



Pre-Start-Up Checks

- Yes ___ No ___ Is there any visible damage to the machine? If yes, describe damage: _____
- Yes ___ No ___ Is the machine installed outdoors?
If outdoors, is the machine on the roof?
- Yes ___ No ___ Is the cooling tower at a different level from the chiller?
If yes, what is the height difference? _____ Tower: Above or Below
- Yes ___ No ___ Are all minimum clearances maintained around the chiller per Yazaki specifications?
If no, which side(s) does not conform to specified clearances? _____
[40" front and back, 28" sides]
- Yes ___ No ___ Is the machine level both in longitudinal and transverse directions, using the Level Reference Bar?
- Yes ___ No ___ Has the Changeover Valve Servo Assembly been installed? [Shipped with the chiller. Accessed from rear of unit, located just above the Junction Box.]

Water Side Pre-Start Checks

- Yes ___ No ___ Are all Flow Switch fluid connections made properly? [Located inside the rear panel to the right]
- Yes ___ No ___ Have all fluid circuits to the machine been flushed, refilled, and stabilized with pumps running and air removed?
- Yes ___ No ___ Is the water piping to the chiller in accordance to Yazaki specifications and connections correct per the installation manual?
- Yes ___ No ___ Are balance valves present?
- Yes ___ No ___ Are isolation valves present?
- Yes ___ No ___ Are drain valves present?
- Yes ___ No ___ Are all appropriate check valves present?
- Yes ___ No ___ Are provisions made for chemical treatment as is considered appropriate for all water loops?
- Yes ___ No ___ Have the pressure drops through all water loops been adjusted and finalized?
- Yes ___ No ___ Is the pressure in any water loop in excess of 85 PSI? If Yes, which loop(s)?: _____

Record pressures on the Data Sheet.

Gas Side Pre-Start Checks

- Yes ___ No ___ Was it necessary to use a flue stack rather than the factory-supplied cap?
- Yes ___ No ___ If yes, is the flue stack sized and assembled correctly in accordance to NFGC and flue stack manufacturer's recommendations?
- Yes ___ No ___ Are there any barometric dampers in the flue assembly?
- Yes ___ No ___ If multiple units use a common flue, is the flue sized and assembled correctly, and are all appropriate barometric dampers installed correctly?
- Yes ___ No ___ Is there sufficient supply air for all appliances in the area including the Yazaki machine(s) in accordance with NFGC requirements? [Recommendations are for one square inch of free air opening per 1,000 BTU of total of all burner inputs of all gas-fired appliances in the space.]
- Yes ___ No ___ Is the factory-supplied gas meter installed in a dedicated fashion so as to measure only the gas consumed by this one machine?
- Yes ___ No ___ Is an appliance regulator installed at the gas supply inlet of the Yazaki machine(s)?
- Yes ___ No ___ Has a leak check been completed on all gas lines?
- Yes ___ No ___ Is the supply gas pressure proper when measured after the gas meter and any applicable appliance regulators? [5-10.5" wc, 7-10.5" wc for 100-ton units] **Record Gas Supply Pressure in the appropriate area on the Data Sheet.**

Electrical Pre-Start Checks

- Yes ___ No ___ Have all electrical terminal connections in the Yazaki unit been checked to be tight? This includes terminal blocks, motor contactors, relay sub-bases, and junction boxes. Also includes all wiring connections in the Burner itself.
- Yes ___ No ___ Are all Molex plugs in the Yazaki unit properly seated?
- Yes ___ No ___ Are all field wiring connections made properly in the Junction Box?
- Yes ___ No ___ Is an electrical disconnect within sight of the unit and readily accessible per section 440-14 of the National Electrical Code?
- Yes ___ No ___ Is the voltage appropriate for the machine?
- Yes ___ No ___ Is the high leg (or wild leg) of 3-phase power connected to L2 (if applicable)?
- Yes ___ No ___ Is the over-current protection sized properly? **Record Breaker/Fuse Size in the appropriate area on the Data Sheet.**
- Yes ___ No ___ Is the electrical wire size correct? **Record Wire Size in the appropriate area on the Data Sheet.**
- Yes ___ No ___ Are there any aluminum conductors used?

Tools Required for Chiller-Heater Start-Up

ACT-3 Diagnostic Tool ----- [shipped with the chiller]
Combustion Analyzer
Gas Pressure Manometer
Inclined Manometer
Phase Meter ----- {Yazaki P/N Hioki 3126}
Pressure Gauge for Water Test Manifold [0-100 PSI] ----- {Yazaki P/N N7630}
Spirit Level ----- {Yazaki P/N N7519}
Standard Hand Tools [Screw Drivers, Pliers, Wire-Cutters, Pipe Wrenches, etc.]
Torque Wrench [200 kgf-cm or 14.4 ft-lb] ----- {Yazaki P/N N7510}
Vacuum Hose Fitting Adapter ----- {Yazaki P/N N7512}
Vacuum Pump [Welch 1402B or equivalent (5-7cfm is adequate)]
Volt-Ohm Meter (should also be capable of reading DC volts)
Water Pressure Test Manifold ----- {Yazaki P/N N7559}

Other Recommended Tools

10' Latex Vacuum Tubing (3/8" ID)
4mm Hexagon Allen Wrench
Calculator
Honeywell Keyboard Display Module – S7800A1142
Permanent Marker
Spirit Level {Yazaki P/N N7519}
Standard Hand Tools [Screw Drivers, Pliers, Wire-Cutters, Pipe Wrenches, etc.]
Tape Measure
Thermometer
Vacuum Gauge
Watch or Stop Watch

Yazaki Literature Required

CH-K Start-Up Procedure [this document]
CH-K30 – CH-K100 Installation Instructions [shipped with the chiller]
CH-K30 – CH-K100 Operating Instructions [shipped with the chiller]
Yazaki Warranty Registration Card [shipped with the chiller]

Other Yazaki Support Literature

CH-K Service Manual
CH-K Start-Up & Maintenance Data Sheet
CH-K Temperature Record Sheet

Start-Up Procedures for CH-K Series with Power Flame Burners

Before beginning the Start-Up Procedure, please read this complete procedure, including Burner Setup and Completing Setup sections. The steps outlined here are intended to help provide the shortest possible time investment in a proper startup of a Yazaki CH-K Chiller/Heater. There are other methods and procedures for start-up that are equally valid, but do not mix procedures. If a different valid start-up procedure is chosen, follow only the steps of that procedure.

Some steps below are listed as "Optional." While this data is neither critical nor required for a proper startup, more complete data often assists with future inquiries in regard to maintenance and troubleshooting.

1. **Record Project, ASP information, and machine data into the proper spaces at the top of the Data Sheet.**
2. **Indicate this work as a Start-Up by checking the box under Type of Service on the Data Sheet.**
3. Make certain the Main Gas Stop Valve, Leak Check Stop Valve, and Pilot Stop Valve are all closed.
4. Make certain the rocker switch on the control panel is in the "Stop" position.
5. Perform initial evacuation.
 - a. Refer to documentation for proper procedures of evacuation.
 - b. **Record final vacuum level achieved on the Data Sheet** (optional).
 - i. An extended evacuation is never necessary. If such an evacuation appears to be necessary, it is likely the oil in the vacuum pump needs to be changed.
 - c. **Record amount of non-condensable gases removed on the Data Sheet** (optional at commissioning start-up).

NOTE: Irreparable damage can occur if oil from a vacuum pump gets into the machine.
Do not leave a vacuum pump unattended. Use of liquid trap is recommended.

NOTE: Service valves should never be open if the vacuum pump is not running.

NOTE: If machine is found to be at atmospheric pressure on initial startup, contact Yazaki Energy Systems at (469) 229-5443 for further instructions.

6. Set up Flow Switch, located in the rear area of the unit.
 - a. Using the chilled water flow balancing valve, adjust the chilled water pressure drop to 65% of the value listed on the Pressure Drop in Unit tag.
 - b. Adjust the flow switch until it opens at the 65% flow rate.
 - c. Adjust the chilled water flow pressure drop to 100% of the value listed on the Pressure Drop in Unit tag. (allowable range on the chilled water circuit is +/- 20%)
 - d. **Check the box on the Data Sheet indicating the Flow Switch was set.**
7. Set flow rates through all water circuits using data from the Pressure Drop in Unit tag on the machine, located on the frame above the front control panel.
 - a. The pressure drop indicated on the Pressure Drop in Unit tag supersedes all other values, including the value on the unit nomenclature tag.
 - b. Set flow rate by adjusting balancing valve(s) until the pressure drop is equal to or slightly exceeds the value listed on the Pressure Drop in Unit tag.
 - c. **Record all requested data from the water circuits on the Data Sheet.**

8. Calculate water flow and **record the information on the Data Sheet** (optional).
9. Prepare test tools and instruments.
 - a. Plug the ACT-3 tool into the control board.
 - b. Attach Draft Gauge to the flue stack (or have it ready).
 - c. Attach Combustion Analyzer to the flue stack (or have it ready).
 - d. Attach a DC meter to the Flame Signal test points (or have it ready).
 - e. Gas pressures will be tested at several test ports on the gas train during the Start-Up procedure. Have tools ready and access clear to each test port.
10. Check main gas supply pressure to verify it is 5-10.5" wc, 7-10.5" wc for 100-ton units.
(Propane units all operate at 11-13" wc.)
11. Check the draft pressure in the vent assembly, unless using the factory-supplied cap.
 - a. Remove the screw from the vent discharge elbow of the generator.
 - b. Attach adapter for the Draft Gauge.
 - c. Adjust the barometric damper to bring the draft pressure into the allowable range of 0.00" to -0.05" wc.
 - d. **Record the Stack Draft in the appropriate area of the Data Sheet.**
12. **Record Dip Switch Positions as requested on the Data Sheet** (optional).
13. **Record whether or not a connection has been made in the Junction Box at the terminals indicated in the appropriate section on the Data Sheet.**
14. Turn power on to the Yazaki machine (no power should have been on to this machine until this point).
15. Measure voltage to ground for each power leg of the Solution Pump. This can be done at the Solution Pump Starter in the control box.
 - a. **Record voltage readings to the Solution Pump on the Data Sheet.**
16. Verify correct phase rotation. If rotation is incorrect, turn off power to the unit. Swap L1 and L3 wires at Junction Box. Restore power and verify correct phase rotation.
 - a. If phase rotation meter is not available, use one of the two following methods:
 - i. Check the amp draw of the Solution Pump while it is running.
 1. Make note of the amp draw, then turn power off to the unit. Swap L1 and L3 wires at the Junction Box. Restore power and make note of the amp draw. Whichever configuration of L1 and L3 in the Junction Box resulted in the higher amp draw reading is the correct configuration for proper rotation.
 - ii. Use solution pressure at the Dilute Solution Access Valve. (It is the lower valve accessible from the rear of the unit).
 1. Attach a pressure gauge to the Dilute Solution Access Valve. Make note of the pressure reading (it will typically be reading in a vacuum or a very slightly positive pressure). Turn off power and swap L1 and L3 in the Junction Box. Restore power and check the pressure reading again. Whichever configuration of L1 and L3 in the Junction Box resulted in the greater pressure reading is the correct configuration for proper rotation.
 - b. **Record amp draws and indicate SP Rotation as Checked on the Data Sheet.**

Burner Setup

1. Remove the inspection port plug for the Butterfly Valve.
2. Push in on the white post to disengage the motor gears. Adjust the Mod Motor position until the Butterfly Valve is confirmed to be closed by visual inspection. Disregard the positioning indicator on the Mod Motor itself. Then reinstall the inspection port plug.
3. Adjust the linkage so that the Air Shutters are fully closed.
4. Verify the Mod Motor Cam positions. Use the adjustment tool or a small screwdriver to adjust the cam position settings.
 - a. Red Cam should be set for 30-degrees +/- 3.
 - b. Blue and Orange Cams should be set for 20-degrees +/- 3.
5. Remove the RRBH relay from its subbase in the control panel. Set aside for later re-installation.
6. Attach one end of a jumper wire to terminal BN10 of the terminal strip at the bottom of the control panel. Attach the other end of the jumper wire to terminal BN8.
 - a. BN10 to BN8 = Low Fire. Uses Blue Cam position.
 - b. BN10 to BN9 = High Fire. Uses Red Cam position.
7. Attach Honeywell Keyboard Display Module to the Burner Control, or attach DC volt meter leads to the appropriate slots on the flame amplifier card.
8. Set rocker switch on the front of the unit to "Run". Observe the voltage reading for the pilot flame once the pre-purge ends and pilot ignition begins. No ignition should occur since the Pilot Gas Stop Valve is still closed. This step is to test safety response logic and also to investigate the quality of the electrical ground for the unit.
 - a. When ignition fails, the Burner Control should go into alarm condition. It should also place the unit control into alarm condition.
 - b. If voltage reading is greater 0.5 vdc, there is likely a faulty electrical ground for the unit. This will usually lead to nuisance error codes and lockouts, therefore, should be addressed, if possible.
9. Open the Pilot Gas Stop Valve. Be ready to adjust the Pilot Gas Pressure Regulator. Attach a manometer to the Pilot Gas Test Port located near the UV Flame Detector.
10. Reset the Burner Control and the Unit Control. This should result in an immediate prepurge for ignition by the burner.
 - a. Once Prepurge has finished, the Pilot Gas Solenoid should open.
 - b. Set pilot gas pressure to 2.5" wc. CW increases, CCW decreases pressure.
 - c. Pilot should light and be stable. Pilot voltage reading should be 1.25 vdc or greater.
 - i. If you get a 0 vdc flame signal, remove the UV Detector from its position and watch through the tube during the next pilot ignition attempt. If pilot flame is observed at all, it should register greater than 0 vdc. Re-attach the UV Detector now that it has been visually verified that the pilot does indeed light.
 1. If more than 0 vdc is observed, but still not enough greater than 1.25 vdc, adjust pilot gas pressure as necessary.

- 2. If 0 vdc readings persist, remove and reinstall the flame amplifier card and check connections and cleanliness of the UV Detector.
- ii. If pilot fails to light, keep in mind it is easier to ignite a rich fuel/air mixture than a lean mixture. Therefore, adjust the linkage to close the air damper very slightly before attempting to light the pilot again.

11. Attach the manometer to the pressure port downstream of the redundant gas valve. If this tap is not present or if it is unreachable, use the tap downstream of the Main Gas Valve.

12. Open the Main Gas Stop Valve. Leave the Leak Check Stop Valve closed.

13. Using the regulator in the Main Gas Valve, adjust the pressure until it reads 3.5" wc, +/- 10%. (10.5" wc, +/- 10% for propane units)

14. Once the manifold pressure is set, close the Main Gas Stop Valve and open the Leak Check Stop Valve.

15. Carefully open the Main Gas Stop Valve. Main flame ignition should occur within a few seconds.

- a. Initial ignition may be a little rough since the air shutters are not yet set to deliver proper combustion supply air.

16. Verify proper gas volume by clocking the gas meter.

- a. If the volume needs to be adjusted, reducing the setting on the Red Cam of the Mod Motor will reduce the volume and thus increase the time per revolution. Increasing the setting will increase the volume and thus decrease the time per revolution. Adjust until satisfied the volume is reasonably correct.
 - i. Using the 2 cubic foot indicator on the gas meter, time how long it takes to make 3 revolutions. Proper volume for High Fire combustion should be:

CH-K Size	Fuel Input	1 rev	3 rev	5 rev
30	353,000	20.4 sec	61.2 sec	102 sec
40	471,000	15.3 sec	45.9 sec	76.5 sec
50	588,000	12.2 sec	36.6 sec	61.0 sec
60	706,000	10.2 sec	30.6 sec	51.0 sec
80	941,000	7.65 sec	23.0 sec	38.3 sec
100	1,176,000	6.12 sec	18.4 sec	30.6 sec

- b. **Record the manifold gas pressure in the appropriate space under the High Fire Data section of the Data Sheet.**

NOTE: When adjusting any cam position, it will be necessary to "cycle" the control signal in order to make it recognize and move to the new position. Do this by moving the jumper wire between BN8 and BN9 and then back to the original position.

17. If the Red Cam was moved, move the Blue Cam to a position equal to 70% of the final Red Cam setting.

18. Install the combustion analyzer probe into the exhaust stack. Without a combustion analyzer, the Power Flame burner **CANNOT** be set up reliably.

- 19.** Adjust the air shutter linkage until combustion analyzer readings are within proper range. Moving linkage to open the air shutter further should have the effect of raising the O₂ value being reported, as well as lowering the CO value being reported. In order of importance:
- a. O₂ should be 4-7%. Giving preference to the O₂ reading ensures sufficient combustion supply air. Also, the lower the O₂ reading, the higher the stack temperature, and vice versa.
 - i. Shorten the travel to reduce the O₂ reading, increase the travel to raise it.
 - ii. NO_x is not a typical measurement to deal with in all areas. If NO_x control is desired, the key to lowering NO_x readings is achieving a cooler flame temperature. Usually, the burner must be specially designed for low NO_x applications, but it is possible to trim a standard burner to minimize the NO_x emissions as well by adjusting the O₂.
 - b. CO should be less than 200 ppm. It is desirable to have as little CO as possible and single-digit or even a 0 ppm reading is reasonably possible to achieve.
 - i. CO = sooting potential. Legal limits on CO are typically 200 ppm, but the lower the number, the better. Power Flame's preference is >50 ppm.
 - c. CO₂ should be 8.5-10%. [10-11.5% for Propane]
 - i. This is the least important of the three main readings.

20. Now that High Fire is set, check Low Fire.

- a. Move the jumper wire from BN9 to BN8.
- b. Clock the meter to verify appropriate volume for Low Fire.
 - i. Watch the 2 cubic foot indicator on the gas meter. If necessary, adjust the volume by moving the setting on the Blue Cam. One revolution of the 2 cubic foot indicator at low fire at proper volume rate should take:

CH-K30	29.1 sec	CH-K50	17.4 sec	CH-K80	10.9 sec
CH-K40	21.9 sec	CH-K60	14.6 sec	CH-K100	8.74 sec

- c. Verify the combustion analyzer readings are still in acceptable ranges.
- d. If any changes had to be made, it will be necessary to go back and verify the combustion analysis of High Fire once again.

21. Once combustion analysis and burner setup are complete for High Fire and Low Fire, cycle the unit several times by switching the rocker switch on the front panel to "Stop" then after waiting for a few seconds, switching it back to "Run". Ignition should be very smooth. It is possible for ignition to be so smooth that it is difficult to hear the main flame ignite.

22. If there are multiple units using the same gas and/or combustion air supply, halt startup on this particular unit at this time. Begin startup of the other units and bring all units to this same step in the startup sequence before continuing to completion of the burner setup for all units.

23. Once all units are at this same step in the startup sequence, fire all units at High Fire by setting all unit jumper wires to jump BN10 to BN9.

- a. Make note of the supply gas pressure. If it falls by more than 2" wc, or if it falls below 5" wc at all (7" wc for 100-ton units) [11" wc for Propane], the installation does not have enough gas supply and that will have to be addressed before all units can operate properly in a simultaneous manner.
- b. Clock the gas meter for each unit to make certain there is sufficient volume available for all units.

- c. Finally, do a combustion analysis of each unit while all are running at high fire. The analysis readings should stay within allowable limits. If these readings are out of line, it is likely to be an indication of insufficient combustion supply air.
- d. **Record clocking times, manifold gas pressures, and combustion analysis readings for both Low and High Fire in the appropriate areas of the Data Sheet(s).**

24. Optimize the Pilot.

- a. Adjust the pilot regulator up and down to determine the upper and lower pressure limits necessary to maintain a flame signal voltage in excess of 4 volts.
- b. Set the pilot pressure near the mid-point of the upper and lower limits.
- c. **Record the final pilot pressure and flame signal strength in the appropriate areas of the Data Sheet(s).**
 - i. It is possible that pilot pressure can approach manifold pressure after optimization, but it should not exceed it.
- d. If pilot cannot be properly optimized, check condition and position of the pilot assembly itself.

25. Burner setup complete. Remove the jumper wire and re-install the RRBH relay. Cycle unit several times to verify proper and expected operation.

26. Mark linkage positions.

- a. Note that the typical "Off" position of the Mod Motor is dictated by the Orange Cam, so it is not unusual for the air shutters to be open slightly when the burner is off once setup has been completed.

Completing Start-Up

1. Set TC and TH points (optional). Adjustment must be done on the CPU board using a screwdriver. It is not possible to set these points by remote interfaces. The TC and TH potentiometers are accessible through a pre-punched hole in the cover over the CPU and IO Boards. Changes to the set point are only observable using the ACT3 tool by plugging it into the jack on the CPU board.
 - a. TC is the chilled water set point.
 - i. The value of this point is found on the ACT-3 under Temperature Display as Data Point 15 in the menu.
 1. The value typically reads 0.00, which is "zero degrees adjusted from standard set point." Standard set point is 43.7F, the temperature at which the chiller shuts down as it has satisfied the chilled water loop temperature requirements.
 - ii. Unit staging can be accomplished by simply setting this number so that set points differ from unit to unit by 1F.
 1. To have multiple units in the same stage, simply set their TC settings to the same point.
 - b. TH is the hot water set point.
 - i. The value of this point is also found on the ACT-3 under Temperature Display as Data Point 16 in the menu.
 1. The value also typically reads 0.00 for the same reasons as TC. However, the standard set point for TH is 135.5F.
 - ii. All the same rules for adjustment and staging used for setting TC apply as well for TH.

2. Set the rocker switch on the front panel to the proper position for your control scheme.
 - a. "Stop" should be used if no operation is desired at time of completion of the start-up.
 - b. "Run" should be used if operation is desired and the machine will be left to control itself.
 - c. "Remote" should be used if building management or other forms of energy management controls will be used to enable or disable the machine.

3. Verify the operation of the Palladium Cell Heater. **Record "Yes" or "No" to indicate proper operation in the appropriate area of the Data Sheet.**
 - a. The simplest method is to simply feel of the tubing down near the elbow into the unit body to see if it is warm.
 - i. **WARNING:** The PCH itself operates 550-600F, so the heat transmits easily down the metal tubing.
 - b. Alternatively, taking an amp draw reading would also prove operation of the PCH.

4. **Record all data points from the ACT-3 as requested by the Data Sheet.**

5. **Fill in all remaining blanks as is possible with the tools and data you have at hand.**

Please send a copy of all paperwork to:

Yazaki Energy Systems, Inc.
701 E. Plano Pkwy, Suite 305
Plano, TX, 75074

or FAX it to (469) 229-5448

or EMAIL it to yazaki@yazakienergy.com or cmccord@yazakienergy.com