MADDEN
ENGINEERED PRODUCTS

Boiler Blowdown Heat Recovery Systems - Operator's Manual

Reduces Boiler Fuel Consumption & Carbon Footprint

Type HC – Horizontal Type: Large Capacities

Type HV – Vertical Type: Saves Floor Space

Type HVX: For Small Boiler Systems

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General Recommendations
Installation & Maintenance

NOTE BEFORE READING – This operator's manual covers ***general*** instructions and good practice recommendations for installing and starting Madden heat recovery systems. PLEASE BE SURE TO REFERENCE OUR WEBSITE'S LITERATURE PAGE AND YOUR SALES ORDER SUBMITTAL PACKET FOR SPECIFIC INFORMATION ON YOUR HC, HV, AND HVX SERIES SYSTEMS. These sources provide specific ancillary equipment manuals, parts lists, and repair procedures (if needed).

The Surface Blowdown Line Connection: Most boilers come with a continuous surface blowdown connection. Typically, an automated blowdown system is now used to control the blowdown based on conductivity and/or total dissolved solids (TDS). Skimming water off the top of the boiler water level with this connection improves boiling efficiency and extends boiler service life. When done so continuously, this is a great opportunity to utilize a Madden heat recovery system to put valuable BTU's back into the boiling process.

If your boiler is not equipped with this connection, contact the boiler manufacturer for their recommendation on how best to add this feature. If the boiler requires field welding, be sure to check with an authorized local inspector for any ASME or related procedures and codes you may need to follow.

The Surface Blowdown Piping: From the continuous surface blowdown connection on the boiler, run the appropriate schedule piping to the Madden heat recovery system inlet manifold. It is recommended at least SCH 80 piping be used. An automated blowdown system, or rugged Madden Orifice Meter should be used to control the flow rate of this blowdown. Typically, the nominal blowdown flow rate is 1% to 3% of the boiler room steam production. With fluctuations and start up situations increasing this to 5% to 10%.

***NOTE 1* -** *If you are using an Automated TDS/Conductivity blowdown system to control boiler surface flow, it is strongly recommended to adjust this system so it blows down more slowly and continuously, as opposed to repeated 'bursts' of timed blowdown. This promotes efficiency by ensuring BTU's will not rush through the system without being fully recovered in the heat exchanger*

Make-Up/Feed Water Piping: The make-up water inlet and outlet connection can be seen on the P&ID's on the following pages. The make-up water should be piped to these connections to allow (2) processes to occur via the heat recovery system's heat exchanger. The first is cooling – assuming your makeup water is 75 degrees F or lower, it will cool the boiler surface waste water blowdown below 140 deg F. The second – it will also pickup anywhere from 3 to 15 degrees F., which would otherwise need to be heated from the D/A and/or Boiler.

If the make-up water flow rate is higher than the Madden heat recovery system's rated capacity, some of the flow should be diverted around the unit; or a globe valve should be used to proportion the make-up water flow rate.

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***NOTE 2* -** *If make-up water rate flow is not constant (perhaps due to significant condensate return usage), if possible, adjust your controls to sync the makeup water flow with the boiler surface blowdown flow. Stagnant makeup water during surface blowdown can allow the waste drain blowdown to exit above 140 deg F. Continuous makeup flow helps to reduce potential thermal cycling which can enhance the service life for the heat exchanger and ASME vessel. If your heat recovery system will see substantial periods of boiler blowdown without fresh makeup water flow, consider a different cooling water source, or feed condensate from the heat recovery system drain to a bottom blowdown tank or separator, rather than directly to the sewer.*

Vent Piping: The steam vent off the Madden heat recovery system should be connected to a low-pressure steam unit, typically a Deaerator (D/A tank). The steam can be directly piped into the D/A or directly into another low-pressure steam "use".

A shut off valve and check valve are recommended for this vent line for maintenance purposes. The check valve specifically will aid in performance if the continuous surface blowdown rate cycles or is irregular. This line and the Madden heat recovery system vessel will operate close to the same pressure as the D/A tank operating pressure.

Drain Piping: We recommend the floor drain utilize a minimum 1' slope per 100' of unobstructed drain. More slope should be added for obstructed or angled draining.

If your Madden heat recovery system utilizes an external Armstrong float trap (opposed to Madden's standard internal float/drain assembly), the size of the exiting drain line should be one fractional pipe size larger than the Madden heat recovery system's drain line.

STARTUP PROCEDURES

The make-up water flow should first be established. The metering valve can be opened to allow the maximum rated water flow through the Madden heat recovery system's heat exchanger. Once the cold-water make-up flow has started through the HV series' lower shell, or the HC series' u-tube bundle, you can then open the continuous surface blowdown valve to the desired setting.

Your boiler manufacturer or water treatment company, along with boiler water testing for total dissolved solids and/or conductivity, should be used to determine the correct continuous surface blowdown valve setting and flow rate.

After the system has run for at least 15 minutes, check the (3) temperature gauges on the Madden heat recovery system's nameplate. These units are designed to cool the waste surface blowdown below 140 deg F. at maximum capacities, though typically this temperature will be closer to 100 deg F. The other (2) gauges show the makeup water temperature in and makeup water temperature out ("out" is also piped to the D/A tank). These should simply show an increase from "in" to "out". Again, typically that is anywhere from a 3 deg. F. to a 10+ deg F. increase. If you see a temperature increase significantly higher than 15 deg F., this is a sign something may be malfunctioning. Call our factory for assistance and confirmation as to whether or not this is an "issue".

***REMINDER / NOTE* -** If you are utilizing an Automated TDS system to control blowdown flow, it is strongly recommended to blowdown as slowly and continuously as can be programmed into the system.

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MAINTINANCE SUGGESTIONS

Standard Madden heat recovery systems are completely mechanically actuated and require very little oversight and maintenance from the boiler room operator(s). Dependent on water quality, in a typical application the heat exchanger will last over 10 years and the ASME vessels will last over 15 years before one should start to consider replacing either.

The following are our recommended good practices for maintaining your Madden H.R.S.:

- **The drain valve and line:** Madden heat recovery systems are self-draining, the operator does not need to worry about utilizing a clean out drain throughout the year; however, for added service life, it is a good idea to occasionally flush your system of any natural sludge accumulation that might not quite naturally drain. Ideally one would do this at least once a year during a shutdown.

- **The exchanger coil or u-tube bundle:** at least once a year it is recommended the unit be completely drained and an operator visually inspect the coil/tubes for wear. It is extremely unlikely this will be noticeable until at least 5 years of operation. If there is noticeable sludge or encrusting on the heat exchanger, a wire brush should be the “heaviest” tool required to adequately clean the unit.

    - **Note 1:** after your first-year inspection, if the heat exchanger is in good condition, this is a good sign you will not need to repeat this process every year. Use your discretion, but it should then be safe to repeat after another 5+ years.

    - **Note 2:** the temperature gauges can then be monitored to determine if the heat exchanger needs service. As long as your waste drain gauge shows 140 degrees or less, and the “IN” and “OUT” temperatures show an increase, your heat exchanger is performing as it should. If all the temperatures appear to be the same, this is a good sign a hole is beginning to wear somewhere in the assembly, allowing the processes to mix together.

- **(OPTIONAL) Bypass Piping – to be performed by installing contractor:** it is ideal to add valves and piping to be able to bypass the Madden heat recovery system during maintenance. This would allow the boiler to continue operating while reviewing your system. If you choose to do this, be sure to send the heat recovery system drain line to a quench tank as opposed to piping straight to a floor sewer drain.

    - **Note:** Again, these units should be relatively “hands free”. A bypass valve and line are NOT crucial. Most applications will be fine year in and year out, allowing you to observe the condition of the equipment once a year during a shut down.

A. System Installation:

Once system is at the installation site, anchor the footpads securely to the floor.
Use the assembly drawing for installation location of the Madden supplied components:

1. Install the Kunkle Relief Valve onto the coupling on the top of the vessel. Vent pipe must exit the building.
2. Screw the Pressure Gauge into the Steam Gauge Syphon and install onto the 1/4” NPT coupling on the vessel.
3. Install the Sight Glass and Valves between the two 3/4" NPT couplings on the vessel. See the Water Gauge and Gauge Glass Installation Instructions.
4. Connect the Madden Nameplate with 3 pre-mounted thermometers onto the nameplate brackets with the 4 supplied bolts.
5. Insert the 3 thermometer probes into the correct couplings as listed on the assembly drawing:
   a. Insert the union connections of the thermometer probe assembly into the 3 couplings.
   b. Insert the probe with capillary tube attached to the gauge in the *first* position on the nameplate into the correct coupling on the inlet.
   c. Insert the probe with capillary tube attached to the gauge in the *second* position on the nameplate into the correct coupling on the outlet.
   d. Insert the probe with capillary tube attached to the gauge in the *third* position on the nameplate into the correct coupling on the blowdown drain at the bottom of the vessel.
6. Install Keckley #62 Globe Valve on the discharge/drain line. Linkage is included to connect to the stainless-steel float controller.
7. If the vessel has an optional high level alarm switch, the alarm should be hooked up by an electrician. Wiring diagram included with order submittal packet.

B. Piping connections:

The contractor must furnish and install all related piping. This system requires a minimum of six connections as described on the assembly drawing provided in your sales order submittal packet. Shut off valves must be installed between the boiler and the flow control valves if using Madden Orifice Meters for the flow control.

VENT PIPING NOTE: it is recommended to use a swing type check valve from the HC upper vessel vent line and the D/A tank. SEE TYPICAL P&ID AT THE END OF THIS MANUAL.

C. The components of the Heat Exchanger System:

1. Horizontal Flash Tank with Integral Heat Exchanger
2. U-Tube Bundle with Stainless-Steel Tubes
3. Float Valve
4. Gauge Panel – Includes 3 Thermometers
5. Manifold – For Inlet Flow Control
6. Ancillary Equipment: Sight Glass, Valves & Rods, Keckley Globe Valve, Pressure Gauge & Syphon Tube and Safety Relief Valve
7. Optional – High Level Alarm

D. Occasional Start Up Leaking Issue with HC Systems: reference the HC011AS stuffing box kit. This device links and seals the HC series internal SS float level control and the external drain globe valve. This assembly ships “snug” from the factory to ensure start up temperatures do not cause the internal packing to overtighten, keeping the actuating linkage from turning. IF AN OPERATOR NOTICES A MINOR LEAK DURING STARTUP from this component, tighten the outer nut, NOT the nut closest to the vessel. This typically seals the system. See document HC_Stuffing-Kit_Packing-Assembly_HC011AS.pdf (website) for more details.

A. System Installation:

Once system is at the installation site, anchor the baseplate securely to the floor.
Use the assembly drawing for installation location of the Madden supplied components:

1. Install the Kunkle Relief Valve onto the coupling on the top vessel. Vent pipe must exit the building.
2. Screw the Pressure Gauge into the Steam Gauge Syphon and install onto the 1/4” NPT coupling on the top vessel.
3. Install the Sight Glass and Valves between the two 3/4" NPT couplings on the top vessel. See the Water Gauge and Gauge Glass Installation Instructions.
4. Connect the Madden Nameplate with 3 pre-mounted thermometers onto the nameplate brackets with the 4 supplied bolts.
5. Insert the 3 thermometer probes into the correct couplings as listed on the assembly drawing:
   a. Insert the union connections of the thermometer probe assembly into the 3 couplings.
   b. Insert the probe with capillary tube attached to the gauge in the *first* position on the nameplate into the correct coupling on the lower vessel inlet.
   c. Insert the probe with capillary tube attached to the gauge in the *second* position on the nameplate into the correct coupling on the lower vessel outlet.
   d. Insert the probe with capillary tube attached to the gauge in the *third* position on the nameplate into the correct coupling on the blowdown drain at the bottom of the lower vessel.
6. If the vessel has an optional high level alarm switch, the alarm should be hooked up by an electrician. Wiring diagram included.

B. Piping connections:

The contractor must furnish and install all related piping. This system requires a minimum of six connections as described on the assembly drawing provided in your sales order submittal packet. Shut off valves must be installed between the boiler and the flow control valves if using Madden Orifice Meters for the flow control.

VENT PIPING NOTE: it is recommended to use a swing type check valve from the HC upper vessel vent line and the D/A tank. SEE TYPICAL P&ID AT THE END OF THIS MANUAL.

C. The components of the Heat Exchanger System:

1. Vertical Heat Exchanger Bottom Vessel with heat exchanger coils –
   Copper coils with bronze manifolds or stainless-steel coils with stainless-steel manifolds
2. Flash Tank Top Vessel
3. Float Valve – Interior of the Flash Tank
4. Gauge Panel – Includes 3 Thermometers
5. Manifold – For Inlet Flow Control
6. Ancillary Equipment: Sight Glass, Valves & Rods, Pressure Gauge & Syphon Tube and Safety Relief Valve
7. Optional – High Level Alarm

A. System Installation:

Once system is at the installation site, anchor the baseplate securely to the floor.
Use the assembly drawing for installation location of the Madden supplied components:

1. Install the Kunkle Relief Valve onto the coupling on the top vessel. Vent pipe must exit the building.
2. Screw the Pressure Gauge into the Steam Gauge Syphon and install both onto the 1/4” NPT coupling on the top, front side of the ASME vessel.
3. Install the Sight Glass and Valves between the two 3/4" NPT couplings. See the Water Gauge and Gauge Glass Installation Instructions in your Equipment Databook.
4. Connect the Madden Nameplate with 3 pre-mounted thermometers onto the nameplate brackets with the 4 supplied bolts.
5. Insert the 3 thermometer probes into the correct couplings as listed on the assembly drawing:
   a. Insert the union connections of the thermometer probe assembly into the 3 couplings.
   b. Insert the probe with capillary tube attached to the gauge in the *first* position on the nameplate into the correct coupling on the vessel makeup water inlet.
   c. Insert the probe with capillary tube attached to the gauge in the *second* position on the nameplate into the correct coupling on the vessel makeup water outlet.
   d. Insert the probe with capillary tube attached to the gauge in the *third* position on the nameplate into the correct coupling on the blowdown drain at the bottom of the vessel. This is part of the external liquid level control drainer’s piping.
6. If the vessel has an optional high level alarm switch, the Mercoid switch should be installed on the side of the vessel. The switch comes pre-plumbed with unions and on the vessel will be open gate valves to connect to. The alarm box should be hooked up by an electrician. Wiring diagram included in your Equipment Databook.

B. Piping connections:

The contractor must furnish and install all related piping. This system requires a minimum of six connections as described on the assembly drawing provided with your sales order submittal packet. Shut off valves must be installed between the boiler and the flow control valves if using Madden Orifice Meters for the flow control.

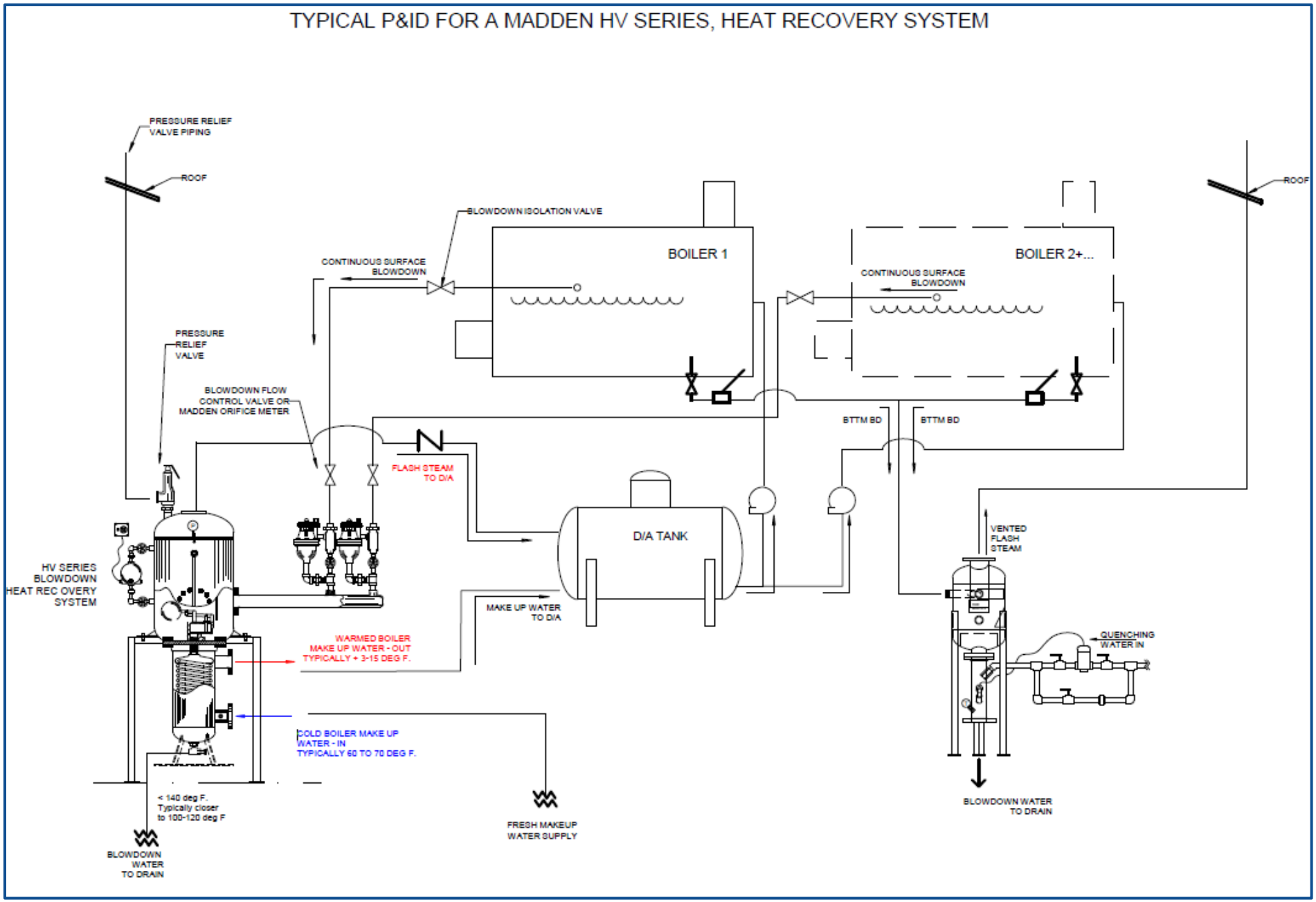
VENT PIPING NOTE: it is recommended to use a swing type check valve from the HVX upper vessel vent line and the D/A tank. SEE TYPICAL P&ID AT THE END OF THIS MANUAL.

C. The components of the Heat Exchanger System:

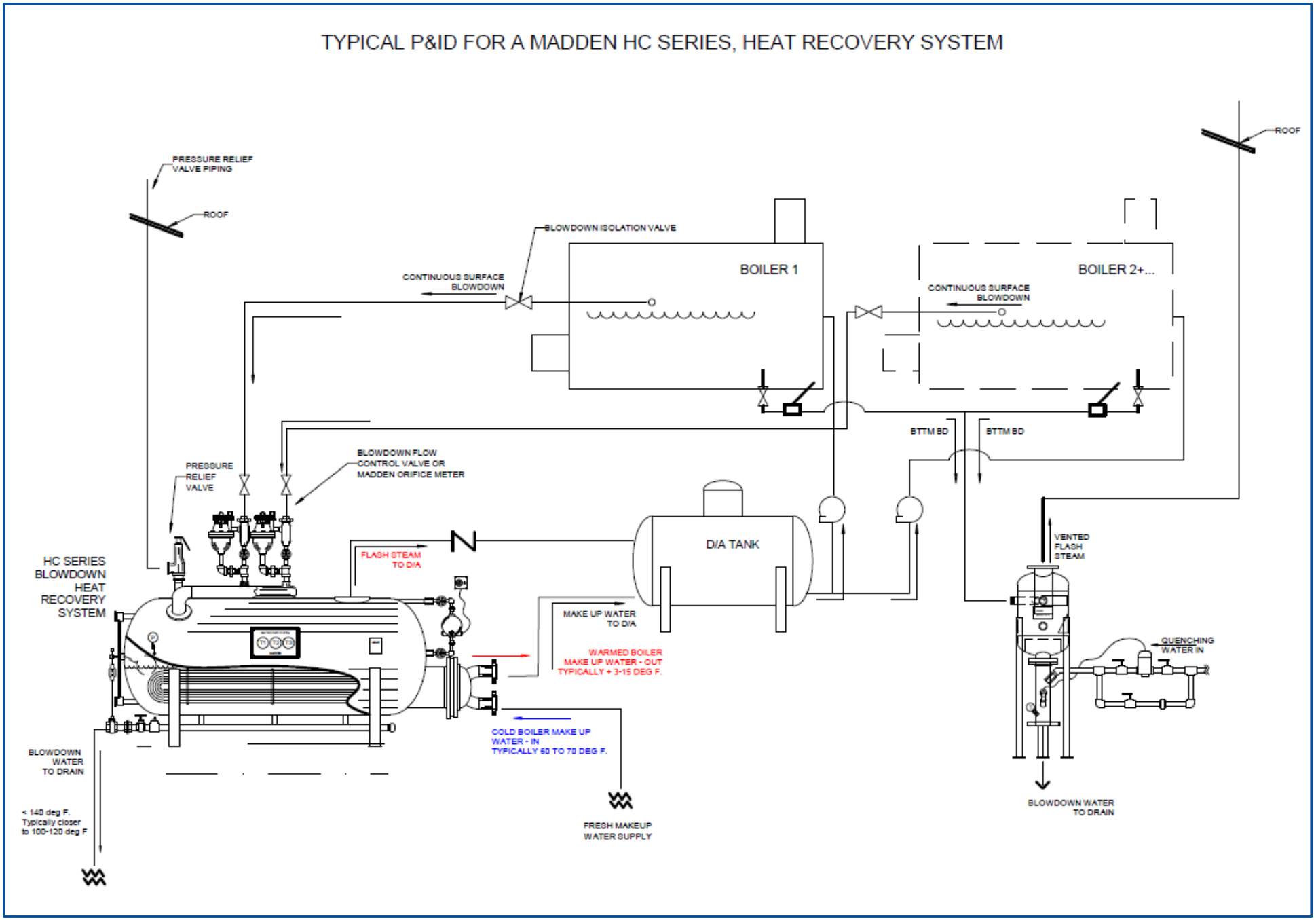
1. Vertical Heat Exchanger – Interior of vessel, copper coil is standard for higher BTU transfer efficiency.
2. Float & Drain Valve – Exterior liquid lever drain trap.
3. Nameplate and Gauge Panel – Includes 3 Thermometers
4. Ancillary Equipment: Sight Glass, Valves & Rods, Pressure Gauge & Syphon Tube and Safety Relief Valve
5. (Optional) Manifold – For Inlet Flow Control
6. (Optional) – High Level Alarm

D. MAKEUP WATER FLOW RATE NOTE: The HVX15 is designed to recover 90% of BTU’s from the surface blowdown (max 1,500 PPH rate) via flash steam and makeup water heat exchange. It is also designed to reduce the waste condensate below 120 deg F with at least 75 deg F makeup water (cooling water). It is intended to be the most cost effective heat recovery for small boiler rooms with low surface blowdown and makeup water rates. The max flow rate through the makeup water connections and coil is 30 GPM, but ideally < 20 GPM to increase coil service life. If your surface blowdown rate is < 1,501 PPH, but your makeup water requirements are > 30 GPM, we recommend diverting a portion of the main makeup water line to this unit. Then run the preheated makeup water discharge from the HVX to an independent feed connection on the D/A or preheating feed tank (not back into the pressurized main makeup water line).

Typical P&ID's for HV SERIES Heat Recovery Systems



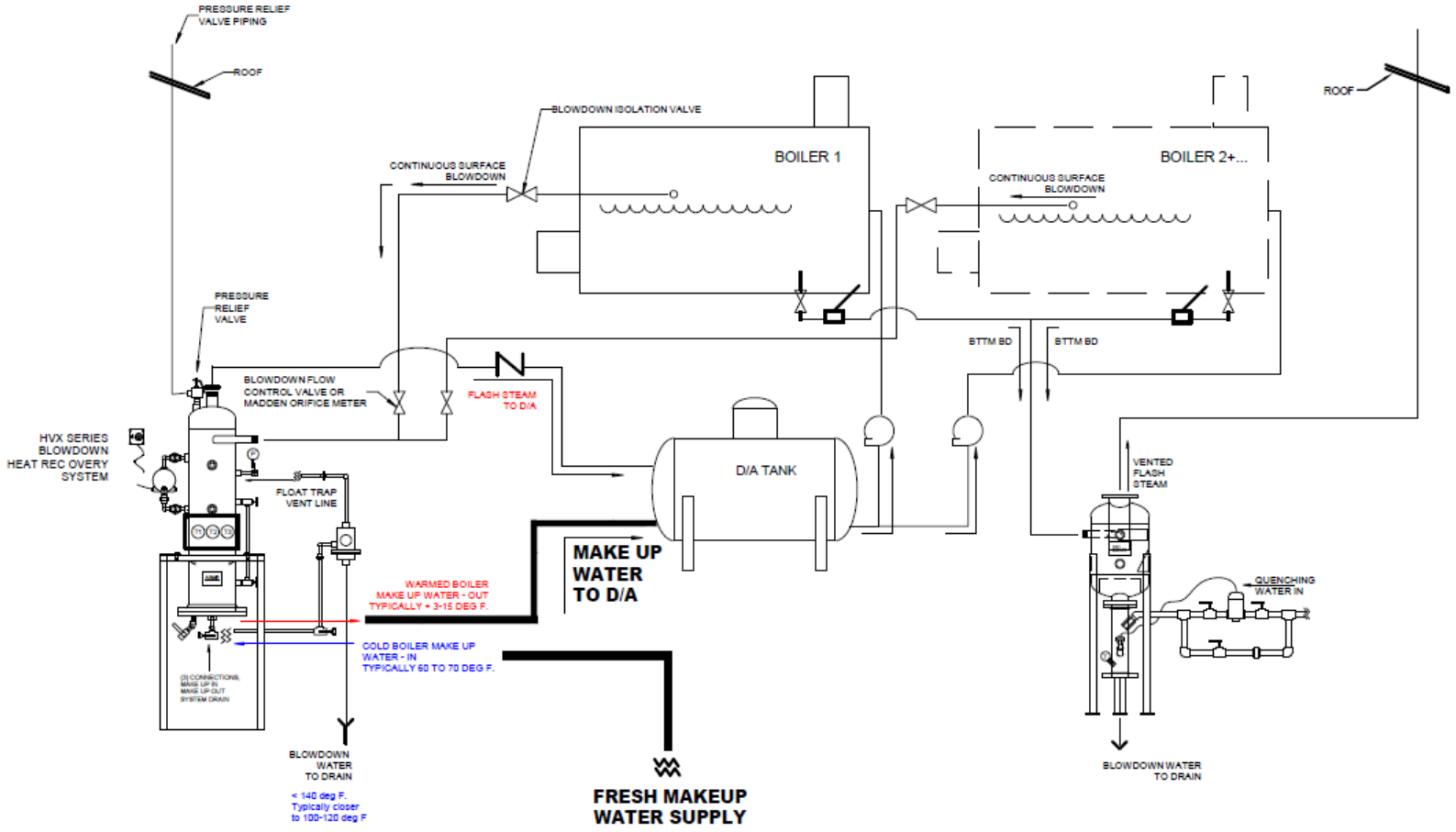
Typical P&ID for HC SERIES Heat Recovery Systems



Typical P&ID for HVX SERIES Heat Recovery Systems (2 PAGES)

MADDEN HVX SERIES P&ID

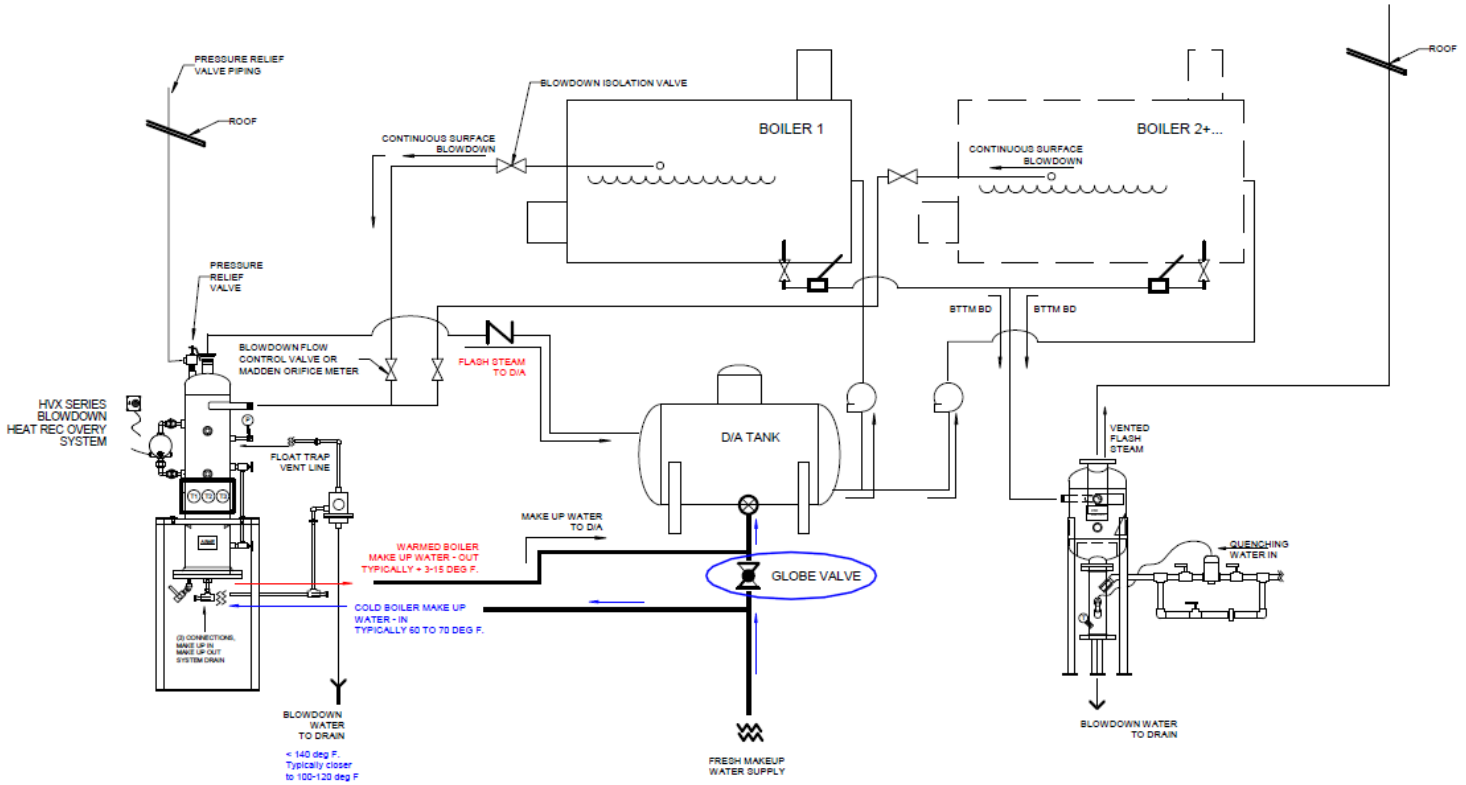
FOR MAKE UP WATER FLOWS < 20 GPM



* In the HVX heat recovery system design, the makeup water passes through a single 7/8" OD copper coil. If your boiler room's makeup water flow rate requirement is less than 20 GPM or 10,015 PPH, passing 100% of this flow through the Madden HVX unit is appropriate. However, if the boiler(s) may call for significantly higher makeup flow rates for extended periods of time, you'll want to consider a piping adjustment. At 20+ GPM flow rates, the resulting 10+ FPS velocity through the coil will reduce the heat exchanger's intended service life.

MADDEN HVX SERIES P&ID

FOR MAKE UP WATER FLOWS > 20 GPM



** The simplest way to help increase the heat exchanger coil's service life, is to continue running the main makeup water line straight to the D/A tank, then diverting only part of the flow to the HVX system.

Add a globe valve, or similar flow control valve, between the outgoing and incoming HVX water line. This will allow the operator to throttle the main makeup water flow until he or she sees enough flow is also passing through the HVX system to ensure the boiler waste water drains below 140 deg F.

If for any reason this is not acceptable in your boiler room, please then consider going "up" to our HV30 heat recovery system design as this style can handle much higher makeup water flow rates - which passes through the shell side opposed to the coil.

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