpot, through force of gravity, promotes rapid sealing so steam and condensate cannot backflow into the boiler even at low pressures. In the NIBCO design stop checks, you will note that the disc and dashpot are one piece to allow positive sealing eliminating any misalignment due to assembly or uneven heat expansion. This feature also permits field repair of the valve seat without fear of misassembly by field mechanics.

It takes about ¾ psi steam pressure to lift disc from seat for all sizes of NIBCO automatic stop check valves.

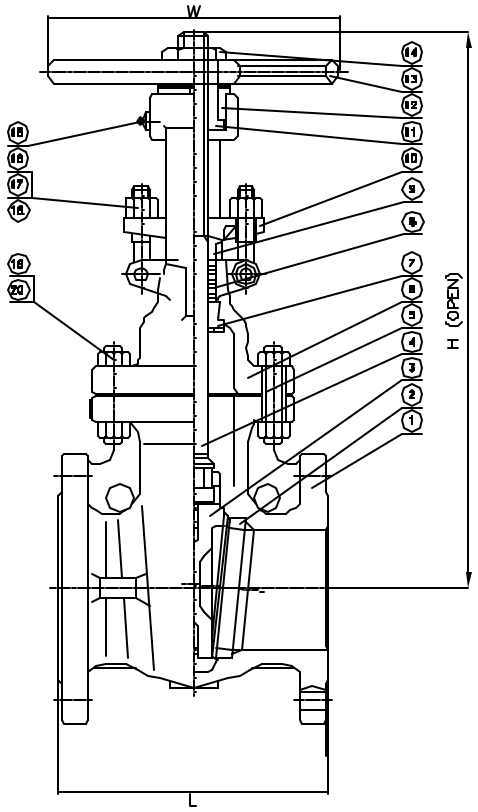
Cast Steel Gate Valve

Class 150 Flanged (2" to 36") - 15FGAW

Class 150 Butt Weld (2" to 36") - 15BGAW



NO.	PART NAME	MATERIAL
1	BODY	A216 WCB
2	SEAT	A105+HF
3	WEDGE	WCB+F6
4	STEM	A182 F6
5	GASKET	Spiral Wound SS/Graphite
6	BONNET	A216 WCB
7	BACK SEAT	A276 410
8	PACKING	Graphite
9	PACKING GLAND	A276 410
10	GLAND	A216 WCB
11	STEM NUT	D-2 Ductile Iron
12	GLAND NUT	1035 Steel
13	HANDWHEEL	Ductile Iron
14	LOCK NUT	A29 1035 Steel
15	GREASE FITTING	Steel
16	EYE BOLT	A193 B7 Steel
17	EYE BOLT NUT	A194 2H Steel
18	EYEBOLT PIN	A29 1035 Steel
19	BOLT	A193 B7 Steel
20	NUT	A194 2H Steel



Davis cast steel valves comply with the following applicable specifications: ANSI B16.10, ANSI B16.5, API 600: Tested to API 598

Working Pressure: 285 WOG Body Testing Pressure: 428 psi
Seat Testing Pressure: 314 psi Air Testing Pressure: 80 psi

NPS		2	2-1/2	3	4	5	6	8	10	12	14	16	18	20	24	30	36
d	mm	51	64	76	102	127	152	203	254	305	337	387	438	489	591	743	915
L	in	7	7.5	8	9	10	10.5	11.5	13	14	15	16	17	18	20	24	28
(RF)	mm	178	190	203	229	254	267	292	330	356	381	406	432	457	508	610	711
L	in	8.50	9.50	11.14	12.00	15.00	15.88	16.50	18.00	19.76	22.50	24.00	26.00	28.00	32.00	36	40
(BW)	mm	216	241	283	305	381	403	419	457	502	572	610	660	711	813	914	1016
H	in	15.20	17.13	19.02	23.11	26.50	30.20	37.60	45.12	52.28	59.80	67.76	74.80	83.31	97.64	134.5	161.8
(open)	mm	386	435	483	587	673	767	955	1146	1328	1519	1721	1900	2116	2480	3417	4109
W	in	7.87	7.87	9.84	9.84	11.81	11.81	13.78	17.72	19.69	18.11	18.11	18.11	24.02	24.02	Gear	Gear
	mm	200	200	250	250	300	300	350	450	500	460*	460*	460*	610*	610*		
WT	RF	44	66	79	117	157	187	300	485	712	853	1219	1455	1786	2756	4343	7070
(Lbs)	BW	37	57	64	101	146	170	256	445	648	772	1116	1268	1587	2491	4482	7209

Davis Valve

70-100 Series
Bronze Ball Valve

Threaded, 600 psig WOG, Cold Non-Shock. 150 psig Saturated Steam. (See referenced P/T charts)
Vacuum Service to 29 inches Hg.
Federal Specification: WW-V-35C, Type: II, Composition: BZ, Style: 3.
MSS SP-110; Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

FEATURES

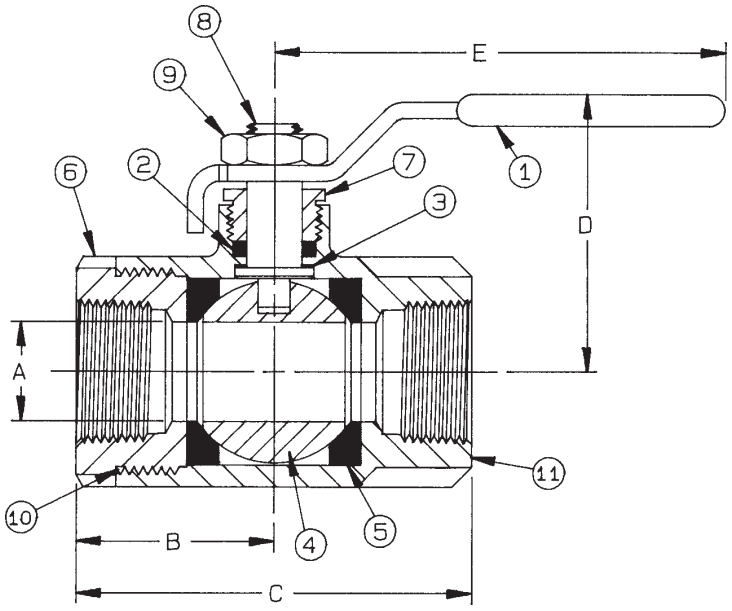
- Two-piece body
- Reinforced seats
- Blow-out-proof stem design
- Adjustable packing gland

STANDARD MATERIAL LIST

1. Lever and grip	Steel, zinc plated w/vinyl	7. Gland nut	B16
2. Stem packing	MPTFE	8. Stem	B16
3. Stem bearing	RPTFE	9. Lever nut	Steel, zinc plated
4. Ball	B16, chrome plated	10. Body seal (1-1/4" to 4")	PTFE
5. Seat (2)	RPTFE		
6. Retainer	B16 (1/4" to 1") B584-C84400 (1-1/4" to 4")	11. Body	B584-C84400

VARIATIONS AVAILABLE:

70-140 Series (316 SS Ball & Stem)
70-190 Series (Locked Retainer)



BRONZE BALL VALVE

NUMBER	SIZE	A	B	C	D	E	Wt.
70-101-01	1/4"	.37	1.03	2.06	1.75	3.87	.60
70-102-01	3/8"	.37	1.03	2.06	1.75	3.87	.56
70-103-01	1/2"	.50	1.12	2.25	1.75	3.87	.63
70-104-01	3/4"	.68	1.50	3.00	2.12	4.87	1.39
70-105-01	1"	.87	1.68	3.37	2.25	4.87	1.72
70-106-01	1-1/4"	1.00	2.00	4.00	2.62	5.50	3.26
70-107-01	1-1/2"	1.25	2.18	4.37	3.06	8.00	4.61
70-108-01	2"	1.50	2.34	4.68	3.25	8.00	6.06
70-109-01A	2-1/2"	2.00	3.12	6.25	3.72	8.00	17.25
70-100-01	3"	2.50	3.37	6.75	4.12	8.00	18.60
70-10A-01	4"	3.12	3.69	7.37	5.25	9.94	25.50

OPTIONS AVAILABLE:

(SUFFIX)	OPTION	SIZES
-02-	Stem Grounded	1/4" to 4"
-04-	2-1/4" CS Stem Extension	1/4" to 3"
-05-	Plain Ball	1/4" to 3"
-07-	Steel Tee Handle	1/4" to 2"
-08-	90° Reversed Stem	1/4" to 3"
-10-	SS Lever & Nut	1/4" to 3"
-11-	Therma-Seal™ Insulating Tee Handle	1/4" to 2"
-14-	Side Vented Ball (Uni-Directional)	1/4" to 4"
-15-	Wheel Handle, Steel	1/4" to 2"
-16-	Chain Lever - Vertical	3/4" to 2"
-17-	Rough Chrome Plated - Bronze Valves	1/4" to 3"
-21-	UHMWPE Trim (Non-PTFE)	1/4" to 3"
-24-	Graphite Packing	1/4" to 3"
-27-	SS Latch-Lock Lever & Nut	1/4" to 3"
-30-	Cam-Lock and Grounded	1/4" to 2"
-32-	SS Tee Handle & Nut	1/4" to 2"
-35-	VTFE Trim	1/4" to 3"
-36-	SS Hi-Rise Round Handle, SS Nut	1/4" to 2"
-39-	SS Hi-Rise Locking Wheel Handle, SS Nut	1/4" to 2"
-40-	Cyl-Loc and Grounded	1/4" to 2"
-41-	Automatic Drain (Bronze Valves Only) see page J-8	1/4" to 2"
-45-	Less Lever & Nut	1/4" to 3"
-46-	Latch Lock Lever - Lock in Closed Position Only	1/4" to 3"
-47-	SS Oval Latch-Lock Handle & Nut	1/4" to 1"
-48-	SS Oval Handle (No Latch) & Nut	1/4" to 2"
-49-	Assembled Dry	1/4" to 4"
-50-	2-1/4" CS Locking Stem Extension	1/4" to 3"
-56-	Multifill Seats & Packing	1/4" to 3"
-57-	Oxygen Cleaned	1/4" to 4"
-58-	Chain Lever - Horizontal	3/4" to 2"
-60-	Static Grounded Ball & Stem	1/4" to 3"
-63-	NPT x Solder/Socket Weld	3/8" to 4"
-64-	250# Steam Trim	1/4" to 3"
-92-	Balancing Stop	1/4" to 3"
-HC-	Hose Cap & Chain	1/2" to 1"
-P01-	BSPP (Parallel) Thread Connection	1/4" to 3"
-T01-	BSPT (Tapered) Thread Connection	1/4" to 3"

For Pressure/Temperature Ratings, Refer to Page M-8, Graph No. 4

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FLOW DATA

For Apollo® Ball Valves

The listed Cv "factors" are derived from actual flow testing, in the Apollo® Ball Valve Division, Conbraco Industries, Inc., Pageland, South Carolina. These tests were completed using standard "off the shelf" valves with no special preparation and utilizing standard schedule 40 pipe. It should be understood that these factors are for the valve only and also include the connection configuration. The flow testing is done utilizing water as a fluid media and is a direct statement of the gallons of water flowed per minute with a 1 psig pressure differential across the valve/connection unit. Line pressure is not a factor. Because the Cv is a factor, the formula can be used to estimate flow of most media for valve sizing.

Flow of Liquid

$$Q = Cv\sqrt{\frac{\Delta P}{SpGr}}$$

or $$\Delta P = \frac{(Q)^2\ (SpGr)}{(Cv)^2}$$

Where:
Q = flow in US gpm
ΔP = pressure drop (psig)
SpGr = specific gravity at flowing temperature
Cv = valve constant

Flow of Gas

$$Q = 1360\ Cv\sqrt{\frac{(\Delta P)\ (P_1)}{(SpGr)\ (T)}}$$

or $$\Delta P = \frac{5.4 \times 10^{-7}\ (SpGr)\ (T)\ (Q)^2}{(Cv)^2\ (P_2)}$$

Where:
Q = flow in SCFH
ΔP = pressure drop (psig)
SpGr = specific gravity (based on air = 1.0)
P_2 = outlet pressure–psia (psig + 14.7)
T = (temp. °F + 460)
Cv = valve constant

Cv FACTORS FOR APOLLO VALVES

Valve Size (inches)	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10	12
Ball Valves															
32-100/200 Series	5.1	6.6	8	24	30	45	55	95	--	--	--	--	--	--	--
64-100/200 Series	6	7	19	34	50	104	268	309	629	1018	1622	--	--	--	--
64W Series	--	--	--	--	--	--	--	--	629	1018	1622	--	--	--	--
70B-140 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
70-100/200 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	---
70-300/400 Series	--	--	15	30	43	48	84	108	--	--	--	--	--	--	--
70-600 Series	2.3	4.5	5.4	12	14	21	34	47	--	--	--	--	--	--	--
70-800 Series	8.4	7.2	15	30	43	48	84	--	--	--	--	--	--	--	--
71AR Series	--	--	--	30	43	48	84	108	190	370	--	--	--	--	--
71-100/200 Series	--	--	--	30	43	48	84	108	190	370	--	--	--	--	--
72-100/900 Series	--	--	26	48	65	125	170	216	--	--	--	--	--	--	--
73A-100 Series	8.4	7.2	15	30	43	48	84	108	--	--	--	--	--	--	--
73-300/400 Series	--	--	26	48	65	125	170	216	--	--	--	--	--	--	--
74-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
75-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
76AR Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
76F-100 Series	8.1	15	15	51	68	125	177	389	--	--	--	--	--	--	--
76-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
76-300/400 Series	--	--	26	48	65	125	170	216	--	--	--	--	--	--	--
76-600 Series	2.3	4.5	5.4	12	14	21	34	47	--	--	--	--	--	--	--
7K-100 Series	--	--	15	51	68	125	177	389	503	--	--	--	--	--	--
77AR Series	8.1	15	15	51	68	125	177	389	--	--	--	--	--	--	--
77C-100/200 Series	4.5	7.2	16	36	68	125	177	389	503	--	--	--	--	--	--
77D-140 Series	4.5	7.2	16	36	68	125	177	389	--	--	--	--	--	--	--
77D-640 Series	--	--	--	11	24	35	--	--	--	--	--	--	--	--	--
77G-UL Series	4.5	7.2	16	36	68	125	177	389	503	--	--	--	--	--	--
77W Series	--	--	16	36	68	125	177	389	--	--	--	--	--	--	--
77X Series	--	--	16	36	68	--	--	--	--	--	--	--	--	--	--
77-100/200 Series	8.1	15	15	51	68	125	177	389	503	--	--	--	--	--	--

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Cv FACTORS FOR APOLLO VALVES

Valve Size (inches)	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10	12
Ball Valves															
79 Series	8.5	8.5	9.8	32	44	66	148	218	440	390	--	--	--	--	--
80/81 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
82-100/200 Series	8.1	14	26	51	68	120	170	376	510	996	1893	--	--	--	--
83A/83B Series	8.1	14	26	51	68	120	170	376	--	--	--	--	--	--	--
83R-100/200 Series	--	--	--	--	--	--	170	376	--	996	1893	--	--	--	--
86A/86B Series	8.1	14	26	51	68	120	170	376	--	--	--	--	--	--	--
86R-100/200 Series	--	--	--	--	--	--	170	376	--	996	1893	--	--	--	--
87A-100 Series	--	--	--	--	--	--	86	104	234	375	673	1099	1902	3890	--
87A-200 Series	--	--	15	19	75	--	195	410	545	1021	2016	4837	9250	15170	22390
87A-700 Series	--	--	--	--	--	--	86	104	234	375	673	1099	1902	3890	--
87A-900 Series	--	--	15	19	75	--	195	410	545	1021	2016	4837	9250	15170	22390
87B-100 Series	--	--	--	--	--	--	--	--	--	375	673	1099	1902	3890	--
88A-100 Series	--	--	--	--	--	--	86	104	234	375	673	1099	1902	3890	--
88A-200 Series	--	--	15	19	75	--	195	410	545	1021	2016	4837	9250	15170	22390
88A-700 Series	--	--	--	--	--	--	86	104	234	375	673	1099	1902	3890	--
88A-900 Series	--	--	15	19	75	--	195	410	545	1021	2016	4837	9250	15170	22390
88B-100 Series	--	--	--	--	--	--	--	--	--	375	673	1099	1902	3890	--
89-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
9A-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
91-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
92-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
93-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
94A-100/200 Series	6	7	19	34	50	104	268	309	629	1018	1622	--	--	--	--
95-100/200 Series	--	--	15	51	68	--	--	--	--	--	--	--	--	--	--
95A-300/400 Series	--	--	19	34	50	--	--	--	--	--	--	--	--	--	--
96-100 Series	8.3	6.7	5.7	10	16	25	40	62	--	--	--	--	--	--	--
399-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
489-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--

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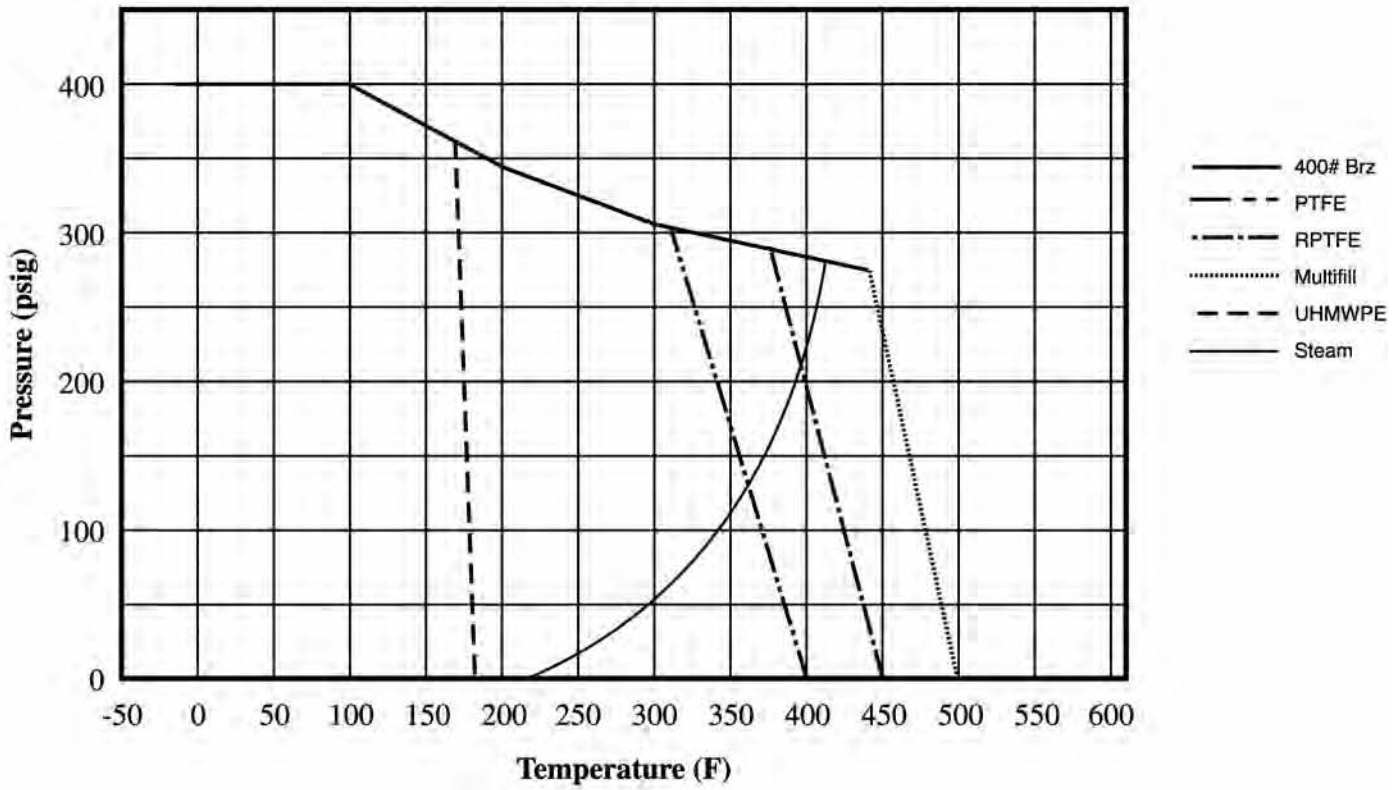
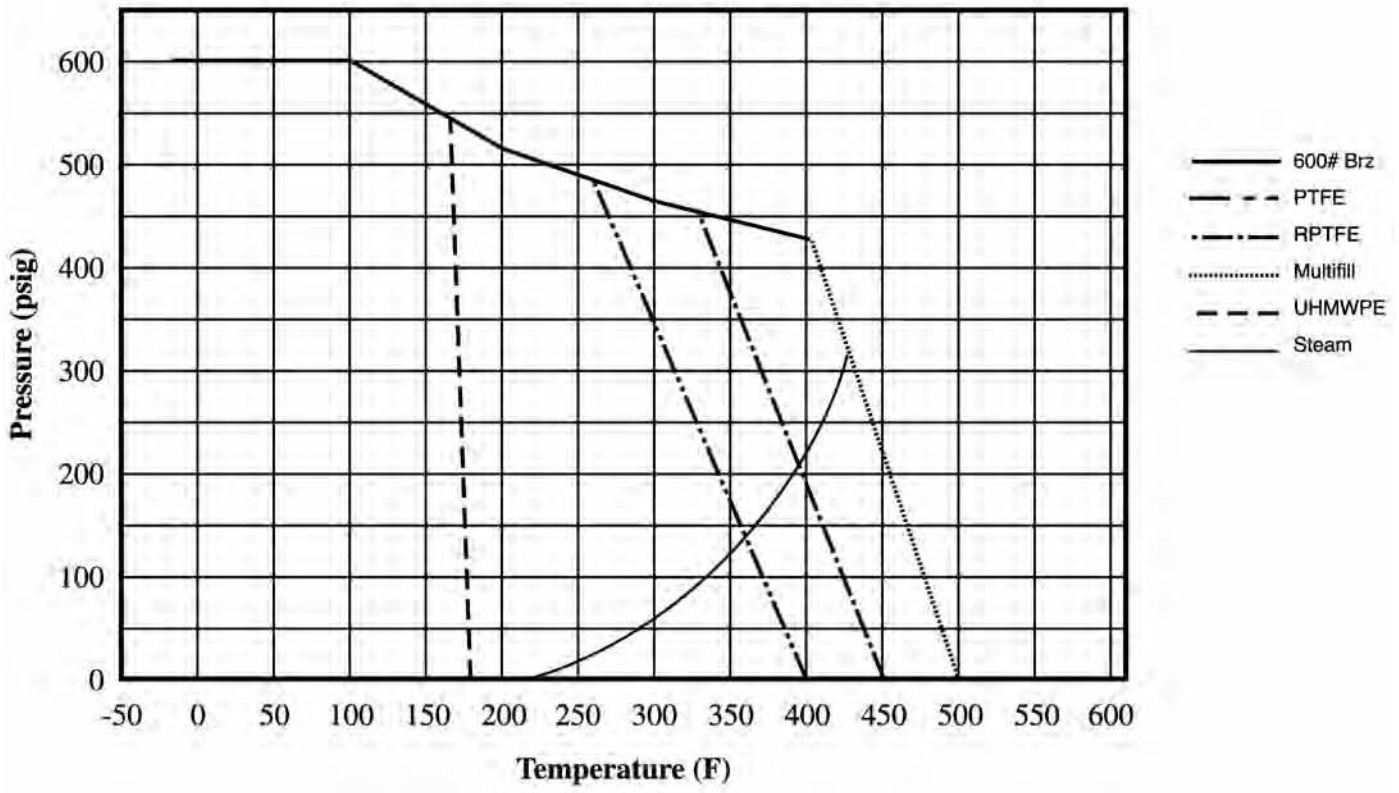
400# Bronze P-T Rating (Graph 3)



600# Bronze P-T Rating (Graph 4)



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United Brass Works
Keystone Foundry Division

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Model 425 Quick Opening Blow Off Valve

Check up to five results to perform an action.

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Class 300
ANSI B16.34
650 psi Working Steam Pressure @ 500F
750 psi @ 100F
100% Pressure Tested
Maximum Boiler Blow-Off Pressure 490 psi per Sec. 1 Table A-361
Threaded Ends
High Temp. Powder Coating for Corrosion Resistance
CRN OCO7135.2, 24, 25, 26
CRN OEO2171.7, 79, 70, 78,7AY, 7T, 7N

The United Brass quick opening boiler blow down valve has been designed for the rugged service of boiler treatment and scale. The cast steel knife gate valve conforms to Class 300 of ANSI B16.34 and features a stainless steel seat and disc hardened to Rockwell 60. ASME Boiler and Pressure Vessel Code Sections 1 PG-42.1.122 and Power Piping Code AS

Request Information | Compare Items

Results Per Page : 25

Results 1 - 4 of 4 **1**

Item #	Size	A	B	C	D	E	Weight
Model 425 - 1"	1 in	5.32 in	5.32 in	10.00 in	60 º	3.80 in	14.00 lb
Model 425 - 1 1/4"	1-1/4 in	5.32 in	5.32 in	10.00 in	60 º	3.80 in	14.00 lb
Model 425 - 1 1/2"	1 1/2 in	8.20 in	8.20 in	12.50 in	60 º	4.40 in	36.00 lb
Model 425 - 2"	2 in	10.50 in	10.50 in	18.00 in	60 º	4.80 in	46.00 lb

Results 1 - 4 of 4 **1**

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FACILITIES
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Keystone Foundry Division

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Model 425 Quick Opening Blow Off Valve

Check up to five results to perform an action.

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Class 300
ANSI B16.34
650 psi Working Steam Pressure @ 500F
750 psi @ 100F
100% Pressure Tested
Maximum Boiler Blow-Off Pressure 490 psi per Sec. 1 Table A-361
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Results 1 - 4 of 4 **1**

Item #	Size	A	B	C	D	E	Weight
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Model 425 - 1 1/2"	1 1/2 in	8.20 in	8.20 in	12.50 in	60 º	4.40 in	36.00 lb
Model 425 - 2"	2 in	10.50 in	10.50 in	18.00 in	60 º	4.80 in	46.00 lb

Results 1 - 4 of 4 **1**

Search Catalog :
By Keyword
Go
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PRODUCTS
- Boiler Trim Valves
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Model 525 Slow Opening Blow Off Valve

Check up to five results to perform an action.

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Class 300
ANSI B 16.34
650 psi Working Steam Pressure @ 500 º F
750 psi @ 100 º F
100% Pressure Tested
Maximum Boiler Blow-Off Pressure 490 psi per Sec. 1 Table A-361
Threaded Ends
High Temp. Powder Coating for Corrosion Reistance
CRN OCO7135.2, 24, 25, 26
CRN OEO2171.7, 79, 70, 78, 7AY, 7T, 7N

The United Brass slow opening boiler blow off valve has been designed for the rugged service of boiler treatment and scale. The cast steel knife gate valve conforms to Class 300 of ANSI B16.34 and features a stainless steel seat and disc hardened to Rockwell 60. ASME Boiler and Pressure Vessel Code Sections 1 PG-42.1.122 and Power Piping Code ASME B 31.1 Table 126.1 reference steel valves to ANSI B16.34. The sliding disc provides a cleaning action that keeps the seating area clear of scale and debris.

Request Information | Compare Items

Results Per Page : 25

Results 1 - 4 of 4 **1**

Item #	Ship Weight	Valve Type	Pressure Class	End Connection	Application	Canadian Registration
Model 525 1" Slow Opening Blow Off Valve	26.0 lb	Gate	300 WSP	Threaded	Water/Steam	Yes
Model 525 11/4" Slow Opening Blow Off Valve	26.0 lb	Gate	300 WSP	Threaded	Water/Steam	Yes
Model 525 11/2" Slow Opening Blow Off Valve	40.0 lb	Gate	300 WSP	Threaded	Water/Steam	Yes
Model 525 2" Slow Opening Blow Off Valve	68.0 lb	Gate	300 WSP	Threaded	Water/Steam	Yes

Results 1 - 4 of 4 **1**

Search Catalog :
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PRODUCTS
- Boiler Trim Valves
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- Laundry & Dry Cleaning Products
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FACILITIES
- United Brass Works
- Keystone Foundry Division

All Categories > Boiler Trim Valves > Boiler Trim Blow Down Valves (Slow Opening) > Model 525 Slow Opening Blow Off Valve > View Items

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Model 525 Slow Opening Blow Off Valve

Check up to five results to perform an action.

larger image

Class 300
ANSI B 16.34
650 psi Working Steam Pressure @ 500 º F
750 psi @ 100 º F
100% Pressure Tested
Maximum Boiler Blow-Off Pressure 490 psi per Sec. 1 Table A-361
Threaded Ends
High Temp. Powder Coating for Corrosion Reistance
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Model 525 11/4" Slow Opening Blow Off Valve	26.0 lb	Gate	300 WSP	Threaded	Water/Steam	Yes
Model 525 11/2" Slow Opening Blow Off Valve	40.0 lb	Gate	300 WSP	Threaded	Water/Steam	Yes
Model 525 2" Slow Opening Blow Off Valve	68.0 lb	Gate	300 WSP	Threaded	Water/Steam	Yes

Results 1 - 4 of 4 **1**

HURST

BOILER & WELDING CO., INC

BDS SERIES

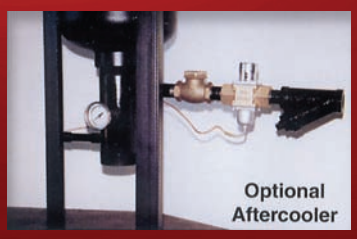
Safely Separates
Steam Vapor from Boiler Blow-Off Water

BLOWDOWN SEPARATOR

The HBC Blowdown Separator is designed to take water from the boiler during blowdown and reduce it to atmospheric pressure for disposal. The HBC Separator accomplishes this by separating the subsequent flashed steam from the hot water. As the blowdown enters the vessel, it is forced into a centrifugal pattern by means of a striking plate. The steam is vented to the atmosphere through a top connection. The HBC Separator is built as per requirements Section VIII of the ASME Code and stamped by the National Board of Pressure Vessel Inspectors. The Hurst Blowdown Separator provides an economical means of safe boiler blowdown.

Designed, constructed and stamped in accordance with the requirements of the ASME Boiler Codes.

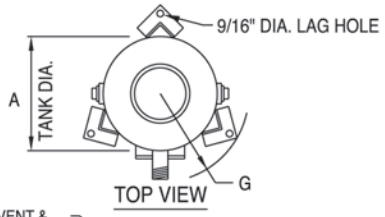
The separator includes a structural steel support stand for mounting to foundation. Options available are after cooler, manual cooling valve assembly, automatic cooling valve assembly, and exhaust heads.



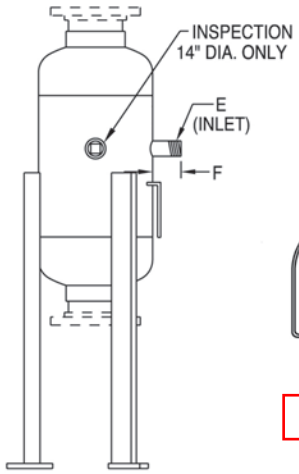
HURST

HURST PERFORMANCE SERIES BOILERS

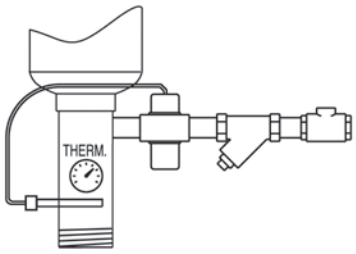
HURST BLOWDOWN SEPARATORS are built to Section VIII, Division 1 of the ASME Code for 250 PSI design pressure. (200 PSI design pressure with 150# ANSI flanges). Blowdown separator design pressure should be a minimum of 25% of the boiler maximum allowable working pressure (MAWP) as recommended by the National Board.



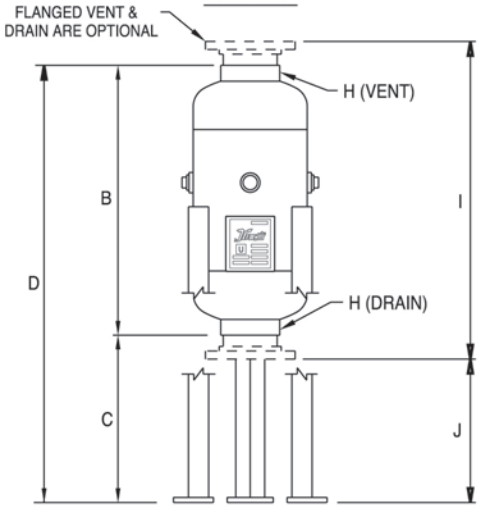
TOP VIEW



LEFT SIDE VIEW



OPTIONAL AFTER-COOLER



FRONT VIEW

SPECIFICATIONS

All Dimensions are in Inches

	BOILER TAIL PIPE DIMENSION	3/4 - 1 1/4 ECONOMY	3/4 - 1 1/2 BLOWDOWN	1 1/14 BLOWDOWN	1 1/2 - 2 BLOWDOWN	2 - 2 1/2 BLOWDOWN
	BDS. MODEL NUMBER	BDS8 (SEE NOTE 1)	BD14X24	BD14X34	BD14X34A	BD14X56
A	TANK DIAMETER	8	14	14	14	14
B	LENGTH	26	24	34	34	56
C	DRAIN TO FLOOR	16	24	24	24	24
D	OVERALL HEIGHT	42	48	60	58 1/4	80
E	INLET SIZE	1 1/4	1 1/2	1 1/4	2	2 1/2
F	INLET LENGTH	3	3 1/2	3 1/2	3 1/2	3 1/2
G	OVERALL RADIUS	7 1/2	10 7/8	10 7/8	10 7/8	10 7/8
H	VENT & DRAIN	2 1/2	2 1/2	3	4	6
I	LENGTH W/FLG.	32 1/2	30 1/2	40	40	62
J	FLANGE TO FLOOR	13	21	21	21	21
	WEIGHT NET/SHIPPING LBS.	80/100	180/200	250/275	250/275	355/395

NOTE: 8" DIAMETER SEPARATORS ARE DESIGNED FOR BOILERS NEEDING SHORT DURATION BLOWDOWN ONLY.
(SUCH AS VERTICAL TUBELESS BOILERS)

HBC-09518
08/2010

hurstboiler.com
HURST BOILER & WELDING CO., INC.
100 Boilermaker Lane • Coolidge, GA 31738-0530
Tel: (229) 346-3545 • Fax: (229) 346-3874
email: info@hurstboiler.com

Steam Control

56-T SERIES

TEMPERATURE ACTUATED WATER REGULATING VALVE

RELIABLE TEMPERATURE CONTROL DESIGNED FOR RUGGED APPLICATIONS

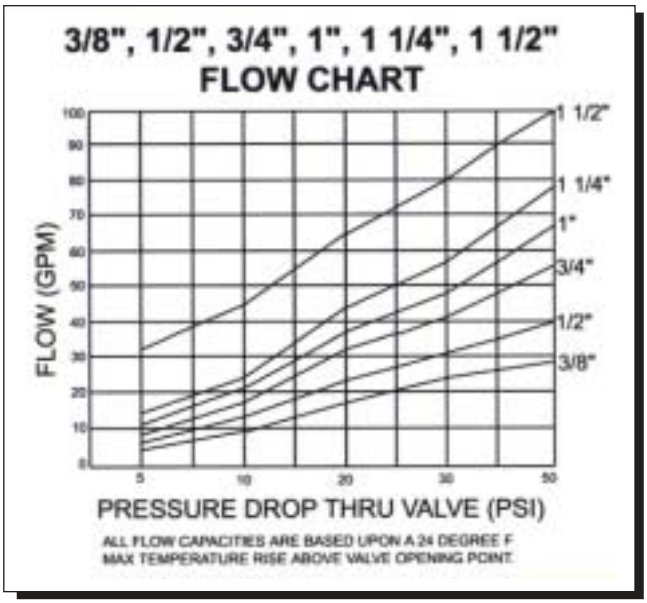
This thermostatic cooling control valve has everything you need for reliable temperature control. The Sterlco® 56-T Series Temperature Actuated Water Regulating Valve evenly regulates cooling water and other fluids in the most rugged applications. It's ideal for hydraulic power packaged equipment, hydraulic presses, or wherever reliable performance is required.

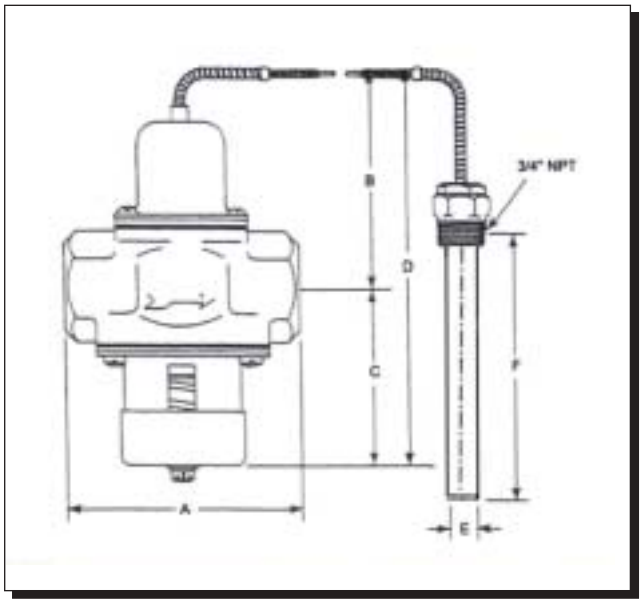
Sterlco's® self-modulating cooling control valves are temperature actuated, self powered, and applicable to cooling processes using water or other fluids. 56-T Series valves are available in eight different sizes. To ensure dependability, every valve is factory-tested three times in different temperature baths. For the temperature control you need, get the valve that can deliver.

FEATURES

- *Precise control from 40º to 275ºF*
- *Sizes from 3/8" to 2 1/2"*
- *Sturdy, brass alloy construction*
- *Heavy-duty, direct acting bellows*
- *Buna-N seat disc*
- *Replaceable seat beads*
- *125# ANSI Flange (2" and 2 1/2" valves)*

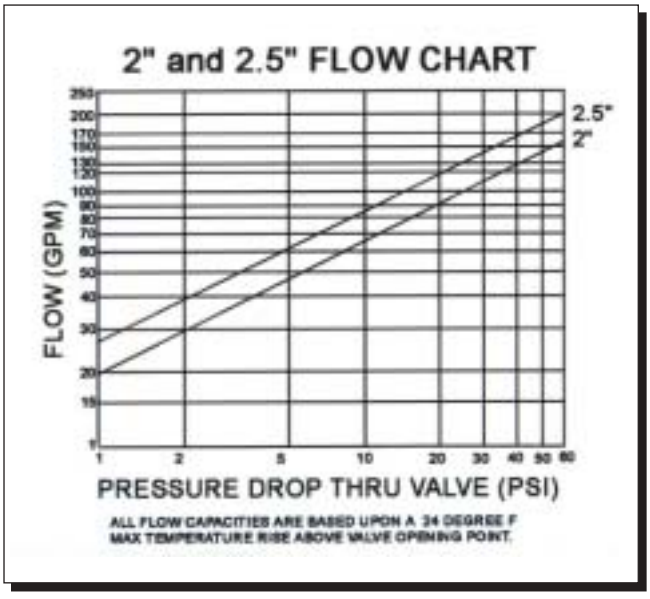
STERLCO

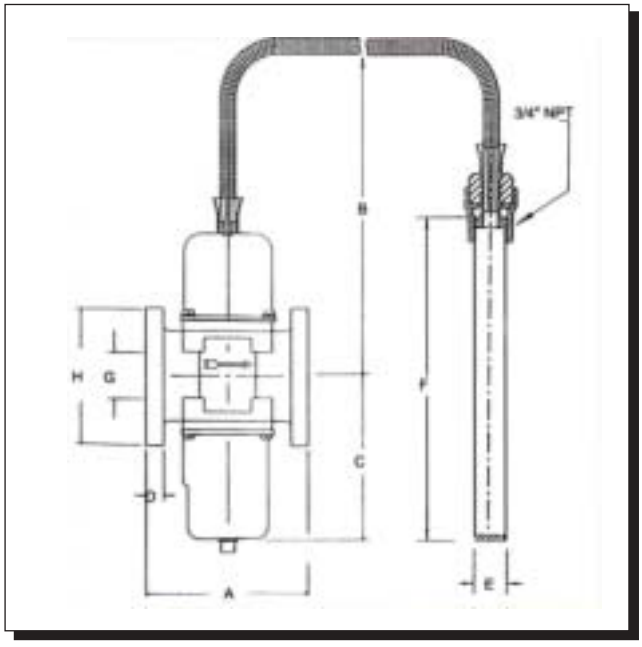




SPECIFICATIONS

	A (in.)	B (in.)	C (in.)	D (in.)	E (in.)	F (in.)	Width (in.)	Weight	C_V
3/8"	3 3/32	3 11/32	3 1/32	6 3/8	5/8	6	2 1/8	2lbs. 6oz	2.06
1/2"	3 3/32	3 11/32	3 1/32	6 3/8	5/8	6	2 1/8	2lbs. 6oz	4.38
3/4"	3 3/8	4 1/16	3 1/4	7 5/16	5/8	8 1/4	2 1/8	3lbs. 6oz	7.70
1"	4 3/4	4 3/16	3 27/32	8 1/16	5/8	8 1/4	2 3/4	6lbs. 2oz	9.72
1 1/4"	5 1/4	4 3/16	3 27/32	8 1/16	5/8	8 1/4	2 3/4	7lbs.	12.5
1 1/2"	5 5/16	7	6 5/16	13 5/16	9/16	8	2 3/4	10lbs.	14





SPECIFICATIONS

	A (in.)	B (in.)	C (in.)	D (in.)	E (in.)	F (in.)	G (in.)	H (in.)	Weight	C_V	# of Holes	Hole Size	Bolt Circle
2"	6 5/8	9	6 3/8	5/8	3/4	11	2 1/4	6	22 lbs.	20	4	3/4	4 3/4
2 1/2"	6 3/4	9 1/2	6 5/8	11/16	3/4	11	2 3/4	7	30 lbs.	26	4	3/4	5 1/2

Size
3/8", 1/2", 3/4", 1", 1 1/4", 1 1/2" 2", 2 1/2"

Fluid Pressure Range
Up to 125 PSI for 3/8" through 1 1/4"
Up to 150 PSI for 1 1/2" through 2 1/2"

Standard Temperature Ranges
(opening point adjustment may be anywhere within the standard ranges shown)

Body
Brass Alloy Casting

Valve parts
Brass Alloy

3/8" through 1 1/4"
- *40ºF - 100ºF*
- *60ºF - 140ºF*
- *100ºF - 175ºF*
- *125ºF - 200ºF*
- *140ºF - 240ºF*
- *200ºF - 275ºF*

1 1/2" through 2 1/2"
- *60ºF - 140ºF*
- *100ºF - 175ºF*
- *160ºF - 230ºF*

Standard Capillary Length
6' (for other capillary lengths, consult factory)

Valve Mounting
Any position

Standard Bulbs
- *For 3/8" and 1/2" valve sizes: 5/8" x 6" with 3/4" union connection*
- *For 3/4", 1", and 1 1/4" valve sizes: 5/8" x 8 1/4" with 3/4" union connection*
- *For 1 1/2" valve sizes: 9/16" x 8" with 3/4" union connection*
- *For 2" and 2 1/2" valve sizes: 3/4" x 11" with 1" union connection*

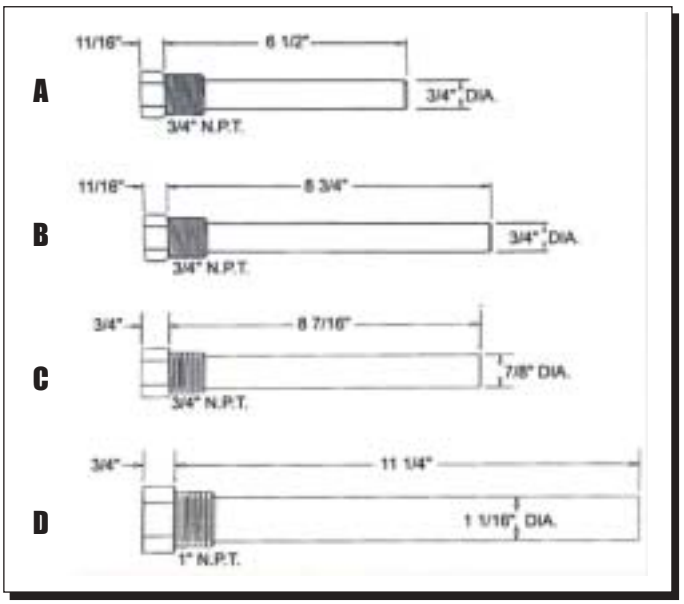
Special Bulbs
3/8" through 1 1/4" sizes: 9/16" x 3 1/4" with 1/2" union connection; 9/16" x 6 3/4" with 1/2" union connection. Available on special order. Please consult factory for details.

Seat Disc
Replaceable Buna-N

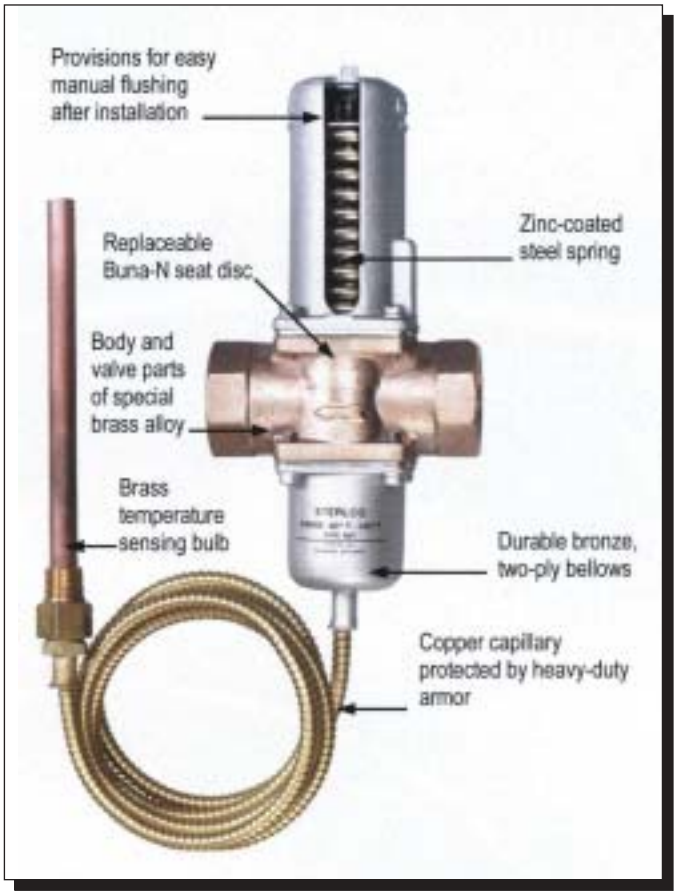
Seat Bead
Replaceable stainless steel (3/8" through 1 1/4")
Replaceable brass (1 1/2" through 2 1/2")

Temperature Adjustment
To adjust for lower temperature, turn adjusting screw counterclockwise. For higher temperature, turn clockwise

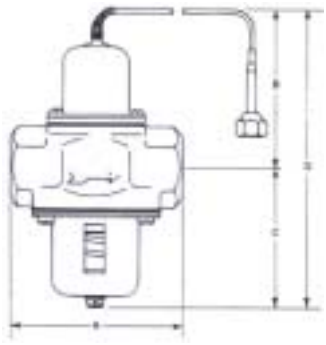
BULB WELLS *(Available in Stainless Steel or Brass)*



A: *Used on 3/8" and 1/2" valves*
B: *Used on 3/4", 1", and 1 1/4" valves*
C: *Used on 1 1/2" valves*
D: *Used on 2" and 2 1/2" valves*



56 SERIES PRESSURE ACTUATED WATER REGULATING VALVE



The Sterlco® 56 Series Actuated Water regulating Valve features a compact, dependable design made from sturdy, brass alloy casting. To accommodate pressures from 70 to 260 PSI without changing springs, simply turn the adjustment screw at the base of the valve.

You can easily mount the valve in any position without mounting the brackets. The 56 Series valve comes with a sturdy actuating element with powerful bellows designed for use with open and hermetically sealed condensing units. The valve is designed with a zinc-coated steel spring and provisions for easy manual flushing after installation.

Head Pressure Range:	70-260 PSI
Water Pressure:	125 PSI
Head Pressure Connection:	1/4" flare, 30" capillary
Body:	Brass alloy casting
Seat Disc:	Buna-N
Seat Bead:	Stainless Steel
Spring Housing:	Enclosed steel for extra strength and protection

	A (in.)	B (in.)	C (in.)	D (in.)	Width (in.)	Weight	Cv
3/8"	2 3/16	3 5/32	2 27/32	6	2 1/8	2lbs. 2 oz	2.0
1/2"	3 3/32	3 11/32	3 1/32	6 3/8	2 1/8	2 lbs 6 oz	4.5
3/4"	3 3/8	4 1/16	3 1/4	7 5/16	2 1/8	3 lbs 6 oz	7.8
1"	4 3/4	4 3/16	3 27/32	8 1/16	2 3/4	6 lbs 2 oz	10.8
1 1/4"	5 1/4	4 3/16	3 27/32	8 1/16	2 3/4	7 lbs	12.5

OTHER PRODUCTS MANUFACTURED BY STERLING STEAM CONTROL PRODUCTS DIVISION:

150F Series Temperature Control

Self-Cleaning "Y" Strainers

Boiler Feed Units

De-Scaling System and Fluid

Condensate Pumps 4100 Series

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STERLCO PRODUCTS INCLUDE: HAND RADIATOR VALVES • THERMOSTATIC TRAPS • FLOAT AND THERMOSTATIC TRAPS • INVERTED BUCKET TRAPS • CAST IRON STRAINERS • BRASS STRAINERS • TANK AND PROCESS TEMPERATURE CONTROL VALVES • BOILER FEED UNITS • CONDENSATE PUMPS

KECKLEY

Style B

Y-Strainer
Cast Iron (ASTM A 126, Class B)
250 lb. Threaded

Cast Iron Y-Strainer

APPLICATIONS
Steam, water, oil or gas where protection from foreign matter in a pipeline is required.

CONSTRUCTION
The Keckley Style B strainers are constructed from rugged cast iron castings that are machined to exacting specifications.

FEATURES
The Keckley Style B strainer features a tapered bushing in sizes ¼" thru 2" and bolted cover with gasket for sizes 2-1/2", 3" and 4". All Keckley Style B strainers are furnished standard with a NPT blow-off connection and can be supplied with a cast iron blow-off plug upon request.

SCREENS
Standard screens are 20 mesh 304 stainless steel through size 2". Sizes 2-1/2", 3" and 4" are furnished with 1/16" perforated 304 stainless steel screens. All screens are spot welded for maximum strength. Different size perforations and meshes are available in stainless steel, monel, and brass to meet specific media requirements. If media is not indicated, screens for *water* will be supplied.

SELF CLEANING
Self cleaning is accomplished by opening the valve or drain plug connected to the blow-off port. **Warning:** See Maintenance Instructions on page S6 of the Strainer Information Section for additional precautions and detailed information on servicing the strainer.

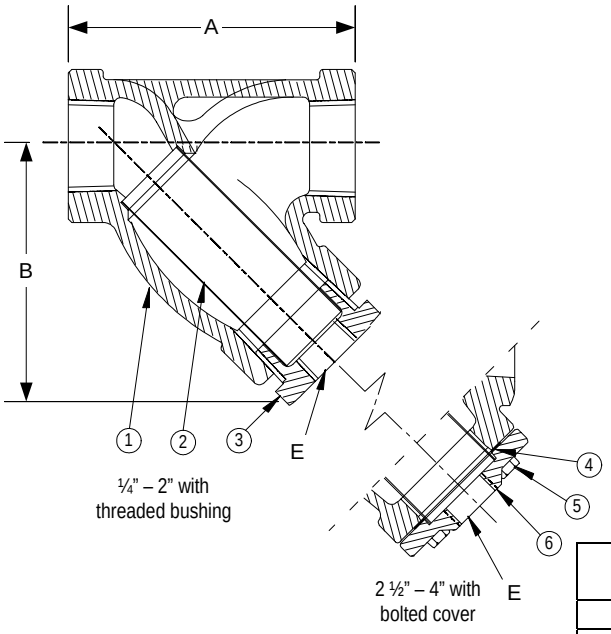
WORKING PRESSURES – NON SHOCK

NOM. RATING	MEDIA	1/4" to 4"	8 mm to 100 mm
250# (THREADED)	STEAM	250 PSI @ 406°F	1724 KPa @ 208°C
	W.O.G.	400 PSI @ 150°F	2759 KPa @ 66°C

GOVERNMENT/MILITARY SPECIFICATIONS
Style B cast iron threaded strainers meet or exceed government specification WW-S-2739 (Supersedes MIL-S-16293).

KECKLEY

TECHNICAL DATA
DIMENSIONS AND WEIGHTS



Style B

Y-Strainer, 250 lb. Threaded
Cast Iron (ASTM A 126, Class B)

PARTS LIST		
ITEM	DESCRIPTION	MATERIAL
1	BODY	CAST IRON (ASTM A 126, CLASS B)
2	SCREEN	STAINLESS STEEL (304)
3	BUSHING	MALLEABLE IRON
4	GASKET*	COMPOSITION
5	CAP SCREW*	STEEL
6	COVER*	CAST IRON (ASTM A 126, CLASS B)

Optional: Blow-off Plug, Malleable Iron * 2 ½", 3" & 4" ONLY

STANDARD SCREENS SUPPLIED

SIZE		SCREEN GAGE	SCREEN PERFORATION					
			FOR STEAM		OPEN AREA	FOR LIQUID		OPEN AREA
in	mm		in	mm		in	mm	
1/4 to 2	8 to 50	20 MESH STAINLESS STEEL						49%
2-1/2 to 4	65 to 100	28	3/64	1.2	33%	1/16	1.6	30%

Standard screens supplied are for liquid service, unless otherwise specified.
Options: Other meshes, perforations, and screen materials are available.

SIZE		DIMENSIONS						WEIGHTS	
		A		B		E			
in	mm	in	mm	in	mm	in	mm	lbs	kgs
1/4	8	3	76	2-5/8	67	3/8	10	2	0.9
3/8	10	3	76	2-5/8	67	3/8	10	2	0.9
1/2	15	3	76	2-5/8	67	3/8	10	2	0.9
3/4	20	4	102	3-5/8	92	1/2	15	3	1.4
1	25	4-7/8	124	4-1/2	114	3/4	20	4.5	2.0
1-1/4	32	5-1/8	130	4-3/4	121	3/4	20	6	2.7
1-1/2	40	5-3/4	146	4-7/8	124	1	25	8	3.6
2	50	7-1/4	184	5-3/4	146	1-1/4	32	15.5	7.0
2-1/2	65	8-7/8	225	7-1/2	191	1-1/4	32	25	11.3
3	80	10	254	8	203	1-1/2	40	36	16.3
4	100	15-1/4	387	12-1/2	318	2	50	95	43.1

Certified dimensional drawings are available upon request.
†This table reflects only the nearest metric equivalents.

FLOW COEFFICIENTS

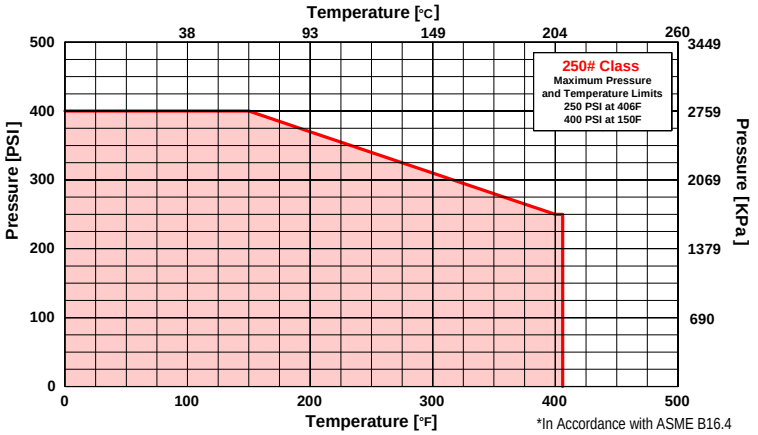
Size	C_v	Size	C_v	Size	C_v
1/2"	9.5	1-1/4"	44.9	2-1/2"	129.7
3/4"	18.7	1-1/2"	61	3"	161.3
1"	30	2"	98	4"	256.2

TOTAL SCREEN AREA

Size	(in^2)	Size	(in^2)	Size	(in^2)
1/2"	5.50	1-1/4"	18.69	2-1/2"	54.13
3/4"	8.59	1-1/2"	23.37	3"	73.51
1"	15.22	2"	36.23	4"	154.98

*See DETERMINING RATIOS on page S5 of the Strainer Information Section for calculating NET FREE AREA of the screen to inside pipe area.

PRESSURE vs. TEMPERATURE CHART
250# Threaded Cast Iron (ASTM A 126, Class B)



*In Accordance with ASME B16.4

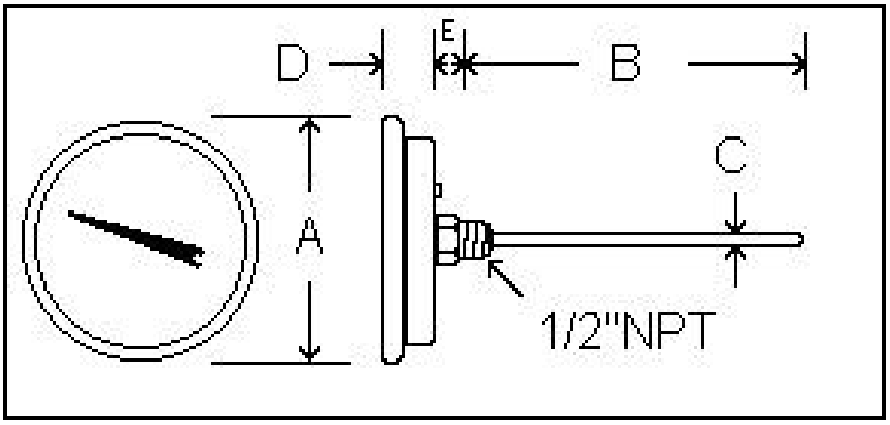
PRECISION INSTRUMENT COMPANY

BIMETAL THERMOMETER

90° BACK ANGLE TYPE

STANDARD FEATURES

- All Stainless Construction
- With Glass Lens
- Anti-Parallax Dial
- Vibration Resistant (No Needle Flutter)
- Fast Response To Temperature Change
- Hermetically Sealed (Moisture Proof)
- +/- 1 % Full Scale Accuracy
- Stem Welded To Connection
- Zero Adjustment on Back of Case



		A	B	C	D	E
3" Dial	IN.	3.18"	STEM LENGTH	.25"	.60"	.38"
	MM	80.78	STEM LENGTH	6.45	15.24	9.76
5" Dial	IN.	5.13"	STEM LENGTH	.25"	.67"	.38"
	MM	130.87	STEM LENGTH	6.45	16.95	9.76

STEM LENGTH*	PART NUMBER	
	3" DIAL	5" DIAL
2 ½	B3B2	B5B2
4"	B3B4	B5B4
6"	B3B6	B5B6
9"	B3B9	B5B9
12"	B3B12	B5B12
15"	B3B15	B5B15
18"	B3B18	B5B18
24"	B3B24	B5B24

STANDARD RANGES*	
CODE	RANGE
AA	-40/120 F & C
BB	-40/160 F & C
EE	0/150 F & C
GG	0/200 F & C
JJ	20/240 F & C
II	0/250 F & C
MM	50/300 F & C
PP	50/400 F & C
RR	50/550 F & C
SS	150/750 F & C
TT	200/1000 F & C

***Note:**

- Other Ranges, Stem Lengths And Configurations Are Available Upon Request.
- Thermowells of all sizes and materials of construction are available also.
- Please Call With Any Inquiries.

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UNITED BRASS WORKS, INC.

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ISO9001 REGISTERED COMPANY

Model 50T Check Valve

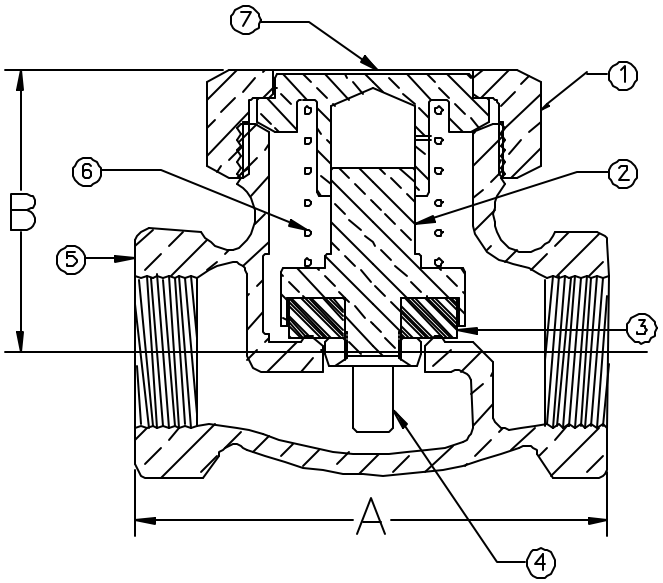
Spring Loaded Lift Check
Complies with MSS-SP-80-97

200WSP @ 406° Max
400 WOG
100% Pressure Tested
Threaded Ends · PTFE Disc
Integral Seat

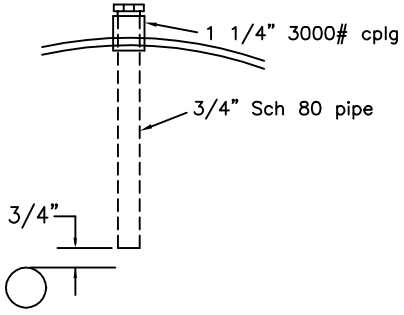
Equipped with 50TG PTFE disc for general service, including steam.

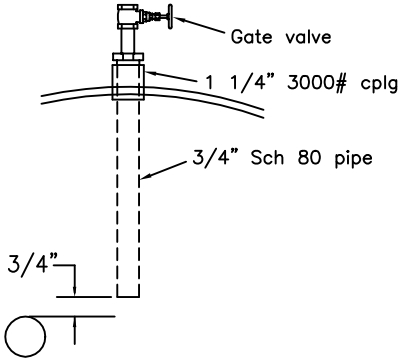
MATERIAL LIST

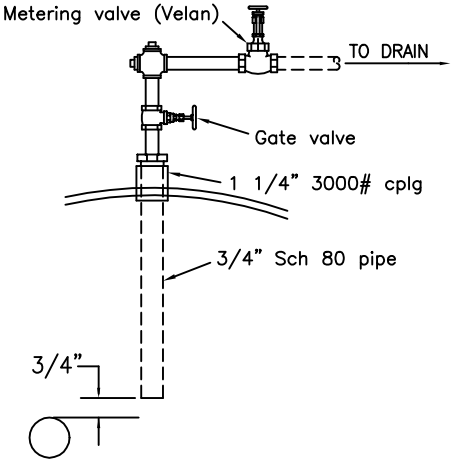
NO.	DESCRIPTION	MATERIAL
1	Bonnet Nut (¼" – 3/8") Bonnet Nut (½" – 2")	Brass Bronze
2	Disc Holder (¼" – ¾") Disc Holder (1 " – 2')	Brass Bronze
3	Disc	PTFE
4	Disc Holder Nut (¼" – 1¼") Disc Holder Nut (1½" – 2")	Brass Bronze
5	Body	Bronze
6	Spring	Stainless Steel
7	Guide (¼" – ¾") Guide (1" – 2")	Brass Bronze

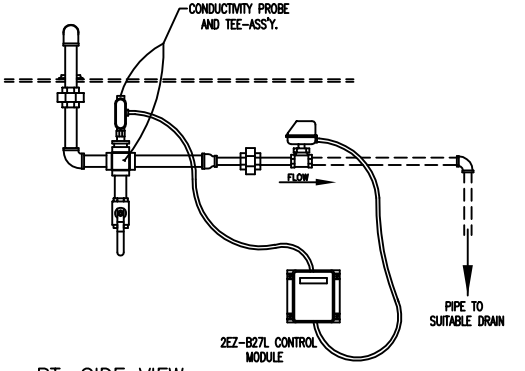


Size	¼"	3/8"	½"	¾"	1"	1 ¼"	1 ½"	2"
A	2.19	2.36	2.59	3.17	3.75	4.28	4.78	5.88
B	1.19	1.50	1.88	1.81	2.06	2.38	2.63	3.25
Ship Wgt. (lbs.)	0.56	0.75	1.03	1.61	2.44	3.84	5.20	9.00
Qty. Per Ctn.	12	12	12	6	6	2	2	1

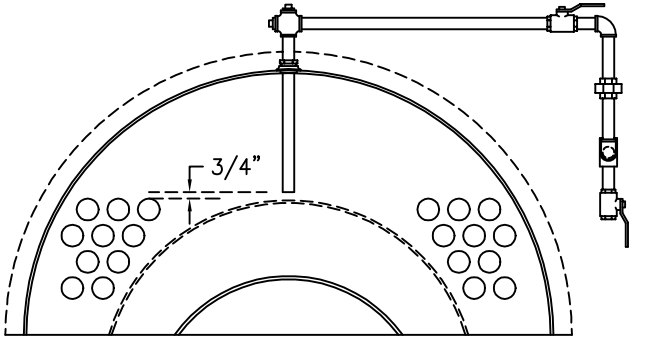








RT. SIDE VIEW

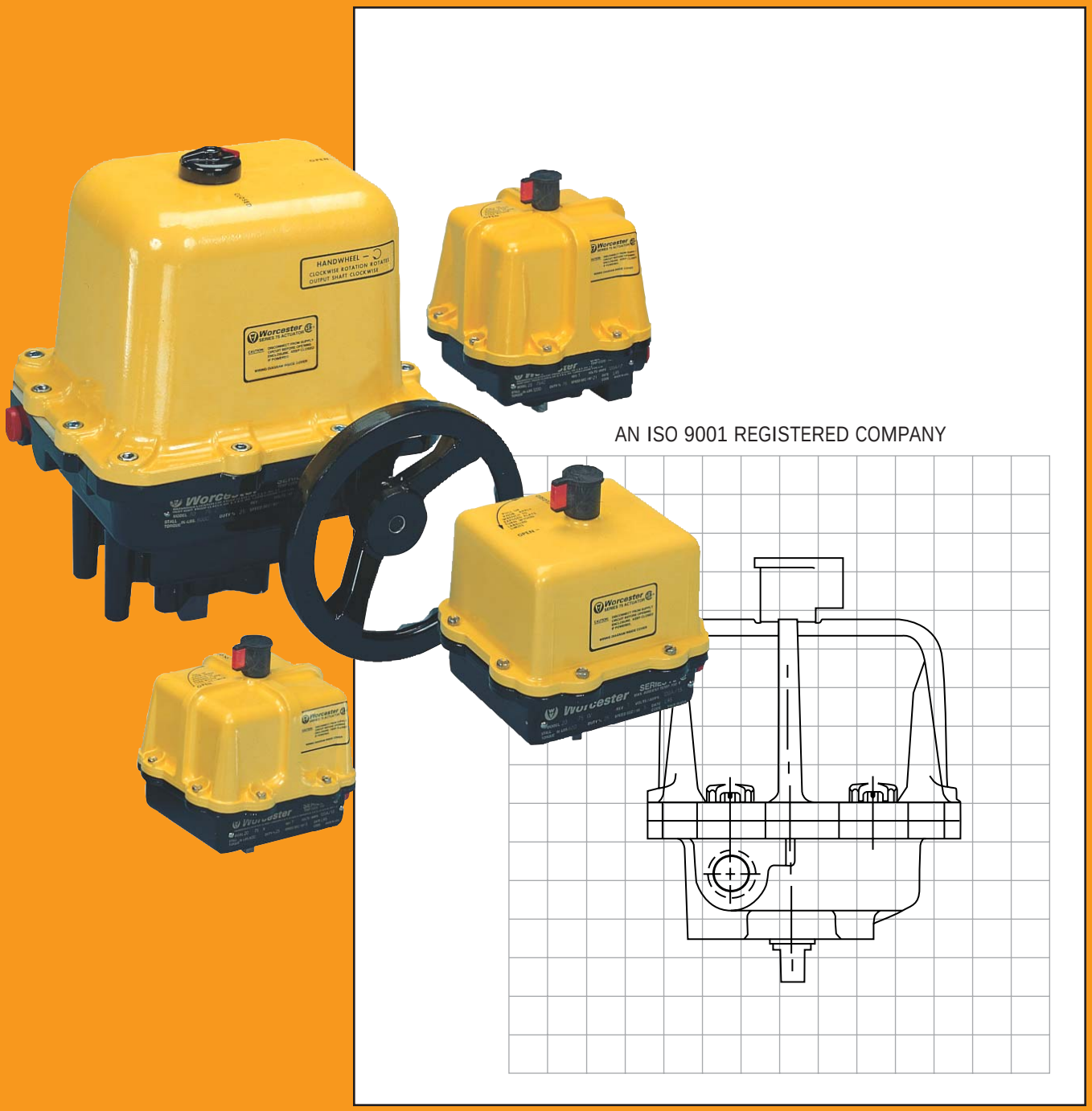


END VIEW

FLOWSERVE

Worcester Actuation Systems

WCABR1014
(Part PB 730)

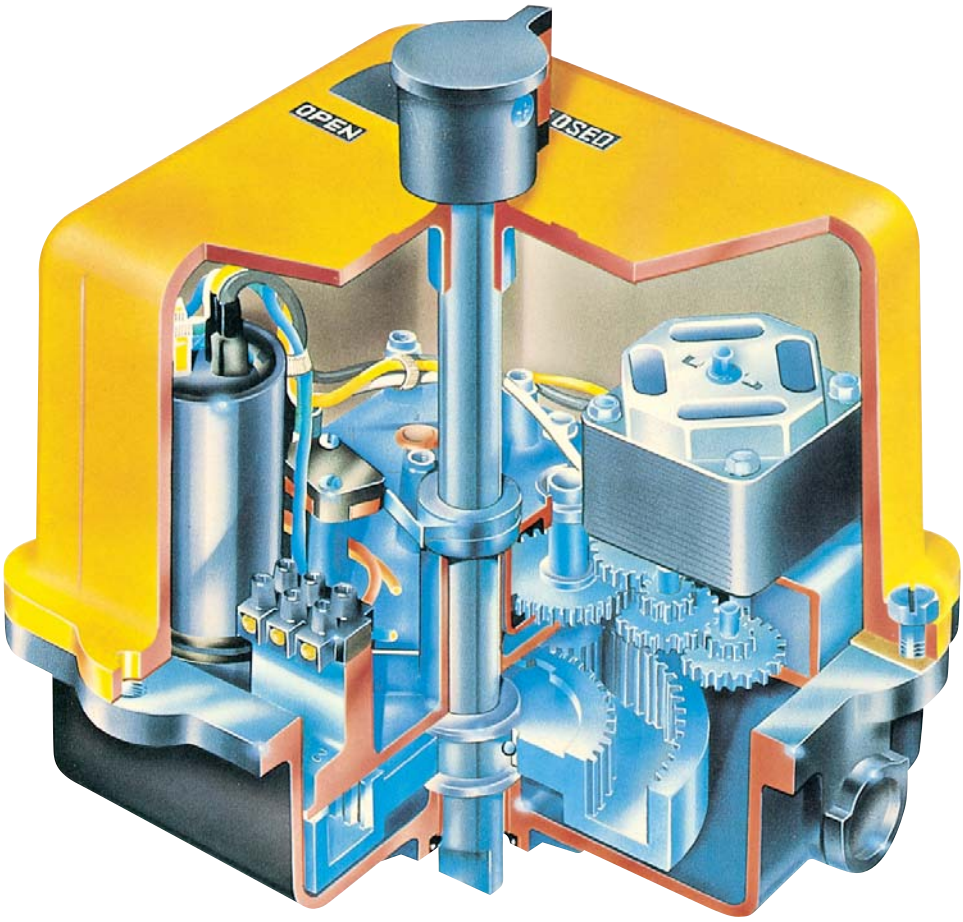


Series 75 Electric Actuator

Specifically designed for rotary valve applications, on/off and modulating

Worcester Controls Series 75

A time-tested, high-quality state-of-the-art electric actuator for remote control of quarter-turn valves and other rotary devices. Simple, compact and reliable.



Series 75 Electric Actuators from Worcester Actuation Systems add a new dimension of operational dependability and flexibility to modern processes controlled by computers, programmable controllers and other electric control equipment. A multi-function capability permits use of the Series 75 actuator throughout the process for on/off, throttling, variable-cycle and any analog or digital control. One of the most reliable electric actuators on the market, the Series 75 is lightweight, compact and powerful. Its split phase capacitor AC reversing motor or DC motor drives a valve through a sealed, permanently lubricated gear train which offers virtually lifetime maintenance-free dependable operation.

The Series 75 is available in eight sizes and produces torques to 3000 in-lbs. Housings are designed to TYPE 1 General Purpose, TYPE 4 Watertight, and TYPE 7, Class 1, Division 1 and 2, Group C, D and TYPE 9, Class II, Division 1 and 2, Group E, F, G. A combined location TYPE 4, 4X, 7, 9 enclosure is also available as a “Z” option. A baked polyester finish is the standard coating, but special coatings are available for extreme hazardous-environment applications.

Series 75 actuators may be used on Worcester Controls complete line of ball valves, other quarter-turn valves or devices requiring rotary operators. Moreover, their ability to provide power in both directions through selected arcs from 20° through 300° makes them ideal for control of heating, ventilating and air conditioning duct systems and automatic, remotely operated equipment.

Options to Fit Your Applications

The Series 75 can be ordered with a variety of options to tailor it to the needs of your application.

Cycle Length Control – This speed control feature allows field adjustment of opening and closing cycle times, 19 minutes for 25% duty and 57 minutes for 75% duty actuators.

Feedback (0-1000 ohm) Potentiometer – provides a variable resistance to signal the exact position of the output shaft and the valve it is powering.

Position Indicator Board – provides a 4-20 mA valve position feedback signal to the control room.

Heater/Thermostat – prevents condensation from collecting inside the actuator.

Condensation Drain Plug – drains accumulated water.

180° Center-Off Kit – provides an extra position for three-way valves and is used for dribble-feed applications in quarter-turn valves.

Additional Limit Switches – may be used to operate lights that indicate valve position or to operate other equipment.

AF-17 Positioner Board – for control valves positions the actuator based on an input signal of current, voltage or resistance.

DFP17 DataFlo P™ – is a microprocessor-controlled electronic positioner with software for on-site or remote operation and diagnostics. This new, smart positioner for Series 75 actuator driven control valves is controlled by a 4-20 mA analog signal from a PLC or digitally from a computer.

DFC17 DataFlo C™ – is a microprocessor based PID single-loop controller that accepts a variety of process inputs. All process parameters are easily programmed through the keypad or via a simple RS-485 computer interface.

I 75 Low-Current Circuit Interface – is a solid-state interface/relay between the PC/controller/computer and actuator motor(s). It protects controlling device outputs from destructive feedback. This high-voltage feedback is due to limit switch action, auto transformer effect of unused winding, and capacitor voltage. The unit, as a printed circuit board, is conveniently mounted inside of standard enclosures. Maximum output ratings are 4 A for 120 VAC and 2 A for 240 VAC. Controllers with outputs that have low current ratings cannot be connected to electric actuator motor(s) that require a current greater than the controller rating.

R 75 Remote Terminal Unit (RTU) – is an interface for DC powered actuators. This solid-state interface card allows you to control a DC-powered electric actuator by a control signal from the Remote Terminal or any low current system (such as a solar powered system). It is equipped with a field-adjustable current limiting circuit, which will trip the power in case of abnormal conditions (it will reset by reengaging the control signal). Optional contact closure to indicate the tripped condition; 0-5 VDC, 0-1000 ohm position feedback, and end of travel SPDT gold contact switches are available.

TYPE 4
Sizes 10, 12, 15, 20, 22
(Enclosure Option – W)

TYPE 1
Sizes 10, 12, 15, 20, 22
(Enclosure Option – Blank)

Combined TYPE 4, 4X, 7 & 9
Sizes 10, 12, 15, 20, 22, 23
(Enclosure Option – Z)

TYPE 7 & 9
Sizes 10, 12, 15, 20, 22
(Enclosure Option – X)

DFP17 Positioner for Control Valves

Combined TYPE 4, 7 & 9
Sizes 25, 30
(Enclosure – Z)

Specifications

Sizes:
Small: 10, 12, 15, 20, 22, 23
Large: 25, 30

Torque:
150-3000 in-lbs.

Enclosures:
TYPE 1 General Purpose
TYPE 4 Watertight
TYPE 7, Class I, Division 1, 2, Group C, D
TYPE 9, Class II, Division 1, 2, Group E, F, G Hazardous Locations
TYPE 4, 4X, 7, & 9 Combined Locations

Enclosure Coatings: Corrosion resistant baked polyester finish standard. Consult Flowserve for special applications.

Voltages:
120 V and 240 VAC, 12 V and 24 VDC

Connection:
Male output shaft (female shaft available on request)

Gearing:
Small: Sealed, permanently lubricated spur gear module driving a final dual-torque bull gear
Large: Two-stage planetary gear, permanently lubricated self-locking gear train

Overload Protection:
AC only. Thermal overload protector with automatic reset.

Travel Stop Limit Switches:
Two SPDT, all sizes; internal, independent, adjustable. Actuated by cams mounted on drive shaft. Adjustable from 20° to 300°.

Manual Override:
All sizes, TYPE 4, 7 and 9 only.
Lift position indicator and turn shaft: Sizes 10,12,15, 20, 22, 23.
Turn side-mounted handwheel: Sizes 25 and 30.

Actuator Model	Stall Torque in.-lbs.	Start-up Torque in.-lbs.	Voltages		Duty Cycles	90° Time seconds	Current at rated stall torque – amps				Approx. Weight Lbs. (kg.)
			AC	DC			120 VAC	240 VAC	12 VDC	24 VDC	
1075	150	120	120, 240	—	10%	2.5	1.5	.60	—	—	8.20 (3.70)
			120, 240	12, 24	25%	5	.70	.40	1.40	.70	
			120, 240	12, 24	75%	17, 15	.30	.15	.50	.25	
			120	—	100%	17	.25	—	—	—	
1275	225	180	120, 240	—	10%	4	1.5	.60	—	—	8.20 (3.70)
			120, 240	12, 24	25%	8	.70	.40	1.20	.60	
			120, 240	12, 24	75%	27, 25	.30	.15	.50	.25	
			120	—	100%	27	.25	—	—	—	
1575	325	260	120	—	20%	5	.70	—	—	—	8.50 (3.83)
2075	600	480	120, 240	—	10%	2.5	2.90	1.30	—	—	9.50 (4.31)
			120, 240	12, 24	25%	5	1.50	.90	5	2.50	
			120, 240	12, 24	75%	17, 15	.70	.30	1.60	.80	
			120	—	100%	27	.50	—	—	—	
2275*	900	720	120, 240	—	10%	4	2.90	1.30	—	—	9.50 (4.31)
			120, 240	12, 24	25%	8	1.50	.90	4.20	2.10	
			120	12, 24	75%	27, 25	.70	.30	1.50	.75	
2375	1200	950	120, 240	12, 24	75%	25	.70	.30	2	1	17.70 (8.04)
2575	1800	1440	120, 240	—	25%	10	2.70	1.30	—	—	48 (21.80)
			120, 240	—	75%	15	2.20	1.20	—	—	
3075	3000	2400	120, 240	—	25%	15	3.50	1.40	—	—	48 (21.80)
			120, 240	—	75%	23	2.20	1.20	—	—	

Options:
All sizes, all enclosures. Cycle Length Control (CLC), dual- or single-feedback potentiometer, 4-20 mA position indicator, heater/thermostat, condensation drain plug (V-53), 180° center-off (three-position), additional limit switches, mechanical brake, I-75 computer interface unit, various duty cycles, positioner, set point controller.

Temperature Limits (All models):
-40°F (with heater and thermostat) to 150°F max. (At elevated temperatures, duty cycle must be derated. Consult Flowserve.)

Lubrication:
Permanently lubricated gear train. Self-lubricated bearings.

Conduit Connection:
One ½" NPT - Two ½" Optional (Size 23 has ¾" NPT)

Operation:
Reversing (bidirectional) for use with quarter-turn valves or rotating equipment to full rotation.

Actuator Sizing

There are a few terms associated with electric actuators that require definition. **Actuator Start-up Torque** is the amount of torque initially produced by an actuator when starting from rest. Use start-up torque when sizing an electric actuator for a ball valve that is used for either on/off or throttling service. **Actuator Stall Torque** is the amount of torque produced by the actuator just prior to the point where the motor stalls. Do not use stall torque for sizing.

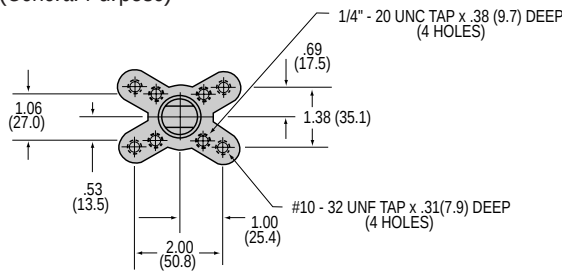
OVERCURRENT PROTECTION WARNING!

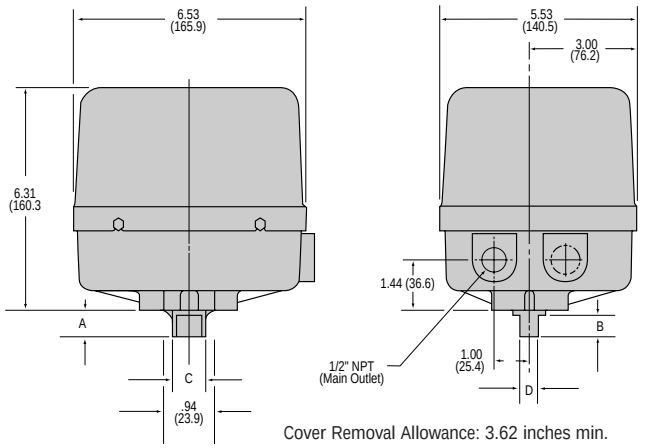
Where overcurrent protection is used in the actuator power circuit, it is recommended that the protection rating not be less than the values listed in the table:

Actuator Size	Voltage	Protection Rating
10-23	120 VAC	5 amps
25/30	120 VAC	10 amps
10-23	240 VAC	3 amps
25/30	240 VAC	5 amps
10-23	12 VDC	10 amps
10-23	24 VDC	5 amps

Dimensions inches (mm)

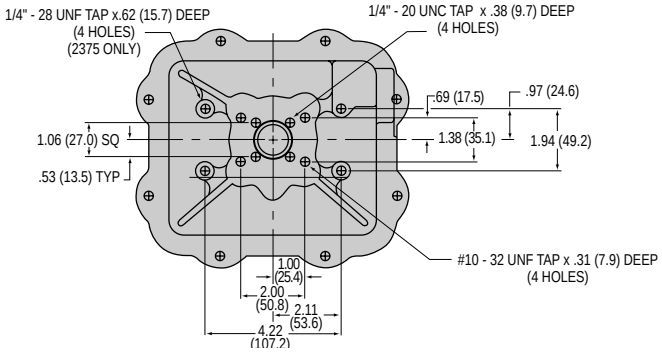
Sizes 10, 12, 15, 20, 22
TYPE 1 (General Purpose)

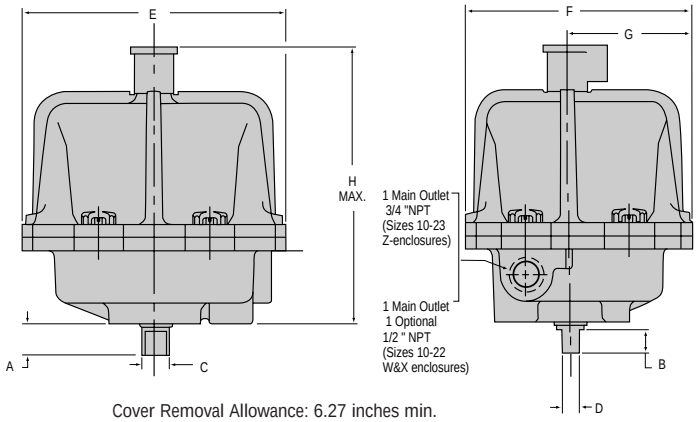




Cover Removal Allowance: 3.62 inches min.

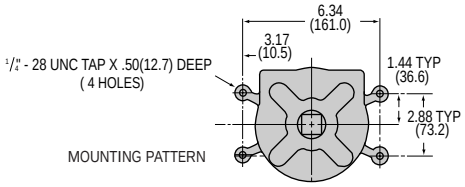
Sizes 10, 12,15, 20, 22, 23
TYPE 4 (Watertight) Enclosure - W,
TYPE 7 & 9 (Hazardous Locations) Enclosure - X,
TYPE 4, 7 & 9 (Combined) Enclosure - Z (shown)

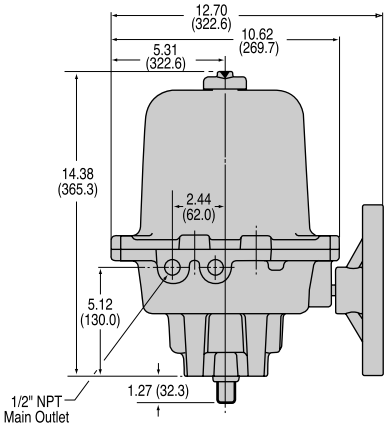


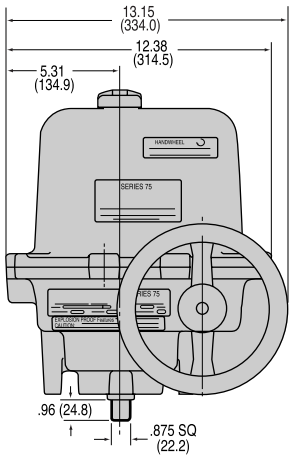


Cover Removal Allowance: 6.27 inches min.

Sizes 25, 30
TYPE 4 (Watertight) and
TYPE 7 & 9 (Hazardous Locations)
Combined Enclosure - Z







Type 1, Sizes 10, 12, 15, 20, 22

DIMENSIONS INCHES (mm)				
Size	A	B	C	D
10, 12	.74 (18.80)	.53 (13.50)	.59 (15)	.36 (9.14)
15, 20, 22	.90 (22.86)	.66 (16.80)	.80 (20.32)	.50 (12.70)

All other types and sizes

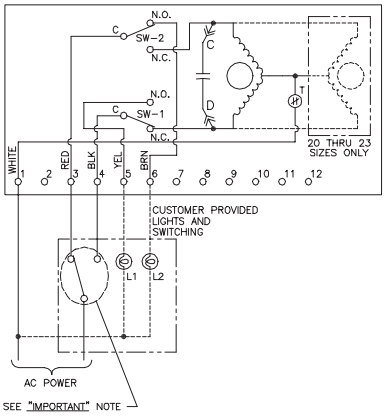
DIMENSIONS									
Size	Enclosure	A	B	C	D	E	F	G	H
10, 12	W	.74	.53	.59	.36	7.80	6.75	3.61	8.50
	X	(18.80)	(13.50)	(15.00)	(9.14)	(198.10)	(171.50)	(91.70)	(215.9)
15, 20	W	.90	.66	.80	.50	7.80	6.75	3.61	8.50
22	X	(22.86)	(16.80)	(20.32)	(12.70)	(198.10)	(171.50)	(91.70)	(215.9)
15-23	Z	.90	.66	.80	.50	8.45	7.45	3.97	9.68
		(22.86)	(16.80)	(20.32)	(12.70)	(124.60)	(189.20)	(100.90)	(245.90)
10-23	Z	.74	.53	.59	.36	8.45	7.45	3.97	9.68
		(18.80)	(13.50)	(15.00)	(9.14)	(124.60)	(189.20)	(100.90)	(245.90)

Wiring Diagrams

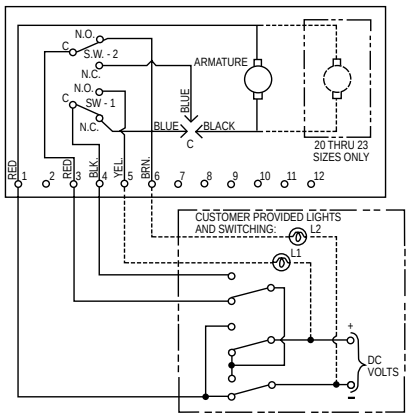
IMPORTANT!

EACH ACTUATOR SHOULD BE ELECTRICALLY POWERED THROUGH ITS OWN INDIVIDUAL SINGLE-POLE SWITCH CONTACTS TO ISOLATE THE UNUSED WINDING.

NOTE: *ACTUATOR SHOWN IN COUNTER-CLOCKWISE EXTREME OF TRAVEL, OR "OPEN" POSITION.*



Sizes 10-30 AC Power

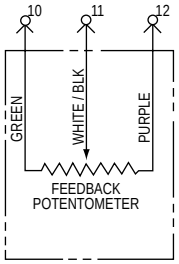


Sizes 10-23 DC Power

NOTE: *AC and DC wiring diagrams shown are for W, X and Z enclosures only. DC wiring diagram shown is for size 10, 20 and 23 actuators. For size 12 and 22 actuators, the red/black motor leads are reversed.*

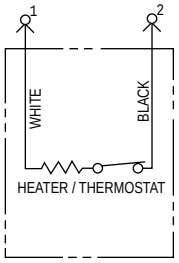
Design Options

Feedback Potentiometer



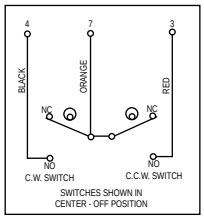
A feedback potentiometer is used when remote indication is desired. Potentiometers are available in 1000 ohms.

Heater/Thermostat



A heater/thermostat kit for cold ambient temperatures or humid environments uses a 15-watt heater and a thermostat set to close at temperatures below 70°F ambient.

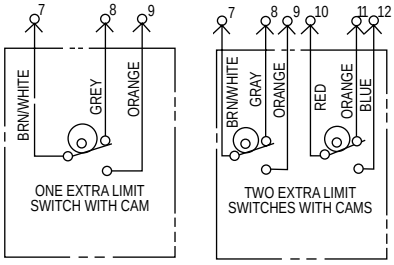
180° Center-off (three positions)



Used with three-way valves or similar products requiring a mid-position stop capability for shutoff. May be adjusted for travel other than 180°.

NOTE: *A three-position switch is required for operation.*

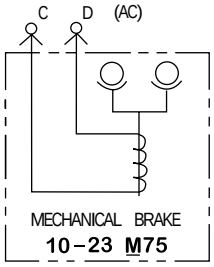
Limit Switches



One Limit Switch **Two Limit Switches**

May be mounted to either operate lights, indicate valve position, or operate other equipment such as pumps, compressors, mixers, etc.

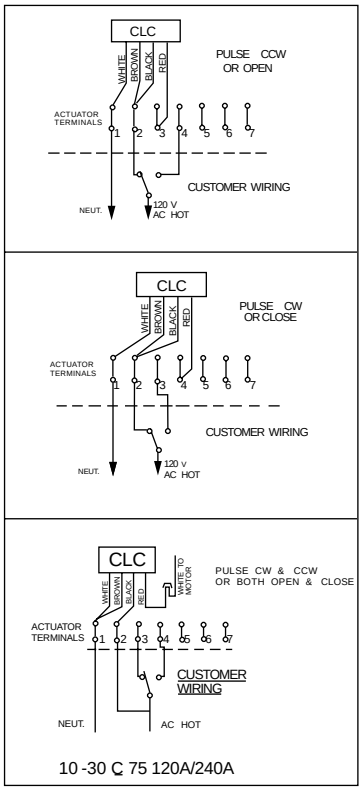
Mechanical Brake



A mechanical brake is used for all butterfly valve applications or when the actuator must be stopped instantaneously and securely. (Used on 10-23 sizes only.) Available for AC actuators only.

NOTE: *A 2" CPT valve should not be sized with an electric actuator smaller than 2275, and a mechanical brake must be ordered.*

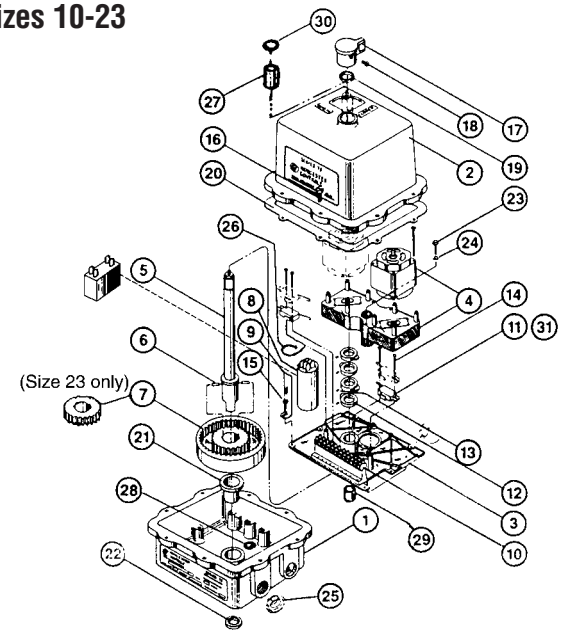
Cycle Length Control (CLC)



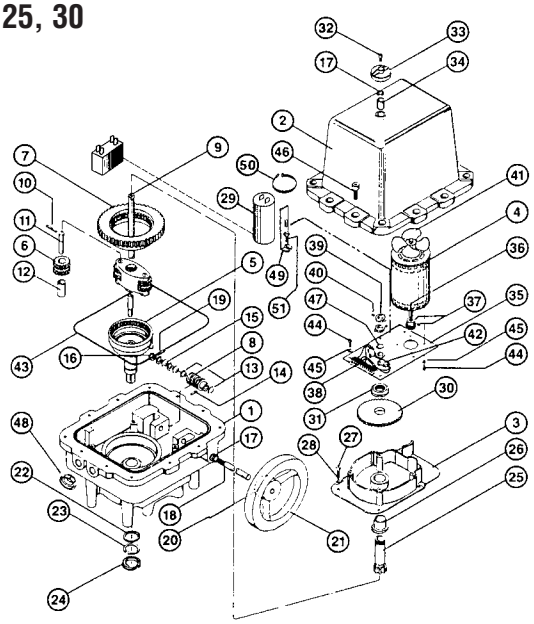
Prevents destructive pipeline shock caused by fast opening or closing valves on steam or hydraulic service. The CLC units allow field adjustment of the standard actuator's cycle time up to approximately 19 minutes for 25% duty and 57 minutes for 75% duty actuators.

Additional Options Available. Consult Flowserve.

Sizes 10-23



Sizes 25, 30



Sizes 10-23

Item	Qty.	Description	Material	Item	Qty.	Description	Material
1	1	Base	Aluminum Casting	16	4	Hex Screw (GP)	Steel
2	1	Cover	Aluminum Casting	17	1	Position Indicator (W,X,Z)	Molded Phenolic
3	1	Base Plate	Zinc Casting	18	1	Indicator Set Screw (W,X,Z)	Steel
4	1	Motor Module	Zinc Casting	19	1	Seal (W,X,Z)	Reinforced Rubber
5	1	Output Shaft	Steel	20	1	Gasket (W only)	Neoprene
6	2	Gear Drive Pin	Steel	20	1	Flange Seal (Z only)	Buna N
7	1	Bull Gear	Steel	21	1	Bearing	Bronze
8	1	Capacitor (w/Fiber Washer if Required)	Phenolic Encapsulated	22	1	Seal	Reinforced Nitrile
				23	4	Screw	Steel
9	1	Capacitor Bracket	Steel	24	4	Lock Washer	Steel
10	1	Terminal Strip	Polyethylene Based Material	25	1	Conduit Plug	Polyethylene
11	2	Limit Switch	Phenolic Encapsulated	26	1	Capacitor Tie	Plastic
12	2	Limit Switch Cam	Zinc Casting	27	1	Bearing (W, X, Z)	Bronze
13	1/Cam	Cam Set Screw	Steel	28	1	Roller Bearing (size 23 only)	Steel
14	4	Limit Switch Screw	Steel	29	1	Bearing, Base Plate	Nylon
15	6	Base Plate Screw	Steel	30	1	O-Ring (W, X, Z)	Buna
16	8	Hex Screw (W,X,Z)	Stainless Steel	31	2	Insulator (not shown)	Nylon

Sizes 25, 30

Item	Qty.	Description	Material	Item	Qty.	Description	Material
1	1	Base	Aluminum	28	4	Lock Washer	Steel
2	1	Cover	Aluminum	29	1	Capacitor (w/Fiber Washer if Required)	Phenolic Encapsulated
3	1	Gear Train Support	Aluminum				
4	1	Motor		30	1	Input Gear	Steel
5	1	Output Gear	Steel Casting	31	1	Nut	Steel
6	2	Planet Gear	Hardened Steel	32	1	Cap Screw	Steel
7	1	Planetary Gear	Ductile Iron	33	1	Position Indicator	Aluminum
8	1	Worm Gear	Steel	34	1	Bushing	Bronze
9	1	Sensing Shaft	Steel	35	1	Motor Support Plate	Aluminum
10	2	Pin, Spring	Steel	36	1	Gear, Pinion	Steel
11	2	Shaft	Hardened Steel	37	2	Set Screw	Steel
12	2	Bushing	Bronze	38	1	Terminal Strip	Polyethylene Based Material
13	2	Thrust Washer	Steel	39	2	Limit Switch Cam	Zinc Casting
14	1	Pin, Spring	Steel	40	1/Cam	Cam Set Screw	Steel
15	4	Belleville Washer	Steel	41	1	Fan	Plastic
16	1	Nut	Steel	42	2	Limit Switches	Phenolic Encapsulated
17	2	Seal	Rubber, Steel	43	1	O-Ring	Buna
18	1	Manual Override Shaft	Steel	44	9	Cap Screw	Steel
19	1	Pin, Cotter	Steel	45	9	Lock Washer	Steel
20	1	Pin, Spring	Steel	46	12	Cap Screw	Steel
21	1	Handwheel, Manual Override	Aluminum	47	1	Sensing Shaft Ret. Ring	Steel
22	1	Thrust Washer	Steel	48	1	Conduit Plug	Polyethylene
23	1	Tru-arc Ring	Steel	49	1	Capacitor Bracket	Steel
24	1	Seal	Rubber, Steel	50	1	Capacitor Tie	Plastic
25	1	Sun Gear	Steel	51	1	Capacitor Bracket Screw	Steel
26	1	Bushing	Bronze				
27	4	Cap Screw	Steel				

How to Order

20		75		X	MI	120A		
Actuator Size	**Options**	**Actuator Series**	**Duty Cycle**	**Enclosures**	**Secondary Options**	**Voltage**	**Option Operation**	**STD Variations**
10 **12** **15*** **20** **22** **23*** **25** **30**	**Blank** - No special service options **A -** AF17 or DRC17 or DFP17/DFC 17 (240 VAC) Positioner/Controller** **B -** For DFP17/DFC17 (DC only) *** ** **††C** - CLC Module for cycle length control **D -** Feedback Dual Potentiometer **H -** Heater and thermostat for low-temperature and high-humidity applications **I -** I-75 Interface Relay Unit (120/240 VAC only) **M -** Mechanical Brake (AC Only) **P -** Feedback Single Potentiometer **R -** Remote terminal relay board or AF17 Positioner (DC only)*** ** **4 -** Position Indicator **9 -** Cross-line mount	**75**	**2 -** 10% duty cycle Sizes 10, 12, 20, 22 only. **Blank -** 25% duty cycle **4 -** 75% duty cycle **5 -** 100% duty cycle. Sizes 10, 12, 20 only. (120 AC) **Note:** All duty cycles are at 70°F ambient temperature. At elevated temperatures duty cycle has to be derated. Consult Flowserve.	**Blank -** General purpose TYPE 1. Sizes 10, 12, 15, 20, 22 **W -** Watertight TYPE 4. Sizes 10, 12, 15, 20, 22 **X -** Hazardous Locations TYPE 7, Class 1, Div. 1, Group C, D TYPE 9, Class 2, Div. 1, Group E, F, G Sizes 10, 12, 15, 20, 22 **Z -** Combined Locations TYPE 4, 4X, 7, 9 Sizes 10, 12, 15, 20, 22, 23, 25, 30	**Blank -** No additional switches **M1 -** One additional switch **M2 -** Two additional switches **D2 -** 180° operation for 180° directional valves **D3 -** Center off for 180° operation	**120A -** 120 VAC - 60 Hz† **240A -** 240 VAC 60 Hz† **12D -** 12 VDC **24D -** 24 VDC	**CLC** **Blank -** Counter-clockwise (open) and clockwise (closed) **C -** Clockwise (closed) **O -** Counter-clockwise (open) **I75** I-75 Input Voltage Signal: **5V** - 5 VDC **XV** - 10 VDC **XX** - 24 VDC **15** - 120 VAC	**Blank -** No variation **V49 -** Anodized and painted cover and base **V53 -** Condensation Drain **V65 -** CE Marking Declaration of Conformity for Electric Actuator European Orders

*1575 can only be ordered with a 20% duty 120 VAC motor. The 2375 can only be ordered with a 75% duty motor.
†† Specify operation in Option Operation column for CLC.
† 120 and 240 VAC actuators will operate on 50 Hz. Torque will remain the same, cycle time will increase by a factor of 1.2 and duty cycle will be reduced by a factor of approximately 20%.
**These options must be ordered as a separate item in addition to being specified in the actuator code.
***Can only be ordered with a 75% duty motor.
NOTE: TYPE 7, 9, (X) UL approved units are available on request. TYPE 4, 7, 9, (X, W, Z) are furnished CSA Approved.
Due to continuous development of our product range, we reserve the right to alter the product specifications contained in this brochure as required.

Flowserve Corporation has established industry leadership in the design and manufacture of its products. When properly selected, this Flowserve product is designed to perform its intended function safely during its useful life. However, the purchaser or user of Flowserve products should be aware that Flowserve products might be used in numerous applications under a wide variety of industrial service conditions. Although Flowserve can (and often does) provide general guidelines, it cannot provide specific data and warnings for all possible applications. The purchaser/user must therefore assume the ultimate responsibility for the proper sizing and selection, installation, operation, and maintenance of Flowserve products. The purchaser/user should read and understand the Installation Operation Maintenance (IOM) instructions included with the product, and train its employees and contractors in the safe use of Flowserve products in connection with the specific application.

While the information and specifications contained in this literature are believed to be accurate, they are supplied for informative purposes only and should not be considered certified or as a guarantee of satisfactory results by reliance thereon. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding any matter with respect to this product. Because Flowserve is continually improving and upgrading its product design, the specifications, dimensions and information contained herein are subject to change without notice. Should any question arise concerning these provisions, the purchaser/user should contact Flowserve Corporation at any one of its worldwide operations or offices.

For more information about Flowserve Corporation, contact www.flowserve.com or call USA 1-800-225-6989.

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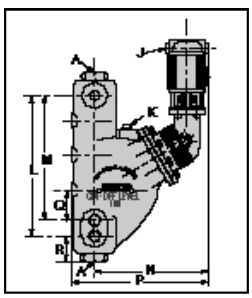
WCABR1014 (Part PB 730)

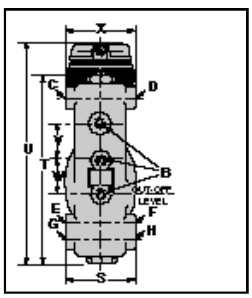
Low Water Cut-Offs – Mechanical
Combination Low Water Cut-Off/Pump Controllers for Steam Boilers

Series 193

Low Water Cut-Off/Pump Controllers

- For commercial and industrial low or high pressure steam boilers
- Maintains consistent water level regardless of pressure
- Water column with integral tappings for gauge glass and tri-cock installations
- For boilers of any steaming capacity
- No. 5 Switch included
- Magnetic repulsion eliminates need for bellows
- Optional features
  – Manual reset
- 7B switch (135ohm proportional control signal) to maintain constant boiler water level
- 1" NPT connections
- Maximum pressure 150 psi (10.5 kg/cm²)





Electrical Ratings

345 VA at 120 or 240 VAC

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
193	163400	Combination low water cut-off/ pump controller w/No. 5 switch	52.5 (23.8)
193-A	163500	193 w/alternate tappings	52.5 (23.8)
193-A-7B	164500	193-A w/No. 7B switch	52.5 (23.8)
193-A-7BM	164600	193-A-7B w/manual reset	52.5 (23.8)
193-A-M	164200	193-A w/manual reset	52.5 (23.8)
193-B	163600	193 w/alternate tappings	52.5 (23.8)
193-B-M	164300	193-B w/manual reset	52.5 (23.8)
193-B-7B	164700	193-B w/No. 7B switch	52.5 (23.8)
193-D	163900	193 w/alternate tappings	52.5 (23.8)
193-D-7B	163903	193-D w/No. 7B switch	52.5 (23.8)
193-M	164100	193 w/manual reset	52.5 (23.8)
193-7B	164400	193 w/No. 7B switch	52.5 (23.8)
193-7BM	164525	193-7B w/manual reset	52.5 (23.8)
193-D-M	163902	193-D w/manual reset	52.5 (23.8)
193-G	164760	193 w/alternate tappings	52.5 (23.8)

Dimensions, in. (mm)

Model	A NPT	B NPT	C NPT	D NPT	E NPT	F NPT	G NPT	H NPT	J NPT	K NPT
193	1	½	½	½	–	–	½	½	½	¾
193-A	1	½	½	½	½	½	–	–	½	¾
193-B	1¼	¾	¾	¾	–	–	¾	¾	½	¾
193-D	1	½	1	½	1	½	–	–	½	¾
193-G	1	½	–	½	1	½	–	–	½	¾

Model	L	M	N	P	Q	R
193	12¾ (324)	–	10 13/16 (274)	13 (330)	–	2⅞ (73)
193-A	–	11½ (292)	10 13/16 (274)	13 (330)	2¼ (57)	–
193-B	12¾ (324)	–	10 13/16 (274)	13 (330)	–	2⅞ (73)
193-D	–	11½ (292)	10 13/16 (274)	13 (330)	2¼ (57)	–
193-G	–	11½ (292)	10 13/16 (274)	13 (330)	2¼ (57)	–

Model	S	T	U	V	W	X
193	6¾ (171.4)	17½ (445)	20½ (521)	3½ (89)	3½ (89)	6 (152)
193-A	6¾ (171.4)	17½ (445)	20½ (521)	3½ (89)	3½ (89)	6 (152)
193-B	6¾ (171.4)	17½ (445)	20½ (521)	3½ (89)	3½ (89)	6 (152)
193-D	6¾ (171.4)	17½ (445)	20½ (521)	3½ (89)	3½ (89)	6 (152)
193-G	6¾ (171.4)	17½ (445)	20½ (521)	3½ (89)	3½ (89)	6 (152)

Hurst BOILER & WELDING COMPANY, INC

Three Pass
Firebox Design

SERIES N65

HIGH PRESSURE DESIGN

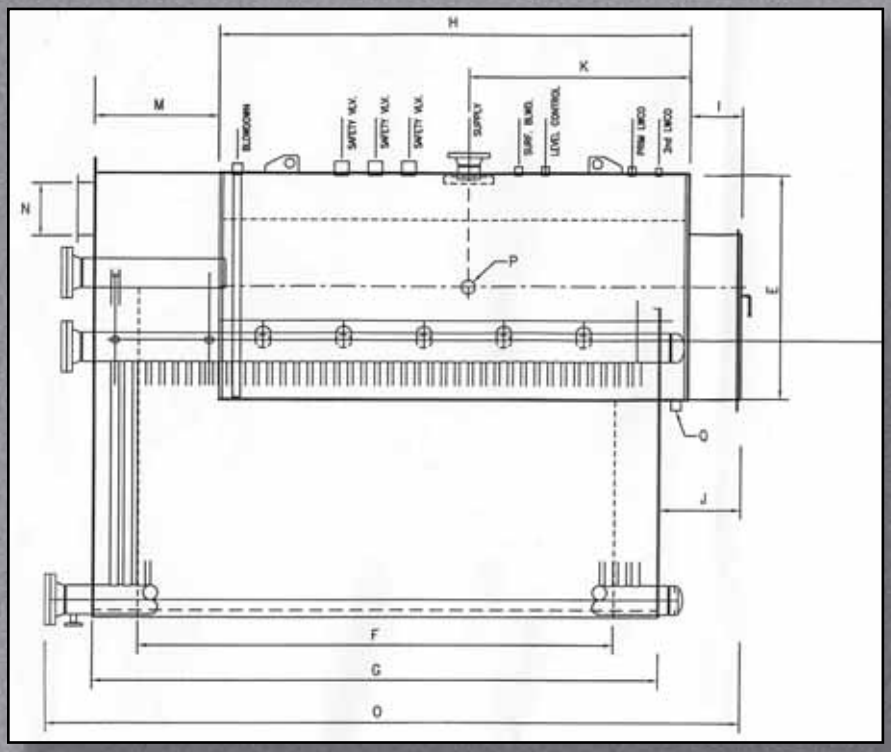
Up Grades any Existing
Solid-Fuel-Fired Boiler System

- OIL
- GAS
- COAL
- WOOD
- PAPER
- BIO-MASS

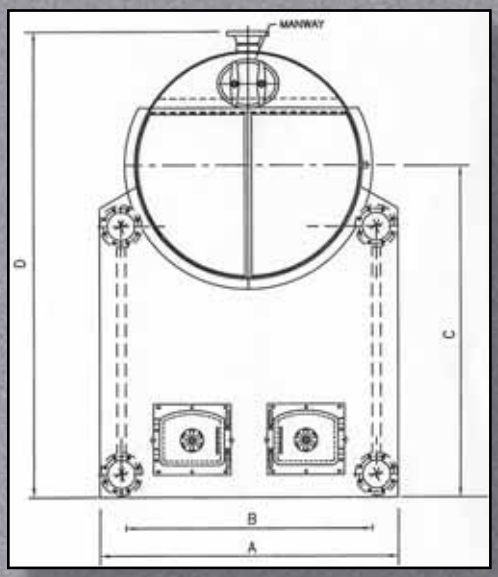
HUGE FURNACE VOLUME

Capacities From 100 HP to 1500 HP

N 6 5 SERIES



SIDE VIEW



FRONT VIEW

SPECIFICATIONS DATA IN INCHES

	BOILER HP (GAS & OIL)	**125**	**200**	**250**	**300**	**400**	**500**	**650**	**800**	**900**	**1000**	**1200**	**1300**	**1400**	**1500**	
	BOILER HP (SOILID FUEL)	**100**	**150**	**200**	**250**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	
	BOILER MODLE NO - N65	650	975	1300	1625	1950	2600	3250	3900	4555	5200	5850	6500	7150	7800	
	STEAM LB/HR (GAS/OIL)	4312	6900	8625	10350	13800	17250	22425	27600	31050	34500	40800	44850	48300	51750	
	STEAM LB/HR (SOLID FUEL)	3450	5175	6900	8625	1035	13800	17250	20700	24150	27600	31050	34500	37950	41400	
	FIRESIDE HTG SUR (SQ FT)	650	975	1300	1625	1950	2600	3250	3900	4550	52000	5850	6500	7150	7800	
	FURNACE VOL (CU FT)	305	415	519	606	737	583	700	800	963	1084	1205	1112	1163	1289	
A	BOILER WIDTH	89	89	89	89	89	101.5	101.5	101.5	122.5	122.5	122.5	140	140	140	**A**
B	FURNACE WIDTH INSIDE	73.63	73.63	73.63	73.63	73.63	90.75	90.75	90.75	107	107	107	124	124	124	**B**
C	CENTER LINE DRUM TO FLOOR	82	98.81	98.81	98.81	98.81	95.69	95.69	95.69	101.5	101.5	101.5	96	96	96	**C**
D	FLOOR TO SUPPLY NOZZEL	122	139	139	139	139	145.5	145.5	145.5	156	156	156	156	156	156	**D**
E	SHELL INSIDE DIA.	67	67	67	67	67	86	86	86	96	96	96	108	108	108	**E**
F	FURNACE LENGTH INSIDE	79	89	118	143	179	147	183	214	207	237	271	237	261	285	**F**
G	FURNACE LENGTH OUTSIDE	105	115	144	169	205	173	209	240	233	263	297	263	287	311	**G**
H	DRUM LENGTH	76	88	117	142	178	142	178	209	202	232	262	222	246	270	**H**
I	FRONT SMOKEBOX DEPTH	16	16	16	16	16	16	16	16	16	16	16	20	20	20	**I**
J	SMOKE BOX TO FRONT PLATE	24	24	24	24	24	24	24	24	24	24	24	28	28	28	**J**
K	SUPPLY NOZZEL LOCATION	42	48	48	72	84	72	84	96	96	108	114	96	108	114	**K**
L	SUPPLY SIZE (150 PSI)	3	4	4	4	4	6	6	6	6	8	8	8	8	8	**L**
M	REAR SMOKEBOX DEPTH	37	37	37	37	41	41	41	41	41	41	41	49	49	49	**M**
N	VENT SIZ- SQ. OR EQUIV.	14	18	20	24	24	30	32	36	38	42	42	48	48	48	**N**
O	LENGTH OVERALL (APPROX)	137	149	178	203	239	205	241	272	265	295	325	229	323	347	**O**
P	FEEDWATER CONNECTION	1.5	1.5	1.5	1.5	1.5	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5	**P**
Q	BLOWDOWN CONNECTION	1.5	1.5	1.5	1.5	1.5	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5	**Q**
	DRY WEIGHT (APPROX-150 PSI)	22100	26800	30000	32800	36400	42400	48300	53500	62100	68000	74000	78500	84200	89800	
	BOILER HP (GAS & OIL)	**125**	**200**	**250**	**300**	**400**	**500**	**650**	**800**	**900**	**1000**	**1200**	**1300**	**1300**	**1300**	
	BOILER HP (SOILID FUEL)	**100**	**150**	**200**	**250**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1000**	**1000**	

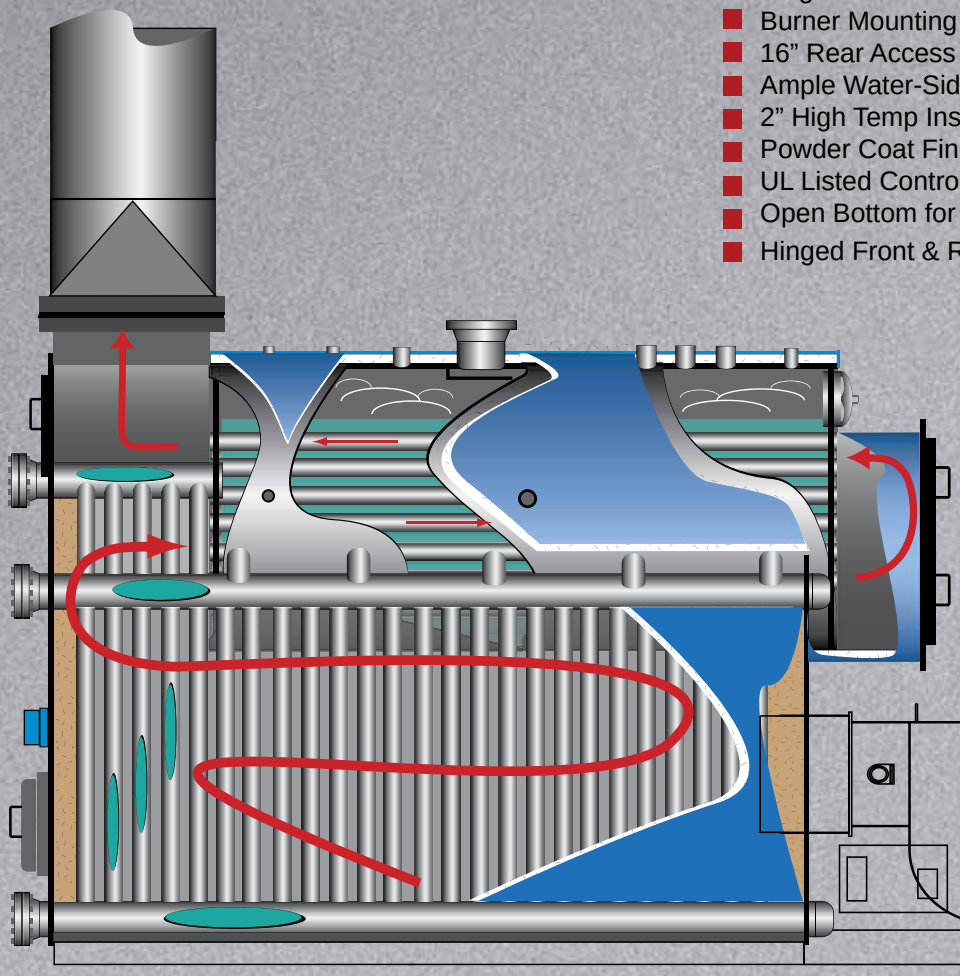
DIMENSIONS SUBJECT TO CHANGE WITHOUT NOTICE, CERTIFIED DRAWINGS AVAILABLE UPON REQUEST

MORE MODELS
CHOICES
SOLUTIONS

Gas / Oil Closed Bottom Design

Solid Fuel Open Bottom Design

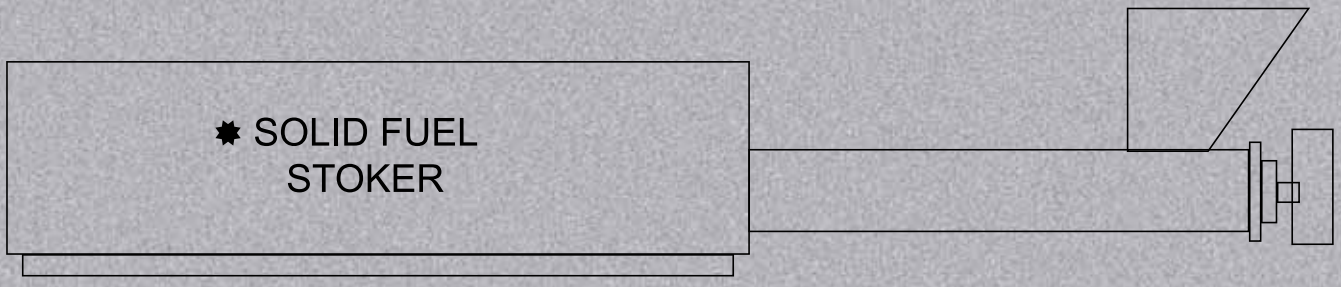
- Efficient 3-Pass Design.
- Water “Leg” Side Walls (High Efficiency Tubed Membrane)
- Wet-Back Construction.
- A.S.M.E. Code Constructed & Stamped.
- Registered with National Board of Inspectors.
- Large Water Cooled Furnace.
- Burner Mounting Ring.
- 16” Rear Access Port.
- Ample Water-Side Clean-out Opening.
- 2” High Temp Insulation.
- Powder Coat Finish on Lagging.
- UL Listed Controls & Trim.
- Open Bottom for Stoker Firing of Solid Fuel.
- Hinged Front & Rear Doors.



150
250
300
450
PSI
High Pressure Design

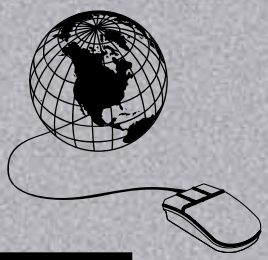
GAS / OIL
✸ BURNER

✸ SOLID FUEL
STOKER



Hurst Knows Combustion

N65 units are factory packaged and shipped with operating controls, relief valves, Hurst offers options of firing equipment to complete the N65 Series vessel. Flexible burner, stoker and grate systems are available for firing natural gas, LP gas, #2 oil, heavy oil, coal wood waste, paper and multiple bio-mass fuels.



Hurst BOILER & WELDING COMPANY, INC

Learn more... hurstboiler.com

MORE MODELS
CHOICES
SOLUTIONS

SOLID FUEL HYBRID

Available in Steam or Hot Water, Multi-Pass Dry Back Design. 100 to 1,800 HP, 15 to 450 PSI Steam. Solid fuel stoker burns the full spectrum of waste products from all the forest related industries. Turn-key systems include E.P.A. equipment and solid fuel handling equipment.

- COAL
- WOOD
- PAPER
- BIO-MASS

OXY-MISER SERIES

The use of deaerators has long been used in power plants and water tube type boilers, primarily because they remove undissolved oxygen and raise the temperature of the feedwater. These advantages are important today for firetube boilers as well, due to higher capital investments.

Operating costs can be reduced by recovering flash steam when returned by high temperature condensate. This feature also raises the feedwater temperature, thus requiring less boiler fuel to convert the feedwater to usable steam. Boiler tubes, condensate lines, and process piping have a much longer useful life by eliminating the pitting action of untreated water. This advantage alone justifies the cost of an "OXY-MISER" deaerator.

Packaged Deaerator Systems, 5,000 to 200,000 PPH.
Conditions feedwater to 0% CO2 and .005cc/liter of oxygen.

We Welcome
Custom Design for Solid Fuel Combustion!

BOILER PARTS IN STOCK

HURST REPLACEMENT PARTS

Hurst is a major supplier of boiler parts and controls that are commonly found on most boiler systems. Whether gas, oil or solid fuel no matter who the maker Hurst can fill all your parts needs.

UPS Overnight Delivery

- Pumps
- Controls
- Gaskets
- Valves
- Burners
- Refractory
- Fire Bricks
- Water Softeners

Hurst BOILER & WELDING COMPANY, INC ™

Tel: (229) 346-3545 • Fax: (229) 346-3874

PO Box 530 • Highway 319 N • Coolidge, GA 31738-0530
www.hurstboiler.com
email: info@hurstboiler.com

For More Information

Hurst Boiler continually strives to provide the most comprehensive information and technical product data available via our web site at www.hurstboiler.com

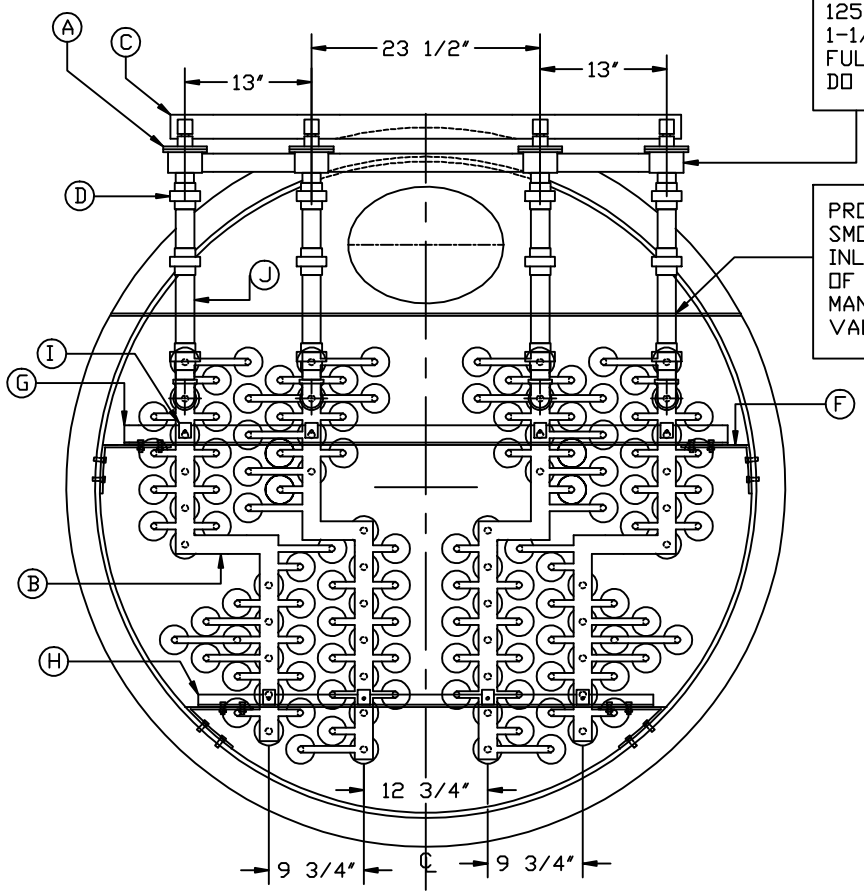
Always visit www.hurstboiler.com for the latest product data, distributor, technical information and literature posting, as well as info on news, events, and specials.

Please visit our site frequently, and be sure to use our CAD drawings or e-mail any of your boiler engineering questions or concerns.

It is always our pleasure to serve you with all your boiler needs.

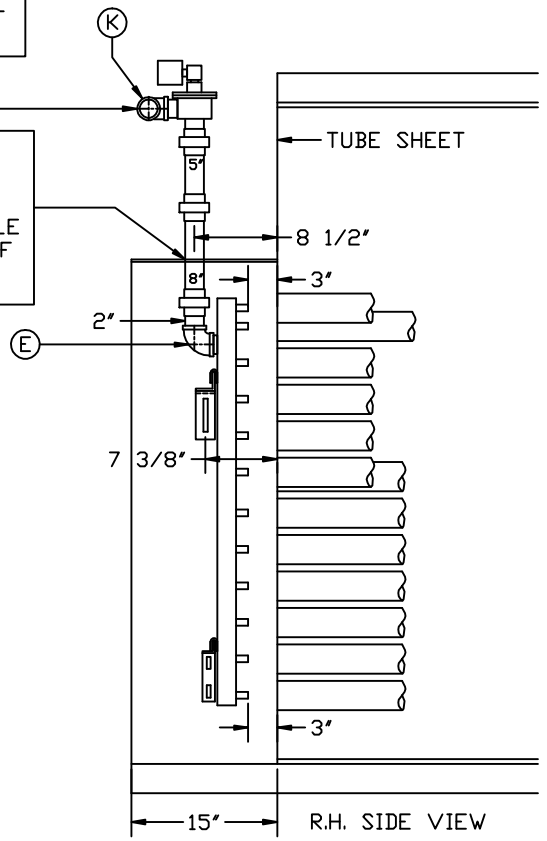
Thank you for considering
Hurst Boiler & Welding Company

REVISIONS		
REV	DESCRIPTION	DATE
1	RELEASED FOR APPROVAL	4-29-13



1-1/2" NPT FEMALE AIR INLET
125 PSIG MAX. SUPPLY LINE
1-1/2" PIPE OR LARGER USE
FULL PORT BALL/STOP VALVE
DO NOT RESTRICT LINE SIZE

PROVIDE (4) 2" HOLES IN
SMOKEBOX AND SEAL WELD
INLET NIPS AFTER ALIGNMENT
OF SUPPORT BRACKETS, NOZZLE
MANIFOLDS & INSTALLATION OF
VALVE MANIFOLD



NOTES: ALL PIPE FITTINGS CLASS 150 MALLEABLE IRON SCREWED. ALL PIPE NIPS 1-1/2" NPT SCH.40 PIPE.
MINIMUM AIR REQUIREMENT: 10 CFM DELIVERY @ 100 TO 125 PSIG. VALVE MANIFOLD WITH MOUNTED WIREWAY ASSEMBLED AND WIRED BY FUEL EFFICIENCY LLC. GOYEN VALVE PART NO. CA35T000321 SPECS: 120V/60H, 125 PSIG MAX., 180°F MAX. FLUID TEMP. REBUILD KITS: DIAPHRAGM KIT NO. K3500, SOLENOID KIT NO. K0380, COIL NO. QT120V

ITEM	DESCRIPTION	QTY.	ITEM	DESCRIPTION	QTY.
A	GOYEN SOLENOID VALVE (SEE NOTES)	4	H	1-1/4"x1-1/4"x3/16"x47-1/2" ANGLE BAR	1
B	NOZZLE MANIFOLD	4	I	U CLIP W/SET SCREW	8
C	WIREWAY (SEE NOTES)	1	J	VARIOUS LENGTH 1-1/2" INLET NIPS	8
D	1-1/2" UNION (SEE NOTES)	8	K	1-1/2" TEE (SEE NOTES)	4
E	1-1/2" 90° ELL (SEE NOTES)	4			
F	SUPPORT BRACKET W/HARDWARE	4			
G	2"x2"x1/4"x62" ANGLE BAR	1			

CUSTOMER JOB DESCRIPTION
AUTOMATIC AIR OPERATED TUBE CLEANER/SOOT BLOWER
JOB NAME: LITTLETON REGIONAL HOSPITAL

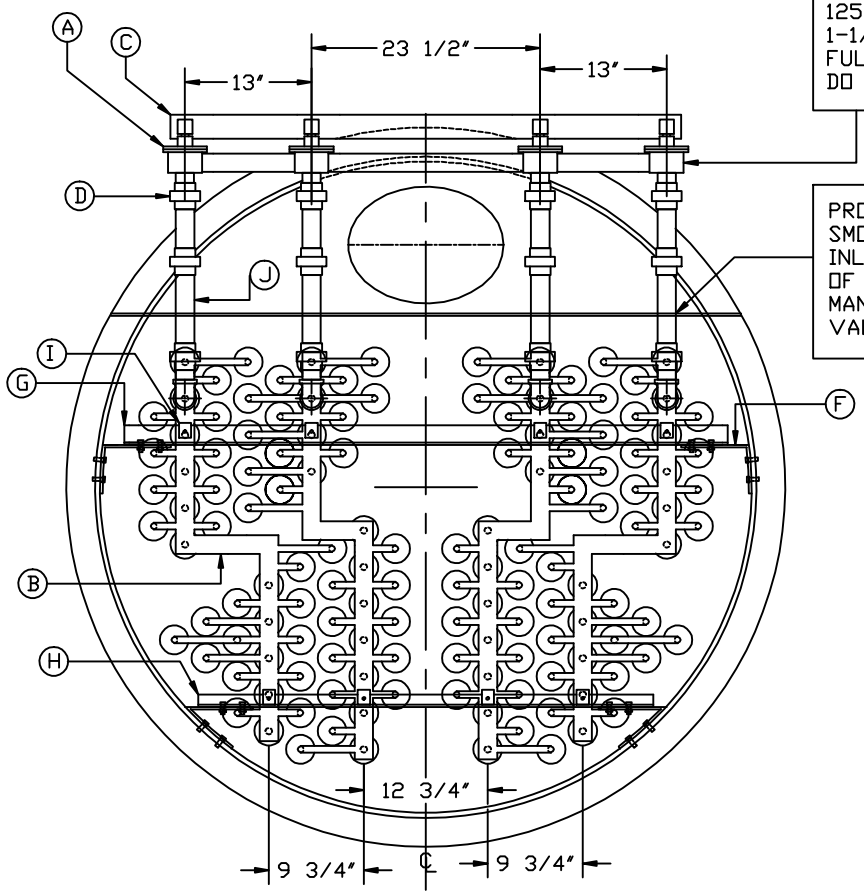
FUEL EFFICIENCY LLC CLYDE, NY
PH:315/923-2511
FAX:315/923-9182

FOR: (1) HURST N65-SF-1300-150
BOILER WITH (138)-3" TUBES
1300 SQ/FT 150 PSIG STEAM

SIZE	JOB NO.	DWG NO.	REV
C		2160	1

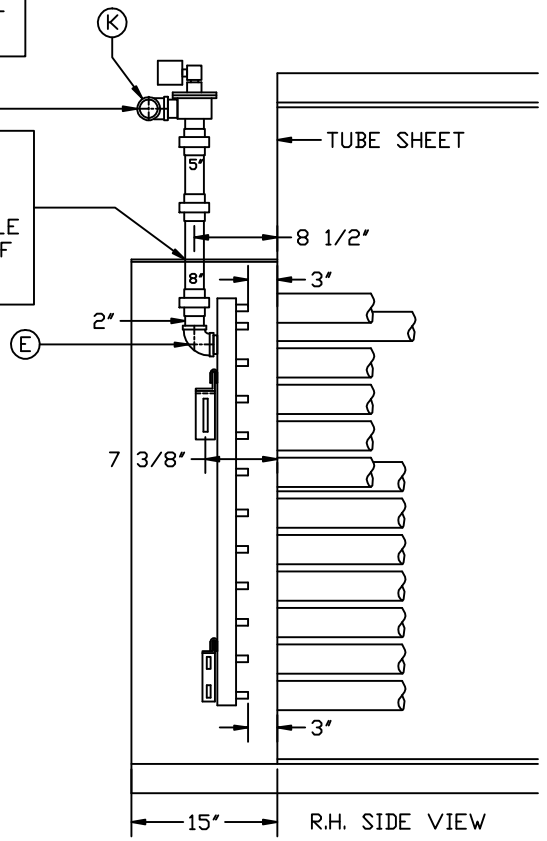
SCALE NONE | DATE 4-29-13 | SHEET 1 OF 1

REVISIONS		
REV	DESCRIPTION	DATE
1	RELEASED FOR APPROVAL	4-29-13



1-1/2" NPT FEMALE AIR INLET
125 PSIG MAX. SUPPLY LINE
1-1/2" PIPE OR LARGER USE
FULL PORT BALL/STOP VALVE
DO NOT RESTRICT LINE SIZE

PROVIDE (4) 2" HOLES IN
SMOKEBOX AND SEAL WELD
INLET NIPS AFTER ALIGNMENT
OF SUPPORT BRACKETS, NOZZLE
MANIFOLDS & INSTALLATION OF
VALVE MANIFOLD



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CUSTOMER JOB DESCRIPTION
AUTOMATIC AIR OPERATED TUBE CLEANER/SOOT BLOWER
JOB NAME: LITTLETON REGIONAL HOSPITAL

FUEL EFFICIENCY LLC CLYDE, NY
PH:315/923-2511
FAX:315/923-9182

FOR: (1) HURST N65-SF-975-150
BOILER WITH (138)-3" TUBES
975 SQ/FT 150 PSIG STEAM

SIZE	JOB NO.	DWG NO.	REV
C		2160	1

SCALE NONE | DATE 4-29-13 | SHEET 1 OF 1

R & PL Series

1.5–35 HP OIL-LUBRICATED RECIPROCATING AIR COMPRESSORS

- Automotive
- Dry Cleaning
- Service Fleets
- Industrial
- Refineries

CHAMPION®

CHAMPION RECIPROCATING COMPRESSORS...

The Value Leaders

At Champion, air compressor systems are our only products. We know and understand the application of our products in many different operating environments. Our goal is to provide you with the compressors that fulfill — and exceed — your expectations and requirements.

Because compressed air is an essential utility, dependability is an essential compressor quality. If your compressor goes down, it can hurt your reputation — and your bottom line. Champion reciprocating compressors are proven units, known for their reliability over decades of use. In addition to dependability, you want a compressor that is user-friendly. Champion comes through again, with a wide selection of configurations and options designed for trouble-free operation.

You can't beat a Champion!

Proven Design.

Today's Champion Reciprocating Compressors are the product of decades of design and development.

Proven Dependability.

You rely on compressed air to perform many tasks efficiently. Champion knows that reliability is one of the main reasons for a purchase. Our slow speed, built-in efficiency through design and the longest compressor warranty in the industry make Champion compressors the proven choice!

High Performance.

R- and PL-Series compressors are loaded with features designed for day-in, day-out performance. For example, Champion's unique automotive-type domed piston design allows the use of large diameter, low lift valves, while minimizing clearance volume for maximum air delivery.

Long Life.

Features such as slow speed operation, rugged cast iron crankcase construction, corrosion resistant steel valves and tapered roller-type main bearings all contribute to long life.

User-friendly Design.

A wide selection of configurations and available options, coupled with serviceability features make it easy to operate and maintain a Champion compressor. Compare all the features on the pages that follow. You'll discover why Champion is the value leader in reciprocating compressors for a broad range of automotive and industrial applications.

The Solution to Your Application

Select the configuration that matches your application.

With many models from which to choose in both single-stage and two-stage, we can match your needs exactly. These configurations, combined with a wide choice of options, provide all the components for a customized installation. They are available in both R-Series splash-lubricated and PL-Series pressure-lubricated models.

Tank-mounted Air Compressors

Available with horizontal or space-saving vertical tanks, two-stage air compressors compress air to a higher pressure than single stage compressors.

Base-mounted Air Compressors

Designed for installations where air tanks are remotely located.

Duplex Air Compressors

For extra air delivery when you need it without wasted space. Plus the flexibility of single operation, alternating between compressors, or duplex operation to meet high air demand.

Gasoline or Diesel Engine Powered Air Compressors

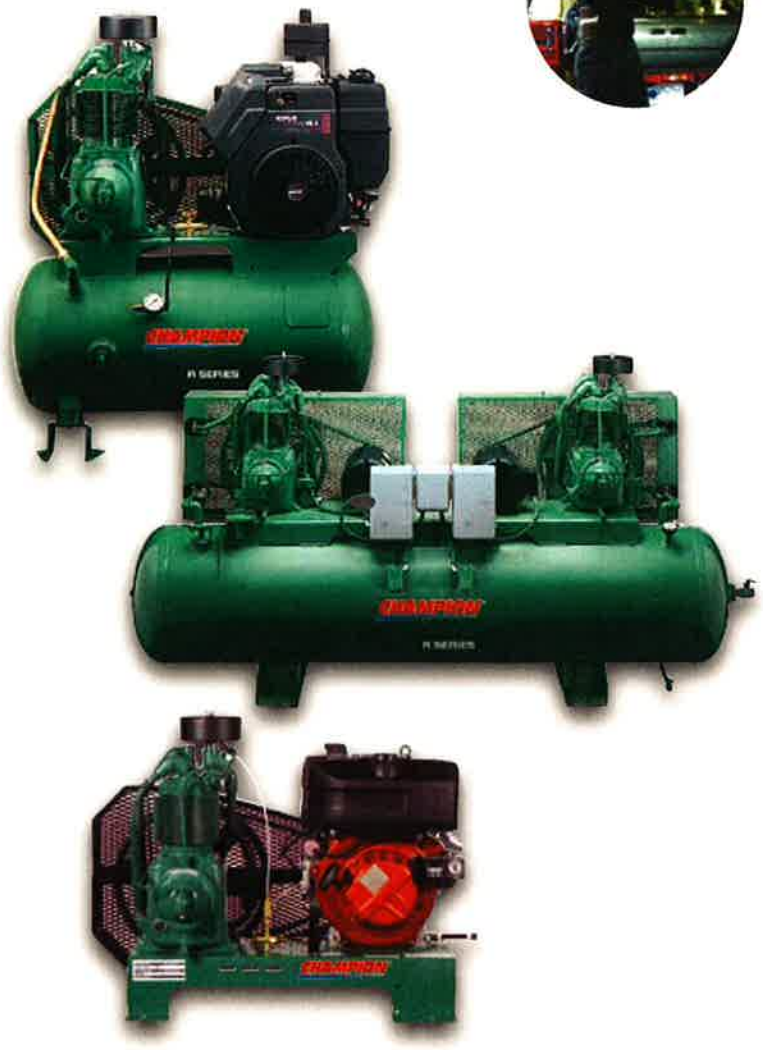
Truck and utility bed mounting design makes these compressors ideal for fleet and field service. Ideal for applications where electricity is not available.

Bare Compressor Pumps

Provide dependable service for industrial applications, pump replacement or OEM applications. The rugged pump design assures reliability and long maintenance intervals.

Receivers

Receivers are ASME approved and include a pressure gauge, pressure relief valve, drain valve and service valve.



Splash-Lubricated R-Series

Loaded with rugged features, the R-Series splash-lubricated compressors deliver high performance, long life and tremendous value.

1 Multi-finned cylinders

Cooler operating temperatures result in longer life and consistent performance over time.

2 Integral cylinder/head

Gasketless design eliminates the possibility of blown head gaskets for trouble-free operation.

3 Balanced pistons

Aluminum alloy first-stage piston is weight-matched to the cast iron second-stage piston, ensuring proper balance.

4 Piston rings

Two compression rings and one oil control ring provide excellent oil control, and high efficiency air delivery.

5 Lightweight connecting rods

High-density, die-cast aluminum alloy rods minimize reciprocating weight. An integral, precision-bored crankpin bearing and a needle bearing for the piston pin properly distribute bearing loads for longer bearing life than bushings.

6 Pressure relief valves

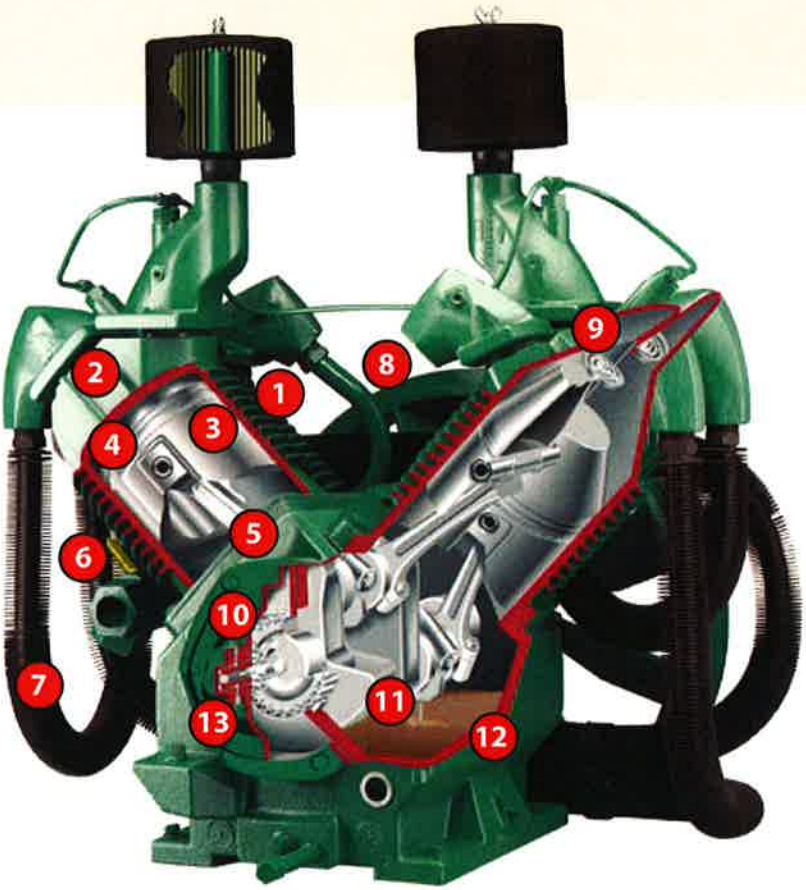
Located in interstage and discharge.

7 Intercoolers

Large-diameter finned tubing is positioned to obtain the greatest cooling effect between stages for maximum compressor efficiency.

8 Optimized cooling fan/flywheel

Precision balanced flywheel has fan blades for optimum compressor cooling and life.



9 Reliable, high-flow valves

Single-unit, disc-type valves provide low lift and long life. Discs are made of corrosion resistant Swedish steel. Valves are easily serviced by removing the manifolds only.

10 Oversized main bearings

Tapered roller-type main bearings provide full contact and support of the crankshaft plus delivers the longest possible life.

11 Balanced crankshaft

Constructed of rugged ductile iron with large diameter throws for minimum bearing loads and counterweights to minimize vibration.

12 Large capacity crankcase

Rugged cast iron oil reservoir has convenient sight gauge glass, corner oil fill boss and large oil drain.

13 Loadless starting

Positive acting, governor-type centrifugal unloader assures longer motor life by allowing the compressor to start unloaded every time.

Quality Accessories

Many options are available to help you develop a Champion compressor package that exactly matches your specific operating requirements.

1 Magnetic starter

(included as standard on most models)

For thermal overload protection, a starter is required for units 3 HP and up. May be mounted or unmounted.

2 Air-cooled or water-cooled aftercooler

The factory mounted, heavy duty, air-cooled aftercooler effectively reduces up to 65% of the moisture from discharged compressed air.

3 Automatic tank drain

Pneumatic drain operates from a centrifugal unloader.

4 Vibration isolators

Isolates the compressor unit from the foundation or floor. Reduces noise and protects the unit from any out-of-level floor situation that could cause vibration and damage.

5 Low oil level monitor

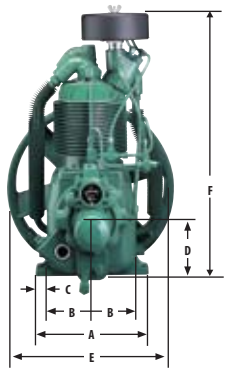
Low Oil Level Monitor shuts down the unit when oil levels are below an adequate level. Prevents the unit from restarting if oil levels are not at an adequate level.

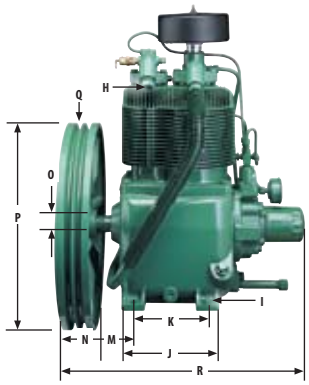
BARE-PUMP DIMENSIONS

	Item	R-10D, R-15B, PL-15 Inch	R-30D & PL-30 Inch	R-40A & PL-40 Inch	R-70A & PL-70 Inch
A	Base – Width	10	11⅛	12⅞	12⅞
B	Boltdown – Width	4⅜	4 13/16	5 11/16	5 11/16
C	Boltdown to Edge	⅝	¾	¾	¾
D	Base to Crank CTR	5½	7	7 15/16	7⅞
E	Overall Width	16⅞	26	30	33½
F	Overall Height	23¼	23 9/16	32	33 9/16
H	HP Exh. Opening Manifold	¾" Tubing	¾ NPT	1" Tubing	1¼ NPT
I	Boltdown Hole Diameter	15/32	17/32	9/16	9/16
J	Base — Depth	7½	9¾	12	13¼
K	Boltdown — Depth	5¾	8 1/16	10	11¼
L	Boltdown to Edge	⅞	27/32	1	1
M	Bolt Hole to Wheel (Max.)	3	3¼	5¾	5¾
N	Flywheel — Width	2½	2 23/32	3½	3½
O	Crank Diameter	1 5/16	1¾	2¼	2¼
P	Flywheel Diameter	16½	18⅞	22	22 3/16
Q	Flywheel Grooves	2VB*	2VB*	3VB*	3VB*
R	Overall Depth	20	22⅜	27½	28 33/64
Approximate Shipping Weight (lbs.)		125	220	440	570

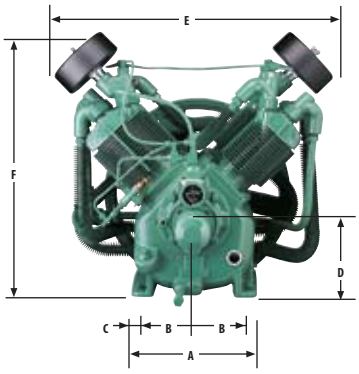
** VB: V Belt*

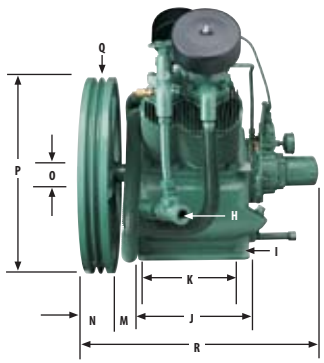
R-10D, R-15B, PL-15A



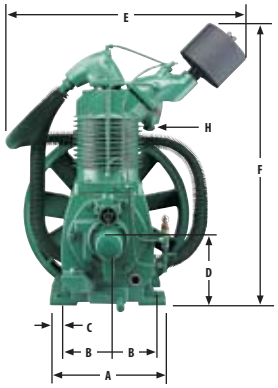


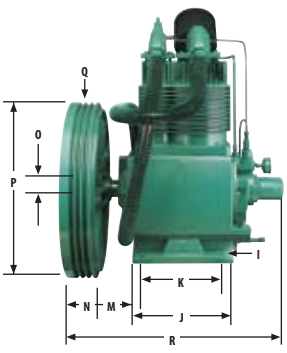
R-30D & PL-30A



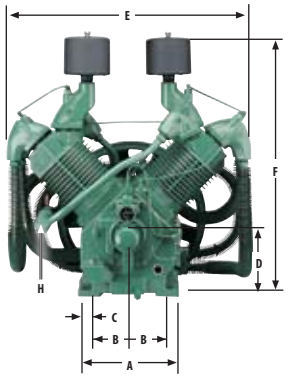


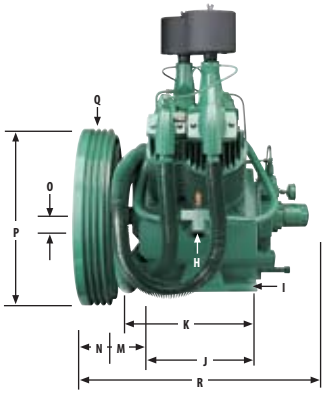
R-40A & PL-40A





R-70A & PL-70A





HORIZONTAL TANK MOUNTED UNITS — ELECTRIC DRIVEN								125 PSI Rating*			175 PSI Rating*			250 PSI Rating*		
Motor HP	Tank Cap Gal.	R-Series CASRSA	Pump Comp Model	PL-Series CBSPLA	Pump Comp Model	L x W x H Dimensions inches	Aprox. Ship Wt.lbs.	RPM	CFM Displ.	CFM Del'y	RPM	CFM Displ.	CFM Del'y	RPM	CFM Displ.	CFM Del'y
1½	30	HR1-3	R-10D	NA	NA	41½ x 20¼ x 44½	300	575	11.2	6.0	542	10.5	5.3	NA	NA	NA
1½	60	HR1-6	R-10D	NA	NA	51½ x 23¼ x 49	400	575	11.2	6.0	542	10.5	5.3	NA	NA	NA
1½	80	HR1-8	R-10D	NA	NA	66½ x 23¼ x 49	425	575	11.2	6.0	542	10.5	5.3	NA	NA	NA
2	30	HR2-3	R-10D	NA	NA	41½ x 20¼ x 44½	320	765	14.9	8.3	725	14.1	7.5	NA	NA	NA
2	60	HR2-6	R-10D	NA	NA	51½ x 23¼ x 49	425	765	14.9	8.3	725	14.1	7.5	NA	NA	NA
2	80	HR2-8	R-10D	NA	NA	66½ x 23¼ x 49	455	765	14.9	8.3	725	14.1	7.5	NA	NA	NA
3	60	HR3-6	R-15B	HPL3-6	PL-15A	51½ x 23¼ x 49	425	485	14.1	10.9	440	12.8	9.7	380	11.0	8.0
3	80	HR3-8	R-15B	HPL3-8	PL-15A	66½ x 23¼ x 49	485	485	14.1	10.9	440	12.8	9.7	380	11.0	8.0
3	120	HR3-12	R-15B	HPL3-12	PL-15A	70½ x 25 x 52¾	725	485	14.1	10.9	440	12.8	9.7	380	11.0	8.0
5	60	HR5-6	R-15B	HPL5-6	PL-15A	51½ x 23¼ x 49	445	805	23.5	19.1	734	21.4	17.3	640	18.6	13.6
5	80	HR5-8	R-15B	HPL5-8	PL-15A	66½ x 23¼ x 49	535	805	23.5	19.1	734	21.4	17.3	640	18.6	13.6
5	120	HR5-12	R-15B	HPL5-12	PL-15A	70½ x 25 x 52¾	765	805	23.5	19.1	734	21.4	17.3	640	18.6	13.6
7½	80	HR7F-8	R-15B	HPL7F-8	PL-15A	66½ x 23¼ x 49	570	990	28.7	23.9	990	28.7	23.1	870	25.5	18.2
7½	120	HR7F-12	R-15B	HPL7F-12	PL-15A	70½ x 23¼ x 52¾	765	990	28.7	23.9	990	28.7	23.1	870	25.5	18.2
7½	80	HR7-8	R-30D	HPL7-8	PL-30A	66½ x 23¼ x 52¾	665	670	39.6	30.0	575	33.5	25.8	520	30.2	21.3
7½	120	HR7-12	R-30D	HPL7-12	PL-30A	70½ x 25 x 53¼	860	670	39.6	30.0	575	33.5	25.8	520	30.2	21.3
10	80	HR10-8	R-30D	HPL10-8	PL-30A	66½ x 23¼ x 49¼	675	810	47.3	37.3	740	43.1	34.8	640	37.1	27.5
10	120	HR10-12	R-30D	HPL10-12	PL-30A	70½ x 25 x 53¼	890	810	47.3	37.3	740	43.1	34.8	640	37.1	27.5
10	250	HR10-25	R-30D	HPL10-25	PL-30A	87½ x 30 x 60½	1295	810	47.3	37.3	740	43.1	34.8	640	37.1	27.5
15	80	HR15F-8	R-30D	HPL15F-8	NA	66½ x 23¼ x 49¼	675	1045	60.9	50.2	1045	60.9	49.0	900	52.5	42.6
15	120	HR15F-12	R-30D	HPL15F-12	PL-30A	70½ x 25 x 53¼	840	1045	60.9	50.2	1045	60.9	49.0	900	52.5	42.6
15	250	HR15F-25	R-30D	HPL15F-25	PL-30A	88½ x 30 x 60½	1275	1045	60.9	50.2	1045	60.9	49.0	900	52.5	42.6
15	120	HRA15-12	R-40A	HPL15-12	PL-40A	72 x 27½ x 62	1110	890	71.1	59.0	770	61.5	53.7	700	55.9	45.8
15	250	HRA15-25	R-40A	HPL15-25	PL-40A	89 x 30¼ x 64	1495	890	71.1	59.0	770	61.5	53.7	700	55.9	45.8
20	120	HRA20-12	R-70A	HPL20-12	PL-70A	72 x 27½ x 64½	1325	770	109.0	91.9	655	93.0	76.7	545	77.4	64.1
20	250	HRA20-25	R-70A	HPL20-25	PL-70A	89 x 30¼ x 71½	1790	770	109.0	91.9	655	93.0	76.7	545	77.4	64.1
25	120	HRA25-12	R-70A	HPL25-12	PL-70A	72 x 27½ x 64½	1365	890	127.8	102.1	770	109.4	90.1	660	93.7	76.8
25	250	HRA25-25	R-70A	HPL25-25	PL-70A	89 x 30¼ x 71½	1735	890	127.8	102.1	770	109.4	90.1	660	93.7	76.8
30	120	HRA30-12	R-70A	HPL30-12	PL-70A	72 x 27½ x 64½	1404	890	127.8	102.1	890	127.8	101.0	770	109.4	90.0
30	250	HRA30-25	R-70A	HPL30-25	PL-70A	89 x 30¼ x 71½	1774	890	127.8	102.1	890	127.8	101.0	770	109.4	90.0

VERTICAL TANK MOUNTED UNITS — ELECTRIC DRIVEN								125 PSI Rating*			175 PSI Rating*			250 PSI Rating*		
Motor HP	Tank Cap Gal.	R-Series CASRSA	Pump Comp Model	PL-Series CBSPLA	Pump Comp Model	L x W x H Dimensions inches	Aprox. Ship Wt.lbs.	RPM	CFM Displ.	CFM Del'y	RPM	CFM Displ.	CFM Del'y	RPM	CFM Displ.	CFM Del'y
1½	60	VR1-6	R-10D	NA	NA	30½ x 24 x 76	400	575	11.2	6.0	542	10.5	5.3	NA	NA	NA
1½	80	VR1-8	R-10D	NA	NA	32½ x 24 x 75	425	575	11.2	6.0	542	10.5	5.3	NA	NA	NA
2	60	VR2-6	R-10D	NA	NA	30½ x 24 x 76	425	765	14.9	8.3	725	14.1	7.5	NA	NA	NA
2	80	VR2-8	R-10D	NA	NA	32½ x 24 x 75	455	765	14.9	8.3	725	14.1	7.5	NA	NA	NA
3	60	VR3-6	R-15B	VPL3-6	PL-15A	30½ x 24 x 76	425	485	14.1	10.9	440	12.8	9.7	380	11.0	8.0
3	80	VR3-8	R-15B	VPL3-8	PL-15A	32½ x 24 x 75	485	485	14.1	10.9	440	12.8	9.7	380	11.0	8.0
3	120	VR3-12	R-15B	VPL3-12	PL-15A	36 x 30 x 81	725	485	14.1	10.9	440	12.8	9.7	380	11.0	8.0
5	60	VR5-6	R-15B	VPL5-6	PL-15A	30½ x 24 x 76	445	805	23.5	19.1	734	21.4	17.3	640	18.6	13.6
5	80	VR5-8	R-15B	VPL5-8	PL-15A	32½ x 24 x 75	545	805	23.5	19.1	734	21.4	17.3	640	18.6	13.6
5	120	VR5-12	R-15B	VPL5-12	PL-15A	36 x 30 x 81	765	805	23.5	19.1	734	21.4	17.3	640	18.6	13.6
7½	80	VR7F-8	R-15B	VPL7F-8	PL-15A	32½ x 24 x 75	635	990	28.7	23.9	990	28.7	23.1	870	25.5	18.2
7½	120	VR7F-12	R-15B	VPL7F-12	PL-15A	36 x 30 x 81	765	990	28.7	23.9	990	28.7	23.1	870	25.5	18.2
7½	80	VR7-8	R-30D	VPL7-8	PL-30A	42½ x 30 x 66¾	665	670	39.6	30.0	575	33.5	25.8	520	30.2	21.3
7½	120	VR7-12	R-30D	VPL7-12	PL-30A	43½ x 30 x 81	800	670	39.6	30.0	575	33.5	25.8	520	30.2	21.3
10	80	VR10-8	R-30D	VPL10-8	PL-30A	42½ x 30 x 66¾	860	810	48.5	37.3	740	43.1	34.8	640	37.1	27.5
10	120	VR10-12	R-30D	VPL10-12	PL-30A	43½ x 30 x 81	890	810	48.5	37.3	740	43.1	34.8	640	37.1	27.5
15	120	VR15F-12	R-30D	VPL15F-12	PL-30A	43½ x 30 x 81	890	1045	63.5	50.2	1045	63.5	49.0	900	52.5	42.6

Pressure Lubricated units are capable of 250 PSIG operation; units tested in accordance with CAGI/PNEUROP Acceptance Test Code PN2CPTC2.

The Champion Assembled Unit Warranties

Compressor Pump Warranty

Each new Champion Assembled Unit has a five (5) year warranty on the compressor pump only, against defects in materials or workmanship under normal use and service, from the date of installation or sixty-six (66) months from the date of shipment by Champion or a Champion distributor, whichever may occur first.

The five-year extended warranty covers parts and labor and is prorated over the five years as follows:

Year One — 100% coverage
Year Two — 90% coverage
Year Three — 80% coverage
Year Four — 70% coverage
Year Five — 60% coverage

Head valves are warranted for Year One only. Champion makes no warranty on components and/or accessories furnished to Champion by third parties, such as electric motors, gasoline engines and controls. These are warranted only to the extent of the original manufacturer's warranty to Champion. Electric motors must be equipped with thermal overload protection to have warranty consideration.

The extended five-year warranty will apply to ASME air receivers if they are installed on rubber vibro isolator pads or approved equivalent.

5 Year Electric Motor

Electric motor is warranted for 60 months from start-up or 63 months from shipment. Other manufacturer's motors furnished due to customer request or special requirements carry the motor manufacturer's warranty.

Limited Warranty

Warranty shall not apply to any equipment which has been subjected to misuse, neglect or accident, nor shall it apply to any equipment that has been repaired or altered by any person(s) not authorized by Champion. Failure caused by lack of proper maintenance is not covered by warranty.

In no event shall Champion be liable for consequential damages or contingent liabilities arising out of failure of any compressor or part to operate properly. When a compressor pump or component is changed or replaced during the warranty period, the new/replaced item(s) is warranted for only the remainder of the original warranty period. Complete warranty details are included in compressor operating manual.

Package Warranty

Champion warrants each new air compressor package to be free from defects in material and workmanship under normal use and service for a period of one year (12 months) from the date of installation or 15 months from the date of shipment by Champion.

U.L. Standards

Champion, in common with other major, industrial compressor manufacturers, does not market compressors which are U.L. listed. In general, U.L. is concerned with electrical components that may be utilized on compressor units, rather than a complete compressor package or system. All electrical components used on Champion compressors are U.L. listed. Each component – motor, starter, pressure switch, control panel – carries a U.L. identification mark on the nameplate or inside the electrical enclosure cover. The mark will be the letters "UR" reversed (as if held up to a mirror), indicating the item is "recognized" by U.L. On tankmounted units, the air receiver tank and tank pressure relief valve are ASME Code. The tank carries a National Board Registration number which appears on a stamped, metal plate welded to the tank.

CHAMPION®

1301 North Euclid Avenue
Princeton, Illinois 61356 USA
Phone 888/436-5499
Fax 815/872-0421
E-mail: Champion@championpneumatic.com
www.ChampionPneumatic.com

Please recycle after use.

ENERGY STAR PARTNER

Member

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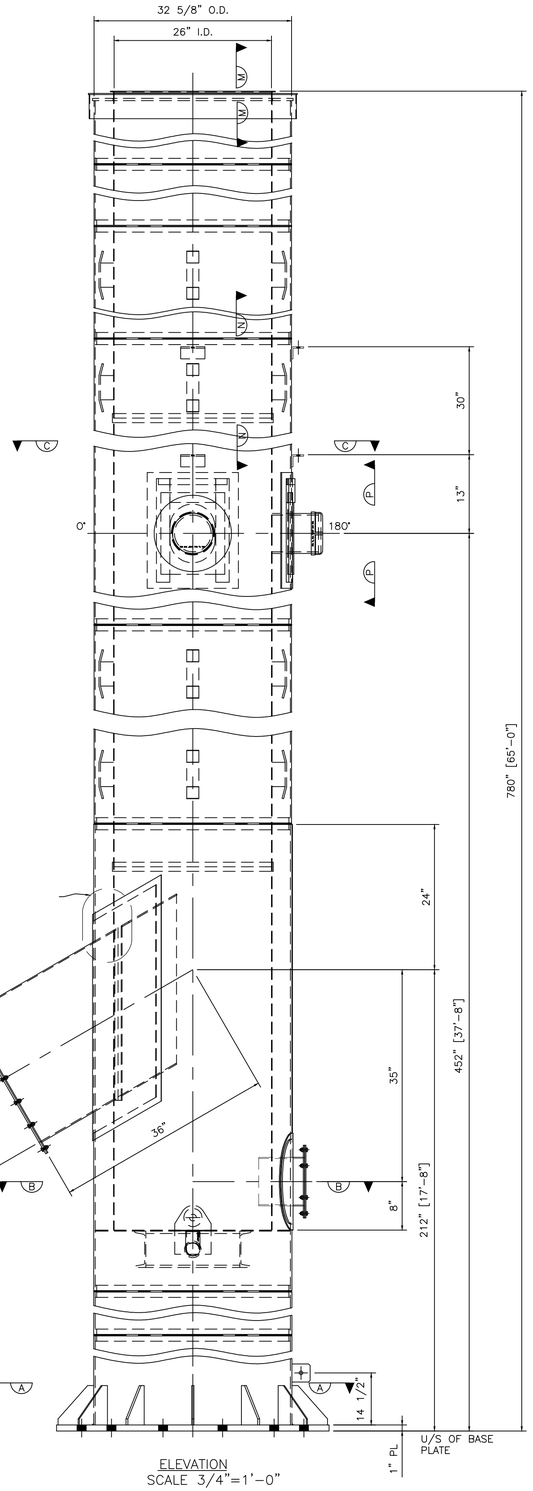
CR-RPL-100 4th Ed. 2/10

Due to Champion's continuing product development program, specifications and materials are subject to change without notice or obligation.



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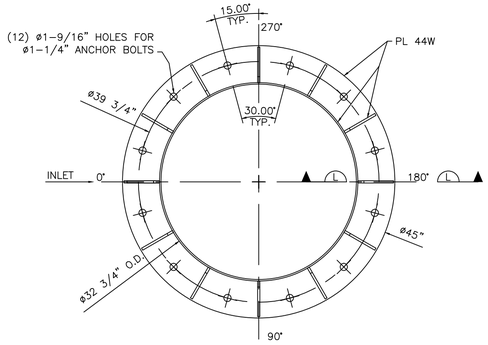

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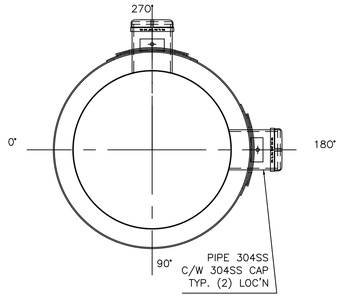

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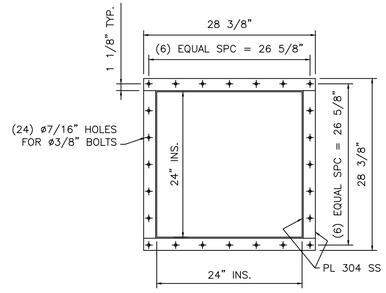

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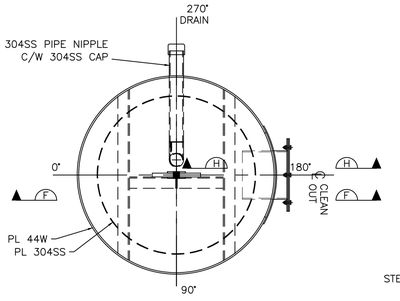

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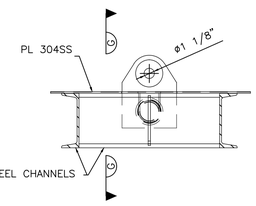

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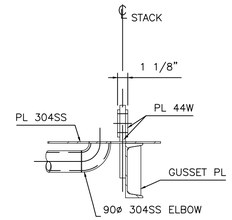

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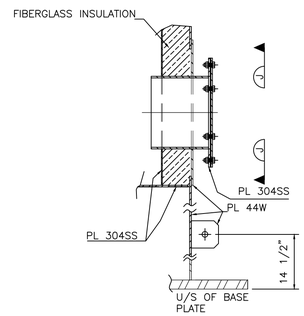

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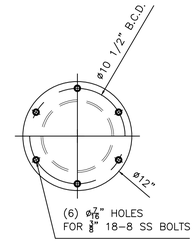

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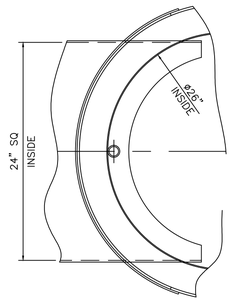

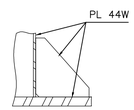

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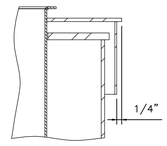

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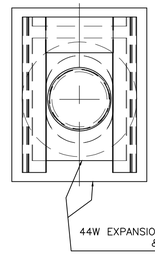

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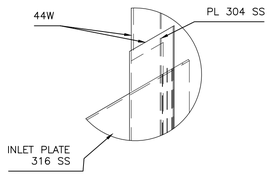

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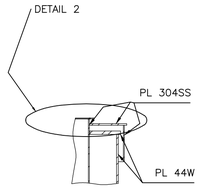

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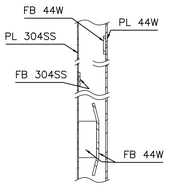

SECTION N
SCALE: 1:8

NOTES 1:
- STACK OUTER SHELL MAT'L IS 44W, INNER SHELL IS STAINLESS STEEL.
- ALL STEEL TO CONFORM WITH CAN/CSA G40.21, GR 44W & 50W.
- ALL WELDING TO BE DONE IN ACCORDANCE WITH CSA STANDARD W59 (LATEST EDITION). (EQUIVALENT TO AWS D1.1 STRUCTURAL STD).
- AT INSTALLATION UNDERSIDE OF BASE PLATE TO BE FULLY GROUTED WITH A MINIMUM OF 1" THICK NON-SHRINK GROUT.
- INLET DUCTING TO HAVE A FLEXIBLE JOINT TO ALLOW FOR LATERAL MOVEMENT.
- STACKS WERE DESIGNED TO IBC 2009 (ASCE 7-05).

NOTES 2:
- WIND REQUIREMENTS:
  - I. BASIC WIND SPEED: 90 mph
  - II. WIND EXPOSURE: B
- SEISMIC REQUIREMENTS
  - I. SEISMIC DESIGN CATEGORY: C
- LOAD (BASED ON A STACK HEIGHT OF 65 FT)
  - I. HORIZONTAL BASE SHEAR = 2,825 Lbs
  - II. VERTICAL REACTION = 8,000 Lbs
  - III. OVERTURNING MOMENT = 91,795 FT-Lbs
- MIN. ANCHOR BOLT YIELD STRENGTH: 44KSI

NOTES 3:
- PAINT SPECIFICATIONS:
  - SURFACE PREP.: SSPC-SP6
  - PRIMER:
    - DEVOE BAR-RUST 235, 4-5mils DFT, COLOUR: GREY
  - TOP COAT:
    - DEVOE DEVTHANE 389, 2-3mils DFT, COLOUR: TO BE DETERMINED

REFERENCE DWG	DESCRIPTION

NO	REVISION	BY	DATE
P	ISSUED FOR SUBMITTAL	M.D	2013.05.13

NORARC
EARLTON, ONTARIO
(TEL)705-563-2656
(FAX)705-563-8020

NORMEX
LA SARRE, QUEBEC
(TEL)819-333-1200
(FAX)819-333-1212

MANUFACTURING TOLERANCES U.O.S.

IMPERIAL	METRIC
FRACTION: ±1/16"	
DECIMALS:	DECIMALS:
1.0 = ±0.020"	1 = ±1.5mm
1.00 = ±0.010"	1.0 = ±0.50mm
1.000 = ±0.005"	1.00 = ±0.25mm
ANGULAR: ±2'	1.000 = ±0.100mm
	ANGULAR: ±2'

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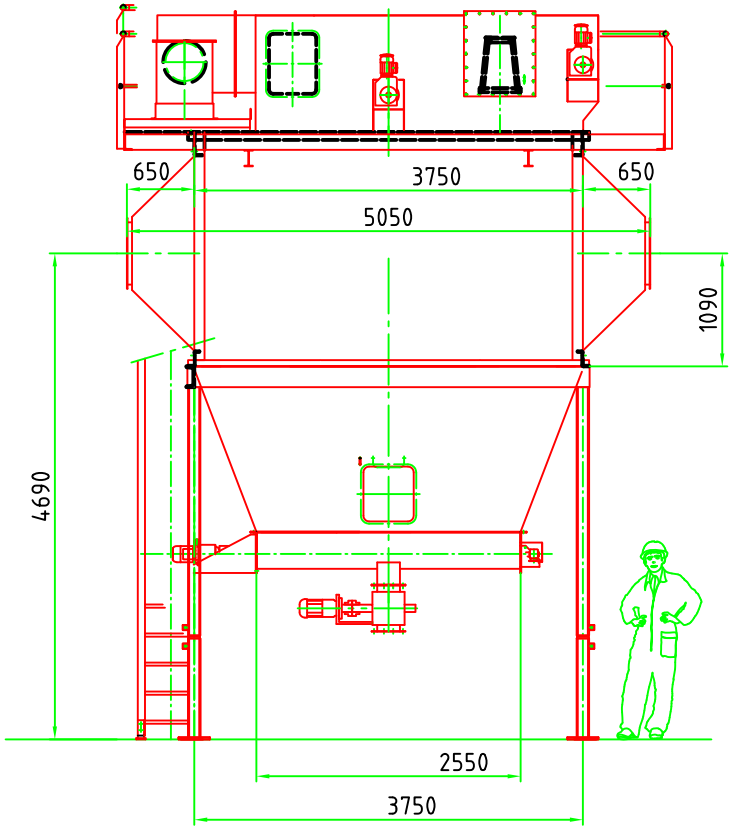
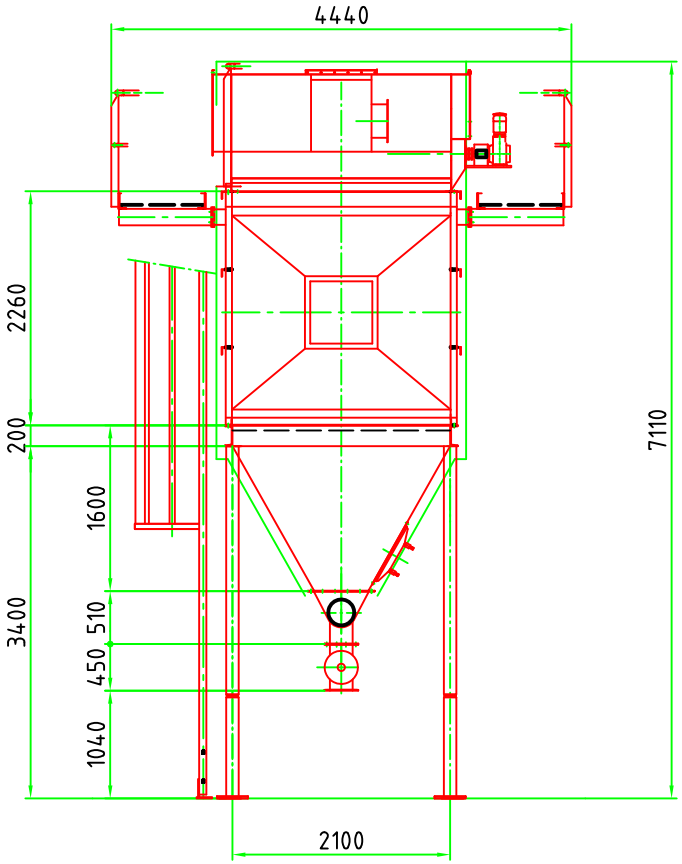
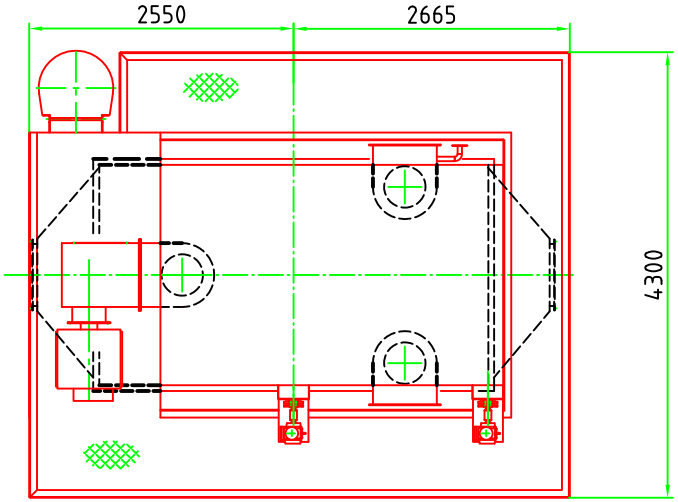
DRAWN BY	M. DALLAIRE
DATE	2013.05.03
SCALE	AS SHOWN
CHECKED	FN
QUOTE	11728
TITLE	26" DIA SELF STANDING STACK 65' LITTLETON, NEW HAMPSHIRE
DWG NO.	FL955
REV	P
PROJECT REF.	LITTLETON REGIONAL HOSPITAL







Gasrichtung
Gasdirection

Änderungen vorbehalten
subject to change

Aend. Index	Datum	Name	Aenderung		Projektionsmethode E
gez.	29.08.2011	Herzog	Massstab: 1:50	Masstoleranzen ohne Angaben nach DIN 7168 grob 0,5 – 400mm mittel 400 – 20000mm	Schutzvermerk nach DIN 34 beachten
gepr.	29.08.2011	Koppetsch			Nur mit CAD bearbeiten
genormt					Gebrauchsstand:
Kunde:					Matchcode:
Auf.-Nr.: / Ang.-Nr.:		ITEM-Nr.:			Stueckliste:
Bezeichnung 1:	Standard-Ausführung ,standard construction				BETH®
Bezeichnung 2:	Klein 5 Typ 250 / 1F 3,5x2-8				Zeichnungs-Nr.: PA / Index:
Bezeichnung 3:					Abm.: / Blatt
					Klass.: / von

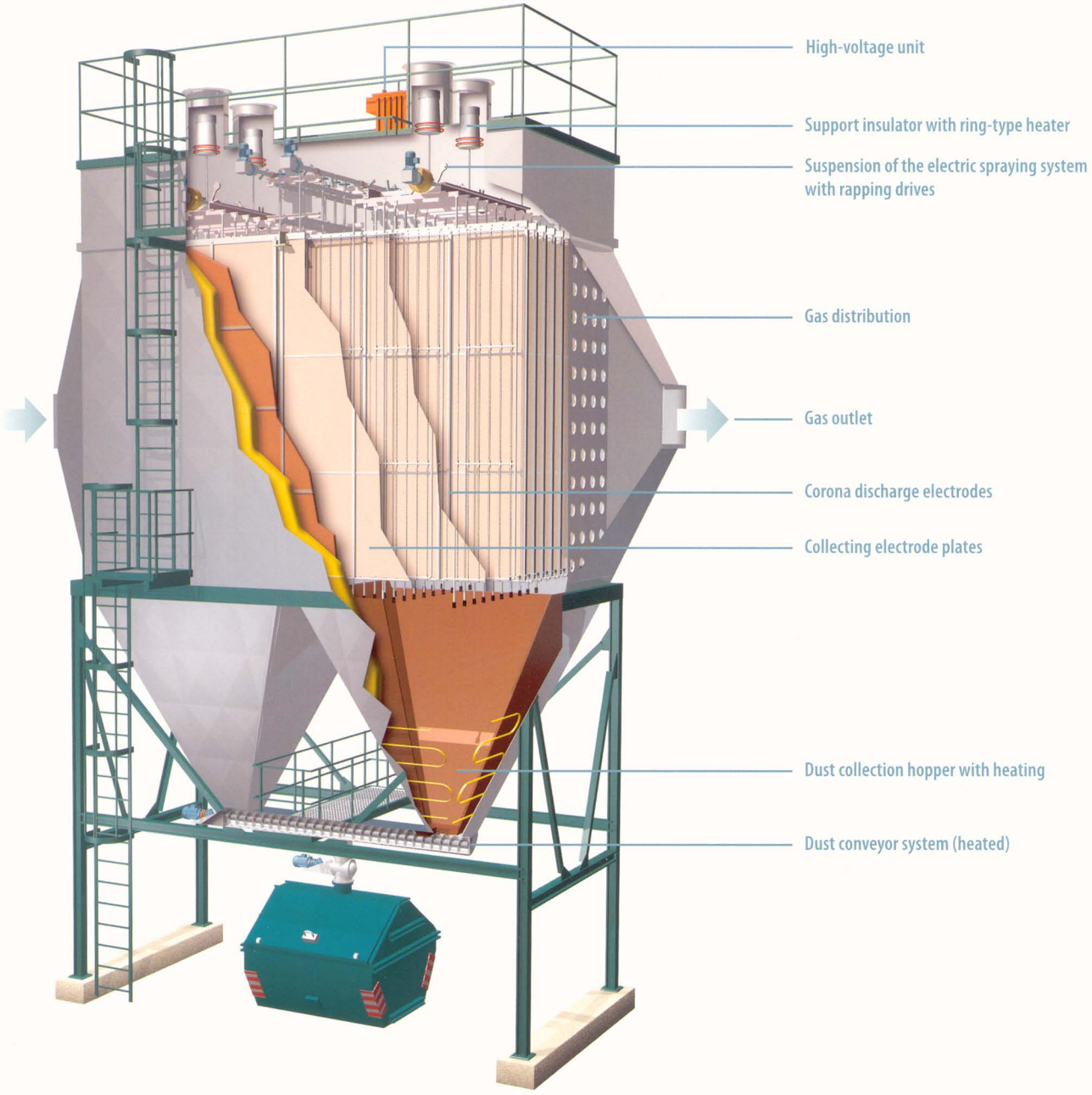
DRY ELECTROSTATIC PRECIPITATOR

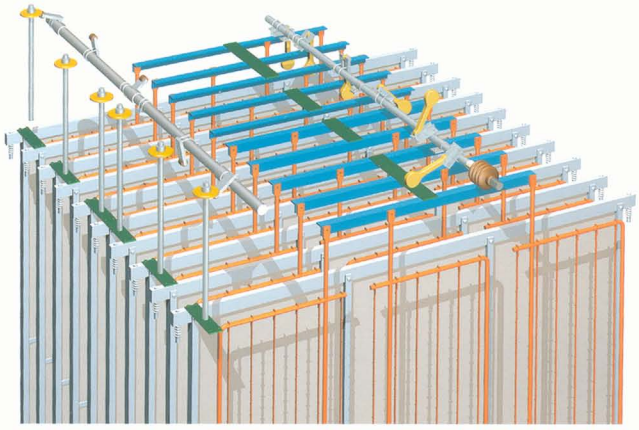
The BETH dry electrostatic precipitator can be used to extract ultra-fine dust particles from process gases up to a temperature of 450° Celsius by means of an artificial electrostatic charge. For this reason, the unit is used in particular for hot gas dust extraction from boiler plants and chemical processes.

Principle of function

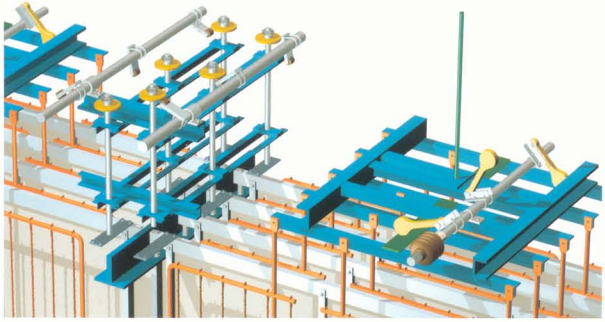
The dust-laden process gas enters the electrostatic precipitator horizontally, and is spread to a uniform flow profile across the entire filter cross-section by means of a gas distribution system.

By means of the high voltage (70 to 110 kV) applied between the corona discharge electrodes and the collecting electrode plates, the process gas and the dust particles are electrically charged.
On the route through the electric field, the charged particles are transported to the collecting electrode plates by the electric field strength, where they agglomerate with the existing dust particles which are then knocked off by a mechanical rapping hammer system.
The rapped off dust particles drop into the filter hopper and are removed through the dust conveyor system. The purified gas leaves the filter through the gas outlet hood.





Electric corona discharge system (gas purification zone)



Collecting and corona discharge electrode rapping system

SHORT DESCRIPTION OF THE TECHNOLOGY

- Perfect gas distribution ensured by gas baffle plates and perforated plates which can be adjusted individually in case of larger gas volumes
- Horizontal passage of the gas through the filter lanes which consist of the mobile suspended collecting electrodes in plate construction with dust collection channels
- Within the lanes, corona discharge electrodes frames with high-performance electrodes made of stainless steel strips arranged in the centre
- Attachment of the corona discharge electrodes by means of screw connections with self-locking nuts
- Cleaning of the corona discharge and collecting electrodes by periodically acting motor-driven rapping systems
- High availability through large lane spacing of 400 mm or 300 mm, respectively
- Electric heating of the insulators, of the filter hopper and of the dust conveying system to prevent any material baking caused by falling short of the dew point
- Dust extraction consisting of dust transport conveyor and rotary valve
- High performance separation properties ensured by current high-voltage control systems
- Filter housing insulation, low-voltage electrical system, installation and commissioning are part of the standard scope of delivery
- Extension of the electrostatic precipitator by other plant components, such as fans, silencers, ductworks and chimneys

ADVANTAGES

- Separation of ultra-fine dust particles to meet the required legal value
- Continuous separation process
- Low pressure loss (approx. 2.5 mbar) at a high degree of separation
- Only one servicing maintenance per year due to few and slowly rotating plant components
- Low energy costs compared to filtering separators
- Volume flows of between 500 and 500,000 m^3/h per filter unit
- Gas temperature up to approx. 450° Celsius
- Individual solutions possible by adaptation of the standard construction to the local conditions
- Maintenance rendered by the BETH Service Team ensures permanent availability of the filtering plant
- Of course, we also supply spare parts for all our filter systems
- **Our 24-hour service is available round the clock, seven days a week, the whole year round**

MINI ELECTROSTATIC PRECIPITATOR

For gas volumes from 900 m³/h to 3,000 m³/h BETH offers mini electrostatic precipitators in two different sizes.

In addition, there are two variants to choose from:

- Variant with ash removal screw conveyor
- Variant with dustbins located directly below the filter hopper

- For small boiler plants up to 1 MW with biomass incineration
- Two different sizes for gas volumes from 900 m³/h to 3,000 m³/h
- Building height from 3.0 m to 4.0 m
- Erection directly below the hall roof possible
- Standard scope of delivery includes electric system, insulation, erection, cables, steel construction and dust conveyor systems

BETH mini electrostatic precipitator
Biomass incineration system,
3,080 m³/h < 40 mg /Nm³ dry at 300° Celsius

No.	Mini electrostatic precipitator filter type	Filtering area [m²]	Weight [kg]	Dimensions (LxWxH) [mm]
MEF 1	300 / 1F - 1,5 x 1 - 4	12	3.300	3.120 x 1.100 x 3.000 - 4.000
MEF 2	300 / 1F - 2,2 x 1 - 4	18	3.700	3.820 x 1.100 x 3.000 - 4.000

SMALL ELECTROSTATIC PRECIPITATOR

For gas volumes from 3,000 m³/h to 9,000 m³/h BETH offers small electrostatic precipitators in five different sizes.

Since the emergence of biomass as a generator of energy promoted by state subsidising programmes, inexpensive and unproblematic methods are required for the dust extraction from small boiler plants of between 500 kW and 2,500 kW, which safely produce the required purified gas dust content of 50 mg/m³ dry.

The small and mini electrostatic precipitators have been developed for these applications in particular. The well-tried technique used in standard electrostatic precipitators could be transferred to these series by any large, thus ensuring that these series have the same characteristics as the mature standard electrostatic precipitators.

The mainly pre-assembled modules permit an inexpensive and fast installation on the building site.

BETH small electrostatic precipitator
Biomass incineration system,
9,600 m³/h < 50 mg /NNm³ dry at 220° Celsius

- For boiler plants of between 1 MW and 2.5 MW
- Five different sizes for gas volumes from 3,000 m³/h to 9,000 m³/h
- Building height from 6.0 m to 7.0 m
- Erection directly below the hall roof possible due to the lateral service access
- Standard scope of delivery includes electric system, insulation, erection, cables, steel construction and dust conveyor systems

No.	Small electrostatic precipitator filter type	Filtering area [m²]	Weight [kg]	Dimensions (LxWxH) [mm]
KEF 1	300 / 1F - 2 x 1,5 - 4	26	5.600	3.500 x 1.300 x 5.600
KEF 2	300 / 1F - 2 x 2 - 4	35	5.900	3.500 x 1.300 x 6.100
KEF 3	300 / 1F - 2 x 2 - 6	53	7.400	3.500 x 1.900 x 6.600
KEF 4	300 / 1F - 3 x 2 - 6	79	9.300	4.500 x 1.900 x 6.600
KEF 5	300 / 1F - 3,5 x 2 - 6	92	10.400	4.950 x 1.900 x 6.600

STANDARD ELECTROSTATIC PRECIPITATOR

For gas volumes from 9,000 m³/h to 200,000 m³/h BETH offers standard electrostatic precipitators in nineteen different sizes.

- On account of the standardised construction, these types of precipitator can be offered at a very reasonable price
- The mainly pre-assembled modules permit an inexpensive and fast installation on the building site
- The robust and simple constructions as well as the mature detail solutions ensure a high availability and long service life

BETH standard electrostatic precipitator
Sewage sludge incineration, 45,000 Bm³/h < 20 mg/Nm³dry at 230° Celsius

No.	Standard electrostatic precipitator filter type	Filtering area [m²]	Weight [kg]	Dimensions (LxWxH) [mm]
SEF 1	300 / 2F - 2 x 2 - 6	106	11.400	6.000 x 1.900 x 8.400
SEF 2	300 / 2F - 2 x 3 - 6	159	13.300	6.300 x 1.900 x 9.400
SEF 3	300 / 2F - 2 x 3 - 8	211	15.500	6.600 x 2.500 x 10.300
SEF 4	300 / 2F - 2,5 x 3 - 8	264	17.700	7.600 x 2.500 x 10.800
SEF 5	300 / 2F - 2,5 x 3 -10	330	22.400	7.600 x 3.200 x 10.700
SEF 6	300 / 2F - 3 x 3 -10	396	24.700	8.800 x 3.200 x 12.000
SEF 7	300 / 2F - 3 x 3,5 -10	462	27.000	9.200 x 3.200 x 12.500
SEF 8	300 / 2F - 3 x 4 -10	528	28.500	9.200 x 3.200 x 13.000
SEF 9	300 / 2F - 3 x 4,5 -10	594	31.300	9.200 x 3.200 x 13.500
SEF 10	300 / 2F - 3 x 5 -10	660	33.600	9.400 x 3.200 x 14.000
SEF 11	300 / 2F - 3 x 5,5 -10	726	34.300	9.600 x 3.200 x 14.500
SEF 12	300 / 2F - 3 x 6 -10	792	36.700	9.800 x 3.200 x 15.300
SEF 13	300 / 2F - 3,5 x 6 -10	924	38.900	10.800 x 3.200 x 15.300
SEF 14	300 / 2F - 3,5 x 6 -11	1.016	40.000	10.800 x 3.500 x 15.300
SEF 15	300 / 2F - 3,5 x 6 -12	1.109	41.300	10.800 x 3.800 x 15.300
SEF 16	300 / 2F - 3,5 x 6 -13	1.201	42.500	10.800 x 4.100 x 16.300
SEF 17	300 / 2F - 3,5 x 6 -14	1.293	43.600	10.800 x 4.400 x 16.300
SEF 18	300 / 2F - 3,5 x 6 -15	1.386	44.700	10.800 x 4.700 x 16.300
SEF 19	300 / 2F - 3,5 x 6 -16	1.488	45.900	10.800 x 5.000 x 16.300

INDUSTRIAL ELECTROSTATIC PRECIPITATOR

For the removal of dust from large volumes of gas up to 500,000 m^3/h per unit, BETH's range of products includes the industrial electrostatic precipitator.

In this size range, the electrostatic precipitators are usually projected especially to the specific process conditions.

For this reason, they are designed individually for each project and are adapted to the customer's requirements.

BETH industrial electrostatic precipitator
Biomass boiler system, 435,000 Bm^3/h < 20 mg /Nm^3 dry at 400° Celsius

REFERENCES

Extract from the "electrostatic precipitator" reference list of DIVISION BETH

Almatis (Alcoa), Netherlands	Kohlbach, Austria
Müller, Switzerland	Seeger Eng., Germany
Mawera, Austria	Weiss, Denmark/Germany
Lambion, Germany (for Ireland)	Isover, Germany
Hüttenwerke Krupp Mannesmann, Germany	Outokumpu, Finland
CTU, Switzerland (for Iran)	Wärtsila, Finland
Compte, France	Bravida, Sweden
Schmid, Switzerland	Vyncke, Belgium (for Canada, France, Benelux)
Urbas, Austria	EIE, Spain
Otto Fuchs Metallwerke, Germany/Hungary	Nova Hut, Czech Republic

Many customers trust the experience of over hundred years of DIVISION BETH, the co-operation with the competent staff members and the world-wide service: BETH stands for customer satisfaction – in engineering, project execution, installation, commissioning and after sales services.

TWELVE-MONTH LIMITED WARRANTY

MESSERSMITH MANUFACTURING, INC. (the Company), warrants to the original purchaser of this product that should this product or any part thereof be proven defective in material or workmanship within twelve months from the date of acceptance, such defects will be repaired or replaced (at the Company's option) without charge for parts or labor.

This warranty does not apply to any product or part thereof which has been damaged through alteration, mishandling, misuse, improper wiring, overheating, neglect, or accident. You are responsible for keeping maintenance records since it may be necessary in some instances for you to show that the required maintenance has been performed.

THIS WARRANTY DOES NOT COVER ANY EXPENSES INCURRED IN THE REMOVAL AND RE-INSTALLATION OF THIS PRODUCT. INCIDENTAL OR CONSEQUENTIAL DAMAGES SUCH AS TELEPHONE CALLS, LOSS OF TIME, INCONVENIENCE OR COMMERCIAL LOSS ARE ALSO NOT COVERED.

This warranty is in lieu of all other warranties, expressed or implied, and no person or representative is authorized to assume for the Company any other liability in connection with the sale of this product.

Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damage, so the above limitations or exclusions may not apply to you.

This warranty gives you specific rights, and you may have other rights, which vary from state to state.

SERVICE

Messersmith offers service through its local representative, Carl Bielenberg. He may be reached at (802) 456-8993. Back up service is provided through the company headquarters at Bark River, Michigan. Gailyn Messersmith can be reached at 906-466-9010 or on his cell phone at 906-630-4120.

MAINTENANCE

It is recommended that ashes be cleaned from the grates on a daily basis. (This depends on the ash content of the material being burned. Fuel containing a large percentage of bark may require cleaning more often.) The ashes must be removed from the boiler periodically and from the container at the base of the collection tube of the cyclone. Maintenance also includes oiling chains, greasing bearings, and checking adjustments of the entire system.

Attachment 3-3

Calibration Remarks

"Please summarize the manufacturer's recommended methods and frequency for metering system calibration and provide reference for source document (e.g. owners/operators manual):"

Electromagnetic Flow Meter:

Manufacturer does not recommend altering factory calibration settings. The unit is self-calibrating. This is fully addressed in the "Instruction Manual" which is apparently not available online. Please find Chapter 9 of the "Instruction Manual" below.

Pressure Transmitter:

The Ashcroft A2XB cannot be calibrated. The manufacturer recommends that the sensor be checked once per year against a known pressure. If there is measureable drift, then the sensor needs to be sent back to the factory and/or replaced.

9. CMag-Prover-Calibration

9.1 Calibration Items

When you check or calibrate the converter or check the excitation current, you have to change the mode to the calibration mode.

You can check or change the zero and span of the converter and the excitation current value as described below.

> However, calibration is already performed when shipped from the factory. Do not perform change calibration unless it is specificity required.

Items	Function items	Display example
9.2.1	0 % flow rate calibration	CAL 0%
9.2.2	50 % flow rate calibration	CAL 50%
9.2.3	100 % flow rate calibration	CAL 100%
9.2.4	Checking the excitation current output	EXC DSPL

9.2 Calibration Using CMag-Prover's Built-In Signal Source

9.2.1 0 % Flow Rate Calibration (Zero Calibration)

Using CMag-Prover's internal calibration circuit, 0% flow rate calibration (hereafter called zero calibration) can be performed.

●Zero point check / calibration

Switch operation	Display example	Description
	R:CAL 1 CAL 0% 2 CAL 50% 3 CAL 100% 4 EXC DSPL 5 EXIT ▼ ESC ↵	Select "CAL 0" from the setting item selection menu.
STEP1 ↵	CAL 0% 0.1 % ESC ↵	When the calibration screen is selected, the internal simulation circuit starts working and 0% value using the internal simulation signal appears. Then push and hold ↵ longer. * Pushing ESC returns you to the setting menu.
STEP2 ↵ Longer	ADJ READY 0.1 % OK NO	The title of the screen changes to "ADJ READY" and the converter is is ready for calibration. Pushing NO returns you to the previous screen.
STEP3 OK	NOW 0% ADJUSTING	Push OK to start calibration for 0% flow rate.
STEP4 (=END)	CAL 0% 0.0 % ESC ↵	It takes several seconds to perform calibration for 0% flow rate and the simulated value of 0% after calibration appears. Pushing ESC returns you to the setting menu.

Note 1: To perform calibration, push and hold ↵ longer.

Note 2: To cancel the adjustment when ADJ READY is displayed, push NO .
The screen returns to the zero display using the simulation input.

9.2.2 50 % Flow Rate Calibration

Using CMag-Prover's internal calibration circuit, 50% flow rate calibration can be performed. For calibration procedure, see the calibration procedure for 0% flow rate. (For 50% flow rate calibration, select "CAL 50" from the setting menu.)

9.2.3 100 % Flow Rate Calibration (Span Calibration)

Using CMag-Prover's internal calibration circuit, 100% flow rate calibration can be performed. For calibration procedure, see the calibration procedure for 0% flow rate. (For 100% flow rate calibration, select "CAL 100%" from the setting menu.)

9.2.4 Checking the Excitation Current

You can monitor the exciting current value.

•Checking the exciting current value

Switch operation	Display example	Description
	R:CAL 1 CAL 0% 2 CAL 50% 3 CAL 100% 4 EXC DSPL 5 EXIT ▼ ESC ↵	Select "EX DSPL" in the setting item selection screen.
STEP1 ↵	EXC DSPL 0.1998 A ESC	The excitation current value appears. Pushing ESC returns you to the setting menu.

YEATON ASSOCIATES, INC.

Attachment

Sample (June) Boiler Checklist

66 Jackson Street | Littleton, NH 03561 | Ph: 603.444.6578 | Fax: 603.444.2364
www.yeatonassociates.com

BIO-MASS DAILY CHECK LIST

ITEM	MONTH JUNE				YEAR 2014																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Boiler #1 / PSI	OFF				OFF								OFF	@FF	OFF																
Boiler Flu Gas Temp																															
Fire Mode																															
Fuel Rate																															
Rake grates Yes/No																															
Pounds of Feedwater																															
Fuel Tons/Day																															
LWCO Test																															
Boiler #2 / PSI	82	83	83	84	84	85	84	85	83	84	80	83	84	82	84	83	84	83	83	80	85	84	85	86	83	83	85	83	85	85	
Boiler Flu Gas Temp	481	459	462	458	488	489	492	489	464	486	404	487	508	496	477	494	475	481	473	485	462	473	507	478	473	501	516	488	508	485	
Fire Mode	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	MED	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	
Fuel Rate	32	33	33	32	33	32	36	31	34	34	23	36	39	43	35	41	31	36	36	45	27	31	35	29	35	41	39	35	39	37	
Rake Grates Yes/No	Y	Y	Y	Y		Y	Y	Y	Y	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	X	Y	Y	Y	Y	Y	
Pounds of Feedwater	135144	138814	21250	424453	59639	78470	96260	125788	154790	181890	245760	284417	327730	355613	432947	478477	521135	548821	614062	662173	713627	767021	819810	869073	921603	972617	1014659	1065738	1114606	1163346	
Fuel Tons/Day	7.00	6.67	6.53	6.46	6.37	6.46	6.61	6.53	6.63	6.58	6.65	6.45	7.06	6.67	6.89	7.04	6.72	6.37	6.36	6.92	7.09	6.98	7.00	6.93	6.98	6.45	6.36	6.71	7.12	7.175	
LWCO Test	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	✓	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Empty overs bucket/sweep Y/N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Clean Undergrate Bi-Weekly				✓														✓													
Air/Water Fire System PSI	16/171	15/173	15/172	14/171	15/174	15/175	18/174	17/173	18/175	17/174	13/185	11/180	16/180	16/180	15/180	18/178	17/175	19/180	12/170	12/170	16/175	16/175	15/176	16/170	15/180	15/178	18/175	18/175	17/175	18/178	
NAME:	WC	DB	DB	DB	WC	RS	DB	DB	DB	DB	MR	WC	GT	Les	Les	DB	DB	WC	DB	DB	RS	RS	DB	DB	DB	WC	RS	WC	WC	RS	

YEATON ASSOCIATES, INC.

Attachment

Calculation Spreadsheet

66 Jackson Street | Littleton, NH 03561 | Ph: 603.444.6578 | Fax: 603.444.2364
www.yeatonassociates.com

Chip Deliveries: January - May				
Date	**Net Weight (lbs)**	**Period Total (lbs)**	**MWh Based Upon Feedwater Data (March - May)**	**MWH using Ave MWh per lb (Line 53) (Jan 15 - Feb)**
1/10/2014	72,860			
1/13/2014	70,700			
1/14/2014	73,020			
1/16/2014	74,040			
1/17/2014	70,080			
1/20/2014	74,580			
1/23/2014	72,580			
1/24/2014	77,180			
1/27/2014	76,460			
1/29/2014	70,300	588,240		505
1/31/2014	77,920			
2/4/2014	63,560			
2/4/2014	71,700			
2/6/2014	65,740			
2/11/2014	62,540			
2/11/2014	72,280			
2/13/2014	66,900			
2/14/2014	75,760			
2/18/2014	71,920			
2/20/2014	74,060			
2/21/2014	64,580			
2/25/2014	70,140	837,100		719
2/28/2014	68,900			
3/3/2014	70,860			
3/6/2014	66,480			
3/7/2014	71,800			
3/1/2014	72,280			
3/14/2014	77,620			
3/18/2014	69,240			
3/20/2014	70,960			
3/25/2014	69,640			
3/27/2014	69,600			
3/28/2014	72,820	780,200	614	
4/3/2014	68,940			
4/4/2014	68,220			
4/9/2014	68,800			
4/14/2014	61,620			
4/15/2014	63,400			
4/18/2014	64,660			
4/21/2014	60,160			
4/22/2014	59,240			
4/29/2014	56,980	572,020	569	
5/2/2014	62,080			
5/6/2014	67,980			
5/6/2014	68,520			
5/12/2014	63,900			
5/14/2014	65,420			
5/22/2014	66,360			
5/22/2014	64,160			
5/27/2014	70,240			
5/28/2014	65,220	593,880	489	
Average MWh per pound (March - May)			0.0008589	

March: Boiler 1						
Month:	**March**					
Boiler:	**#1**					
Day	Cumulative Total Feedwater (lbs)	Daily Net Feedwater (lbs)	Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)	Feedwater Specific Enthalpy @ 240˚F (Btu/lb)	Daily Useful Thermal Energy (minus 2%) (Btu)
Feb 31	174,458.0					
March 1	273,552.0	99,094.0	86.0	1,188.4	208.6	95,147,541.8
2	357,991.0	71,961.0	83.0	1,187.8	208.6	69,052,811.3
3	434,750.0	76,759.0	81.0	1,187.4	208.6	73,626,818.3
4	98,750.0	98,750.0	85.0	1,188.2	208.6	94,797,886.8
5	192,609.0	93,859.0	81.0	1,187.4	208.6	90,029,046.0
6	280,651.0	88,042.0	81.0	1,187.4	208.6	84,449,411.0
7	280,651.0	0.0	off			0.0
8	280,651.0	0.0	off			0.0
9	280,651.0	0.0	off			0.0
10	280,651.0	0.0	off			0.0
11	280,651.0	0.0	off			0.0
12	280,651.0	0.0	off			0.0
13	280,651.0	0.0	off			0.0
14	36,269.0	36,269.0	82.0	1,187.6	208.6	34,796,137.7
15	60,826.0	24,557.0	86.0	1,188.4	208.6	23,579,007.7
16	77,169.0	16,343.0	84.0	1,188.0	208.6	15,685,727.0
17	77,169.0	0.0	off			0.0
18	95,481.0	18,312.0	71.0	1,185.4	208.6	17,528,880.0
19	200,627.0	105,146.0	84.0	1,188.0	208.6	100,917,301.3
20	280,998.0	80,371.0	74.0	1,186.1	208.6	76,989,036.5
21	345,374.0	64,376.0	80.0	1,187.1	208.6	61,730,185.0
22	423,472.0	78,098.0	84.0	1,188.0	208.6	74,957,101.5
23	505,534.0	82,062.0	80.0	1,187.1	208.6	78,689,301.0
24	571,518.0	65,984.0	85.0	1,188.2	208.6	63,343,227.9
25	652,780.0	81,262.0	78.0	1,186.9	208.6	77,906,253.2
26	740,148.0	87,368.0	85.0	1,188.2	208.6	83,871,410.3
27	827,101.0	86,953.0	82.0	1,187.6	208.6	83,421,890.8
28	827,101.0	0.0	off			0.0
29	827,101.0	0.0	off			0.0
30	827,101.0	0.0	off			0.0
31	827,101.0	0.0	off			0.0
Monthly Total (Btu)						**1,300,518,975.1**
Monthly Total (MWh)						**381.2**

March: Boiler 2						
Month:	**March**					
Boiler:	**#2**					
Day	Cumulative Total Feedwater	Daily Net Feedwater (lbs)	Supply Steam Pressure	Supply Steam Specific Enthalpy	Feedwater Specific Enthalpy @ 240˚F	Daily Useful Thermal Energy (minus 2%)
Feb 31	0.0					
March 1	0.0	0.0	off			0.0
2	0.0	0.0	off			0.0
3	0.0	0.0	off			0.0
4	0.0	0.0	off			0.0
5	0.0	0.0	off			0.0
6	0.0	0.0	off			0.0
7	78,189.0	78,189.0	85.0	1,188.2	208.6	75,059,766.8
8	164,233.0	86,044.0	83.0	1,187.8	208.6	82,566,669.4
9	232,646.0	68,413.0	83.0	1,187.8	208.6	65,648,198.1
10	308,800.0	76,154.0	82.0	1,187.6	208.6	73,061,431.8
11	342,697.5	33,897.5	71.0	1,185.4	208.6	32,447,859.9
12	376,595.0	33,897.5	84.0	1,188.0	208.6	32,534,230.7
13	413,384.0	36,789.0	80.0	1,187.1	208.6	35,276,994.2
14	422,850.0	9,466.0	82.0	1,187.6	208.6	9,081,591.4
15	436,850.0	14,000.0	86.0	1,188.4	208.6	13,442,444.4
16	446,084.0	9,234.0	84.0	1,188.0	208.6	8,862,632.5
17	47,750.0	47,750.0	85.0	1,188.2	208.6	45,838,978.2
18	47,750.0	0.0	off			0.0
19	47,750.0	0.0	off			0.0
20	47,750.0	0.0	off			0.0
21	47,750.0	0.0	off			0.0
22	47,750.0	0.0	off			0.0
23	47,750.0	0.0	off			0.0
24	47,750.0	0.0	off			0.0
25	47,750.0	0.0	off			0.0
26	47,750.0	0.0	off			0.0
27	47,750.0	0.0	off			0.0
28	69,725.0	21,975.0	85.0	1,188.2	208.6	21,095,529.7
29	126,373.0	56,648.0	80.0	1,187.1	208.6	54,319,801.2
30	194,263.0	124,538.0	55.0	1,181.5	208.6	118,736,098.4
31	256,712.0	130,339.0	80.0	1,187.1	208.6	124,982,145.3
Monthly Total (Btu)						**792,954,371.8**
Monthly Total (MWh)						**232.4**

April: Boiler 1

Month:	**April**					
Boiler:	**#1**					
Day	Cumulative Total Feedwater (lbs)	Daily Net Feedwater (lbs)	Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)	Feedwater Specific Enthalpy @ 240˚F (Btu/lb)	Daily Useful Thermal Energy (minus 2%) (Btu)
1	Boiler Off					
2	Boiler Off					
3	Boiler Off					
4	Boiler Off					
5	Boiler Off					
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30	Boiler Off					
31	Boiler Off					

April: Boiler 2						
Month:	**April**					
Boiler:	**#2**					
Day	Cumulative Total Feedwater (lbs)	Daily Net Feedwater (lbs)	Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)	Feedwater Specific Enthalpy @ 240˚F (Btu/lb)	Daily Useful Thermal Energy (minus 2%) (Btu)
March 31	256,712.0					
April 1	341,141.0	84,429.0	87.0	1,188.6	208.6	81,083,129.4
2	71,961.0	71,961.0	80.0	1,187.1	208.6	69,003,446.1
3	137,200.0	65,239.0	83.0	1,187.8	208.6	62,602,470.2
4	223,483.0	86,283.0	86.0	1,188.4	208.6	82,846,745.0
5	270,564.0	47,081.0	83.0	1,187.8	208.6	45,178,296.7
6	333,591.0	63,027.0	81.0	1,187.4	208.6	60,455,158.1
7	405,113.0	71,522.0	86.0	1,188.4	208.6	68,673,607.7
8	471,068.0	65,955.0	82.0	1,187.6	208.6	63,276,607.0
9	527,344.0	56,276.0	82.0	1,187.6	208.6	53,990,665.4
10	597,914.0	70,570.0	84.0	1,188.0	208.6	67,731,858.1
11	670,634.0	72,720.0	84.0	1,188.0	208.6	69,795,390.7
12	741,440.0	70,806.0	84.0	1,188.0	208.6	67,958,366.8
13	805,960.0	64,520.0	86.0	1,188.4	208.6	61,950,465.2
14	860,416.0	54,456.0	85.0	1,188.2	208.6	52,276,594.6
15	913,463.0	53,047.0	86.0	1,188.4	208.6	50,934,382.0
16	975,140.0	61,677.0	84.0	1,188.0	208.6	59,196,511.4
17	1,053,526.0	78,386.0	83.0	1,187.8	208.6	75,218,155.2
18	1,132,423.0	78,897.0	81.0	1,187.4	208.6	75,677,576.4
19	1,206,985.0	74,562.0	84.0	1,188.0	208.6	71,563,310.2
20	1,277,127.0	70,142.0	83.0	1,187.8	208.6	67,307,323.3
21	1,369,489.0	92,362.0	71.0	1,185.4	208.6	88,412,102.1
22	1,430,169.0	60,680.0	79.0	1,187.1	208.6	58,183,115.1
23	1,487,843.0	57,674.0	71.0	1,185.4	208.6	55,207,548.3
24	1,532,851.0	45,008.0	85.0	1,188.2	208.6	43,206,716.8
25	1,607,201.0	74,350.0	84.0	1,188.0	208.6	71,359,836.3
26	1,684,563.0	77,362.0	84.0	1,188.0	208.6	74,250,701.5
27	1,740,945.0	56,382.0	84.0	1,188.0	208.6	54,114,462.6
28	1,817,892.0	76,947.0	80.0	1,187.1	208.6	73,784,524.5
29	1,866,579.0	48,687.0	85.0	1,188.2	208.6	46,738,478.1
30	1,939,128.0	72,549.0	83.0	1,187.8	208.6	69,617,048.2
Monthly Total (Btu)						**1,941,594,593.0**
Monthly Total (MWh)						**569.0**

May: Boiler 1						
Month:	**May**					
Boiler:	**#1**					
Day	Cumulative Total Feedwater (lbs)	Daily Net Feedwater (lbs)	Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)	Feedwater Specific Enthalpy @ 240˚F (Btu/lb)	Daily Useful Thermal Energy (minus 2%) (Btu)
1	Boiler Off					
2	Boiler Off					
3	Boiler Off					
4	Boiler Off					
5	Boiler Off					
6	Boiler Off					
7	Boiler Off					
8	Boiler Off					
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29	Boiler Off					
30	Boiler Off					
31	Boiler Off					

May: Boiler 2						
Month:	**May**					
Boiler:	**#2**					
Day	Cumulative Total Feedwater (lbs)	Daily Net Feedwater (lbs)	Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)	Feedwater Specific Enthalpy @ 240˚F (Btu/lb)	Daily Useful Thermal Energy (minus 2%) (Btu)
April 30	1,939,128.0					
1	2,006,084.0	66,956.0	84.0	1,188.0	208.6	64,263,203.8
2	2,054,865.0	48,781.0	84.0	1,188.0	208.6	46,819,155.0
3	2,115,841.0	60,976.0	84.0	1,188.0	208.6	58,523,703.8
4	2,174,371.0	58,530.0	84.0	1,188.0	208.6	56,176,075.6
5	2,232,912.0	58,541.0	84.0	1,188.0	208.6	56,186,633.2
6	2,306,229.0	73,317.0	84.0	1,188.0	208.6	70,368,380.9
7	2,376,786.0	70,557.0	84.0	1,188.0	208.6	67,719,380.9
8	72,812.0	72,812.0	84.0	1,188.0	208.6	69,883,690.7
9	146,744.0	73,932.0	89.0	1,188.9	208.6	71,023,855.2
10	204,360.0	57,616.0	85.0	1,188.2	208.6	55,310,127.0
11	256,244.0	51,884.0	83.0	1,187.8	208.6	49,787,191.2
12	311,482.0	55,238.0	82.0	1,187.6	208.6	52,994,818.0
13	369,763.0	58,281.0	84.0	1,188.0	208.6	55,937,089.7
14	427,919.0	58,156.0	85.0	1,188.2	208.6	55,828,515.5
15	481,340.0	53,421.0	87.0	1,188.6	208.6	51,303,957.8
16	530,939.0	49,599.0	84.0	1,188.0	208.6	47,604,257.2
17	579,973.0	49,034.0	85.0	1,188.2	208.6	47,071,590.7
18	633,999.0	54,026.0	84.0	1,188.0	208.6	51,853,214.7
19	682,900.0	48,901.0	85.0	1,188.2	208.6	46,943,913.5
20	739,485.0	56,585.0	83.0	1,187.8	208.6	54,298,207.8
21	790,770.0	51,285.0	85.0	1,188.2	208.6	49,232,502.5
22	839,800.0	49,030.0	82.0	1,187.6	208.6	47,038,921.1
23	882,719.0	42,919.0	83.0	1,187.8	208.6	41,184,497.3
24	935,995.0	53,276.0	84.0	1,188.0	208.6	51,133,377.8
25	988,439.0	52,444.0	81.0	1,187.4	208.6	50,304,001.6
26	1,038,449.0	50,010.0	84.0	1,188.0	208.6	47,998,727.8
27	1,089,817.0	51,368.0	83.0	1,187.8	208.6	49,292,044.5
28	1,140,424.0	50,607.0	83.0	1,187.8	208.6	48,561,799.1
29	1,210,350.0	69,926.0	77.0	1,186.7	208.6	67,024,672.4
30	1,251,172.0	40,822.0	82.0	1,187.6	208.6	39,164,243.1
31	1,300,101.0	48,929.0	84.0	1,188.0	208.6	46,961,202.8
Monthly Total (Btu)						**1,667,792,952.0**
Monthly Total (MWh)						**488.8**

June: Boiler 1						
Month:	**June 2014**					
Boiler:	**#1**					
Day	Cumulative Total Feedwater (lbs)	Daily Net Feedwater (lbs)	Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)	Feedwater Specific Enthalpy @ 240˚F (Btu/lb)	Daily Useful Thermal Energy (minus 2%) (Btu)
1	Boiler Off					
2	Boiler Off					
3	Boiler Off					
4	Boiler Off					
5	Boiler Off					
6	Boiler Off					
7	Boiler Off					
8	Boiler Off					
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29	Boiler Off					
30	Boiler Off					

June: Boiler 2

Month:	June 2014					
Boiler:	#2					
Day	Cumulative Total Feedwater (lbs)	Daily Net Feedwater (lbs)	Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)	Feedwater Specific Enthalpy @ 240˚F (Btu/lb)	Daily Useful Thermal Energy (minus 2%) (Btu)
May 30	1,300,101.0					
1	1,351,614.0	51,513.0	82.0	1,187.6	208.6	49,421,088.0
2	1,388,146.0	36,532.0	83.0	1,187.8	208.6	35,055,617.7
3	21,250.0	21,250.0	83.0	1,187.8	208.6	20,391,215.3
4	42,433.0	21,183.0	84.0	1,188.0	208.6	20,331,074.8
5	59,639.0	17,206.0	84.0	1,188.0	208.6	16,514,019.4
6	76,170.0	16,531.0	85.0	1,188.2	208.6	15,869,406.2
7	96,260.0	20,090.0	84.0	1,188.0	208.6	19,282,032.4
8	125,788.0	72,812.0	85.0	1,188.2	208.6	69,897,961.8
9	154,730.0	28,942.0	83.0	1,187.8	208.6	27,772,355.4
10	181,890.0	27,160.0	84.0	1,188.0	208.6	26,067,695.4
11	245,760.0	63,870.0	80.0	1,187.1	208.6	61,244,981.3
12	284,417.0	38,657.0	83.0	1,187.8	208.6	37,094,739.2
13	327,730.0	43,313.0	84.0	1,188.0	208.6	41,571,063.8
14	385,675.0	57,945.0	82.0	1,187.6	208.6	55,591,888.3
15	432,947.0	47,272.0	84.0	1,188.0	208.6	45,370,843.1
16	478,477.0	45,530.0	83.0	1,187.8	208.6	43,689,977.9
17	522,135.0	43,658.0	84.0	1,188.0	208.6	41,902,188.8
18	564,821.0	42,686.0	83.0	1,187.8	208.6	40,960,913.6
19	614,062.0	49,241.0	83.0	1,187.8	208.6	47,251,003.8
20	662,173.0	48,111.0	80.0	1,187.1	208.6	46,133,666.8
21	713,627.0	51,454.0	85.0	1,188.2	208.6	49,394,738.9
22	767,081.0	53,454.0	84.0	1,188.0	208.6	51,304,219.1
23	819,810.0	52,729.0	85.0	1,188.2	208.6	50,618,711.6
24	869,073.0	49,263.0	86.0	1,188.4	208.6	47,301,081.3
25	921,603.0	52,530.0	83.0	1,187.8	208.6	50,407,084.1
26	972,617.0	51,014.0	83.0	1,187.8	208.6	48,952,350.8
27	1,016,359.0	43,742.0	85.0	1,188.2	208.6	41,991,383.9
28	1,065,738.0	49,379.0	83.0	1,187.8	208.6	47,383,426.7
29	1,114,606.0	48,868.0	85.0	1,188.2	208.6	46,912,234.2
30	1,163,340.0	48,734.0	85.0	1,188.2	208.6	46,783,597.1
Monthly Total (Btu)						**1,242,462,560.6**
Monthly Total (MWh)						**364.1**

July: Boiler 1

Month:	July 2014					
Boiler:	#1					
Day	Cumulative Total Feedwater (lbs)	Daily Net Feedwater (lbs)	Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)	Feedwater Specific Enthalpy @ 240˚F (Btu/lb)	Daily Useful Thermal Energy (minus 2%) (Btu)
1	Boiler Off					
2	Boiler Off					
3	Boiler Off					
4	Boiler Off					
5	Boiler Off					
6	Boiler Off					
7	Boiler Off					
8	Boiler Off					
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31	Boiler Off					

July: Boiler 2

Month:	July 2014					
Boiler:	#2					
Day	Cumulative Total Feedwater (lbs)	Daily Net Feedwater (lbs)	Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)	Feedwater Specific Enthalpy @ 240˚F (Btu/lb)	Daily Useful Thermal Energy (minus 2%) (Btu)
June 30	1,163,340.0					
1	1,207,792.0	44,452.0	85.0	1,188.2	208.6	42,672,968.7
2	44,894.0	44,894.0	84.0	1,188.0	208.6	43,088,480.0
3	91,538.0	46,644.0	78.0	1,186.9	209.6	44,672,106.2
4	140,873.0	49,335.0	81.0	1,187.4	210.6	47,225,169.0
5	198,099.0	57,226.0	85.0	1,188.2	211.6	54,767,490.9
6	243,821.0	45,722.0	86.0	1,188.4	212.6	43,721,872.8
7	293,078.0	49,257.0	85.0	1,188.2	213.6	47,044,306.6
8	46,475.0	46,475.0	84.0	1,188.0	214.6	44,332,623.3
9	97,174.0	50,699.0	83.0	1,187.8	215.6	48,302,285.9
10	142,807.0	45,633.0	83.0	1,187.8	216.6	43,431,052.6
11	199,835.0	57,028.0	84.0	1,188.0	217.6	54,231,495.2
12	247,865.0	48,030.0	85.0	1,188.2	218.6	45,637,078.2
13	295,653.0	47,788.0	83.0	1,187.8	219.6	45,341,569.8
14	348,867.0	53,214.0	84.0	1,188.0	220.6	50,448,074.6
15	392,418.0	43,551.0	85.0	1,188.2	221.6	41,253,188.3
16	423,346.0	30,928.0	81.0	1,187.4	222.6	29,241,638.4
17	473,083.0	49,737.0	85.0	1,188.2	223.6	47,015,321.7
18	515,764.0	42,681.0	86.0	1,188.4	224.6	40,311,974.0
19	566,014.0	50,250.0	84.0	1,188.0	225.6	47,391,910.7
20	607,358.0	41,344.0	81.0	1,187.4	226.6	38,927,633.4
21	654,880.0	47,522.0	84.0	1,188.0	227.6	44,725,929.1
22	698,125.0	43,245.0	81.0	1,187.4	228.6	40,632,768.5
23	744,900.0	46,775.0	83.0	1,187.8	229.6	43,922,033.7
24	794,155.0	49,255.0	81.0	1,187.4	230.6	46,183,192.2
25	841,826.0	47,671.0	83.0	1,187.8	231.6	44,669,948.5
26	888,688.0	46,862.0	84.0	1,188.0	232.6	43,875,138.0
27	935,280.0	46,592.0	82.0	1,187.6	233.6	43,558,422.8
28	981,524.0	46,244.0	85.0	1,188.2	234.6	43,214,953.3
29	1,027,360.0	45,836.0	83.0	1,187.8	235.6	42,770,790.8
30	1,071,480.0	44,120.0	84.0	1,188.0	236.6	41,134,955.5
31	1,128,182.0	56,702.0	82.0	1,187.6	237.6	52,787,895.0
Monthly Total (Btu)						**1,386,534,267.7**
Monthly Total (MWh)						**406.4**

Saturated Steam Enthalpy values	
Supply Steam Pressure (PSI Gauge)	Supply Steam Specific Enthalpy (Btu/lb)
55.0	1,181.5
71.0	1,185.4
74.0	1,186.1
77.0	1,186.7
78.0	1,186.9
79.0	1,187.1
80.0	1,187.1
81.0	1,187.4
82.0	1,187.6
83.0	1,187.8
84.0	1,188.0
85.0	1,188.2
86.0	1,188.4
87.0	1,188.6
89.0	1,188.9