

Document No	ENG-SVC-0005	Author	J. Roby	Approved	J. Roby	Revision	A
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1 Site Planning

Refer to the Cincinnati Inc. Site Planning Guidelines ENG-SVC-0004 for proper chiller placement and facilities requirements.


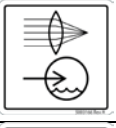
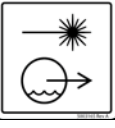
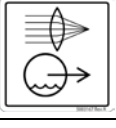
2 Installation

2.1 Pre-Installation

Read the chiller manual prior to installation. A printed manual can be found in the pocket on the inside of the electrical panel door. An electronic PDF of the manual can be accessed by scanning the QR code on the chiller Data Tag.

2.2 Plumbing Connections

The laser system is supplied with a hose kit for making the connections to the chiller. The table below identifies the chiller plumbing connections:

Symbol	Description	Symbol	Description
	Laser circuit fluid inlet to the chiller from the laser system.		Optics circuit fluid inlet to the chiller from the laser system.
	Laser circuit fluid outlet from the chiller to the laser system.		Optics circuit fluid outlet from the chiller to the laser system.



CAUTION

Do not use ferrous (galvanized or black iron) fittings when connecting the chiller to the laser system. The laser system uses de-ionized water that is incompatible with ferrous fittings.

2.3 Filling the Coolant Reservoir

Fill the chiller reservoir with deionized water (DI) or distilled water up to the high level mark on the reservoir sight glass.



CAUTION

Do not use tap water or glycol in the chiller. Tap water takes excessive time to de-ionize and glycol will break down the deionizing material in the DI filter.

2.4 Electrical Power Connections


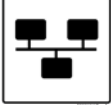
Connect 460V 3-Phase power to the chiller's main circuit breaker disconnect. Ensure that the electrical supply conforms to all local and national electrical codes for the chiller power requirements listed in the table below:

Criterion	5 Ton Chiller	10 Ton Chiller
Voltage [V]	460 ± 10%	460 ± 10%
Phase	3	3
Frequency [Hz]	60	60
FLA [A]	25	37
MCA [A]	27	40
MOPD [A]	40	50
SCCA [kA]	5	5

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2.5 Laser System Communication Connections

Connect the interlock and MODBUS cables to the chiller. The communication connections are located on the back side of the chiller to the right of the fluid connections. The table below identifies the communication connections:

Symbol	Description	Connection Type
	Chiller physical interlocks	6-Pin M12 Circular Connector
	MODBUS communication port	RJ-45 for Ethernet cable

3 Pre-Startup Procedure


3.1 Power-up

- Ensure the system On/Off Switch is in the “O” position.
- Turn the Main Disconnect Handle to the “On” position.

NOTE

The PLC controller will turn on and go through an automatic self-test. When the self-test is complete, the controller will begin to monitor the system, but the chiller will not start.

3.2 Fault Check

Once the chiller is powered on, any active alarms or warnings will be displayed on the controller after its start-up and self-test sequences are complete. To access the alarm list, press the Alarm Button  on the controller. Most chiller alarms indicate a condition that prevents the chiller and/or laser system from operating safely. When this is the case the chiller controller deactivates the laser system Chiller OK interlock circuit and illuminates the “Chiller Fault” light (red) next to the controller.

3.2.1 Sensor Check

Upon power-up, the controller will begin monitoring the chiller system for proper operation. If any sensors read open, short, or out of range, the controller will display warning messages on the screen and the controller alarm will sound.

3.2.2 Phase Monitor

The chiller is equipped with a phase monitor which checks for proper phasing and phase imbalance. If the incoming power line connections to the main circuit breaker disconnect are not connected properly, or if there is more than a 10% imbalance between phases, the controller will display a “Phase Monitor Alarm” (AL22) upon power-up. To correct a phase monitor alarm, swap any two phases on the incoming power line connections to the chiller Main Circuit Breaker Disconnect. If the phase monitor alarm does not go away after swapping the phase leads, a power conditioner may need to be installed.

3.2.3 DI Water

The chiller is equipped with an internal DI water conditioning circuit that is configured to control the cooling water between 35 and 40 $\mu\text{S}/\text{cm}$. If the chiller is initially filled with Distilled water, the DI level will often be higher than the DI control range and the controller may indicate a DI warning or alarm. This is corrected by starting the chiller in “Local Mode” (See section 4.3.5).

3.3 Compressor Warm-up

Once the Main Disconnect Handle on the chiller is turned on, power is supplied to crankcase heaters on the compressor crankcase. The crankcase heaters heat the oil in the compressor crankcases to ensure that no liquid refrigerant has condensed in the crankcase oil. **Allow the chiller to sit for at least 8 hours with the Main Disconnect Handle in the “On” position**, prior to turning on the chiller with the On/Off Switch.



CAUTION

Starting the chiller pre-maturely without allowing adequate time for the compressors to warm-up can allow the liquid refrigerant to be pumped through the compressor lubrication system and cause permanent damage to the compressor bearings and void the chiller warranty.

4 Startup Procedure

4.1 Check Plumbing Connections

Check all the connections between the chiller and the laser system to ensure that the hoses are free of kinks and all valves are open.









4.2 Manual Review

Before starting the chiller, review Section 4 (Operation) and Section 5 (Controller) of the chiller manual to become familiar with the basic chiller operation and controller navigation.

4.3 Local Mode Start-up

The chiller can be operated in a Local Mode where it operates independent of the laser system, or in the default Remote Mode where it starts and stops automatically based on the state of the Remote Start/Stop interlock from the laser system. Upon initial startup, the chiller should be started in Local Mode to verify chiller operation independent of the laser system. Depending on the type of water used to fill the chiller coolant reservoir, it may take several hours for the internal DI water conditioning system to bring the water DI level down to the proper levels.

4.3.1 Activating Local Mode

To activate Local Mode, press  on the chiller home menu to highlight the MAINTENANCE & SERVICE selection and press . Next press  on the MAINTENANCE & SERVICE menu to select TEST RUN and press . On the “Local Mode” screen press  again to highlight the Local Mode switch and press  to change the Local Mode switch state to ON. Press  again to accept the change and press  to return back to the home screen. There should now be a “Unit on in Local Mode” message on the home screen.

4.3.2 Starting the Chiller





To start the chiller turn the On/Off Switch below the controller to the “I” position. The pumps will turn on and start circulating water.


4.3.3 Leak Check

- Thoroughly check all the plumbing hoses and fittings between the chiller and laser system to ensure no leaks are present.
- Remove the filter panel from the side of the chiller and inspect the internal chiller plumbing to ensure there are no internal plumbing leaks.





- Replace the filter panel.
- If any leaks are found turn the On/Off Switch to the “O” position and wait for the pumps to automatically shut off (~2min).
- Once any leaks have been repaired restart the procedure at 4.3 Local Mode Start-up.

4.3.4 Pump Check

From the chiller controller home screen press  and/or  to highlight the MONITORING selection. Press  to access the Monitoring menu and press  until the “Laser Circuit” monitoring screen appears. Check the laser pump “Flow Rate” to make sure it matches the flow setpoint. Also check the laser circuit discharge pressure (“Dis Press”) to ensure it is at least 5 psi below the shutdown pressure of 90 psi.

After confirming the Laser Pump is operating as expected, press the  again to access the “Optics Circuit” monitoring screen. Check the optics pump “Flow Rate” to make sure it matches the flow setpoint. Also check the optics circuit discharge pressure (“Dis Press”) to ensure it is at least 5 psi below the shutdown pressure of 75 psi.

4.3.5 DI Check

From the chiller controller home screen press  and/or  to highlight the MONITORING selection. Press  to access the Monitoring menu and press  until the “DI Circuit” monitoring screen appears. If the “Level” is greater than 40 $\mu\text{S}/\text{cm}$ make sure that the “Solenoid Status” is “On.” Monitor the DI level for a few minutes to make sure the DI level is decreasing.




NOTE

The chiller is equipped with an automatic DI water conditioning system. The system is designed to maintain the DI water between 35 $\mu\text{S}/\text{cm}$ and 40 $\mu\text{S}/\text{cm}$. Upon initial startup, the DI water level may be much higher than this. If the DI level is greater than 46 $\mu\text{S}/\text{cm}$ the chiller controller will generate an alarm and shut down the laser system. This alarm resets when the level is less than 42 $\mu\text{S}/\text{cm}$. Starting the chiller up in Local Mode allows the DI water conditioning circuit to bring the DI level within the desired operating range before the laser system is started.









NOTE

The chiller controller also generates a DI Warning message when the DI level is greater than 41 $\mu\text{S}/\text{cm}$. This warning is used during normal operation to alert the operator that the DI filter is worn out and should be replaced. The warning resets when the DI level is less than 37 $\mu\text{S}/\text{cm}$.

4.3.6 Temperature Check

From the chiller controller home screen press  and/or  to highlight the MONITORING selection. Press  to access the Monitoring menu. The first screen will be the Process Temperature Monitoring screen. Check the laser and optics circuit temperatures on this screen. On initial startup the laser circuit temperature will typically be 10-15°F below setpoint. To increase the temperature quickly the chiller will automatically turn on the inline heater in the optics circuit at 100% and re-position the optics circuit diverting valve to direct all the optics circuit water returning from the laser system to the chiller reservoir. Once the laser outlet temperature gets close to its setpoint, the optics circuit diverting valve will reposition to regulate the optics circuit outlet temperature.

4.4 Remote Mode

Once the chiller temperatures and DI water levels are in the desired range, the chiller is ready to be controlled remotely by the laser system. To enable Remote Mode, press  on the chiller home menu to highlight the MAINTENANCE & SERVICE selection and press . Next press  on the MAINTENANCE & SERVICE menu to select TEST RUN and press . On the Local Mode screen, press  again to highlight the Local Mode switch and press  to change the Local Mode switch state to OFF. Press  again to accept the change and press  to return back to the home screen. There should now be a “Unit on in Remote Mode” message on the home screen.

The chiller will now be running in Standby Mode awaiting the Remote Start signal from the laser system. While in Standby Mode the refrigeration system will not run, but the chiller will start the pumps and heater as needed to keep the water warm. While waiting for the Remote Start signal, the chiller water temperature may exceed the setpoints if the ambient temperature is high. As soon as the chiller receives the Remote Start signal, the refrigeration system will start and the water temperatures will drop to the setpoints.

5 Shutdown

For normal shutdown, turn the On/Off Switch below the controller to the “O” position. The chiller controller will begin the normal shutdown sequence and display a “Shutdown in Progress” status message. The normal shutdown sequence typically takes 2-5 minutes. During this time the controller closes the liquid line solenoid in the refrigeration system and pumps the refrigerant into the coil, so there is no risk of slugging liquid refrigerant through the compressor on the next startup. It also turns off the in-line heater in the optics circuit, while the pumps continue to run to dissipate any residual heat in the heater element. Once the shutdown sequence is complete the chiller controller will display a “UNIT OFF” status message.



CAUTION

Shutting off the chiller using the Main Disconnect Handle will bypass the normal shutdown sequence and should only be used in emergency situations. Repeated shutdown using the main disconnect handle will cause damage to the compressor system and void the chiller warranty. It can also cause overheating of the inline heater and trip the heater limit switch.

6 Service

For chiller service, turn the On/Off Switch below the controller to the “O” position and allow the chiller to complete its normal shutdown sequence. Once the shutdown sequence is complete and the controller indicates “Unit Off” turn the Main Disconnect Handle to the “Off” position.



WARNING

Do not service unit until power is secure. Follow standard Lockout/Tag-out procedures.

After completing service, turn the Main Disconnect Handle back to the “On” position and allow the crankcase heaters to warm-up the compressors prior to restarting the chiller. Follow the table below for recommended warm-up times.

Disconnect off Time	Compressor Warm-up Time
< 30 min	0 min
30 min to 2 hrs	2 hrs
2 hrs to 4 hrs	4 hrs
> 4 hrs	8 hrs