1500-5L AND 1500-20L
BOTANICAL OIL EXTRACTION SYSTEM
OWNER’S MANUAL

⚠️ WARNING ⚠️
FAILURE TO FOLLOW THE SETUP AND OPERATION PROCEDURE PROVIDED IN WITHIN THIS MANUAL MAY VOID THE EXTRACTION SYSTEM’S WARRANTY

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1. Critical Safety Overview

Throughout these instructions, this symbol is used to indicate that the instructions are critically important to your safety and the safety of your system. Failure to follow the instructions as written can result in a rapid release of high pressure CO₂ potentially causing equipment or personnel damage.

⚠️ WARNING ⚠️

Subcritical and Supercritical CO₂ systems operate under high pressure. Operators must be fully trained and familiar with the system. Failure to operate the system can result in equipment damage and/or bodily injury.

⚠️ WARNING ⚠️

Subcritical and Supercritical CO₂ systems use large amounts of CO₂ during operation. Ensure that system is installed in a well-ventilated area to prevent buildup of CO₂ which can cause asphyxiation. Use of a CO₂ monitor is strongly recommended.

⚠️ WARNING ⚠️

Opening a vessel under pressure can result in a rapid release of pressure and ejection of the material inside the vessel. DO NOT ATTEMPT TO OPEN A VESSEL UNDER PRESSURE! Always make sure a vent path for the vessel is opened and the corresponding pressure gage reads zero prior to loosening the vessel closure bolts.

⚠️ WARNING ⚠️

Subcritical and Supercritical CO₂ systems are designed to operate in doors. Extreme temperatures (below 50°F and above 85°F) will negatively impact the functionality of the system. The environmental temperature range is for the system, chiller, pump and CO₂ bottles.

⚠️ WARNING ⚠️

Only use Propylene Glycol and distilled water in the chiller and cooling system. Never use Deionized Water in the chiller or cooling system.

⚠️ WARNING ⚠️

Never turn on the chiller without the thermocouple probe installed and connected to the chiller.
2. Unpacking Instructions

Apeks 1500-5L and 1500-20L systems are shipped in three separator crates. One containing the chiller, one containing the air compressor and one containing the botanical extraction system. Following are the steps for removing the system from the crates and making service connections for initial use.

2.1. Shipping Crate Inspection

2.1.1. Prior to opening the crate(s), verify that that there was no external damage caused to the wood crate. If damage is found, do not accept the delivery from the shipping company without first opening the crate to verify that there was no damage to the system. Additionally, call Apeks at 614-354-4451 to report damage and start the reporting process with the shipping company.

![Figure 1. Approximate appearance of 1500-5L and 1500-20L Shipping Crate](image1)

2.1.2. Locate the two TiltWatch Plus sensors on the outside of the crate. Ensure that the crate has not exceeded 30° in any direction. If the crate has exceeded 30°, do not accept the delivery from the shipping company until contacting Apeks at 614-354-4451.

![Figure 2. TiltWatch Sensor](image2)
2.2. Unpacking Instructions

2.2.1. Remove the plywood from the all four sides and the top of the crate using a Phillips head screwdriver.

2.2.2. Remove the support hardware inside the crate. Support hardware should include a cordless impact wrench, impact wrench socket, 11/16-in open end wrench, 5/8-in ratchet wrench, aluminum funnel, two O-rings, four sanitary gaskets, a flexible metal hose, a vacuum hose, vacuum pump and four rubber coated leveling feet.

2.2.3. Remove the horizontal 2x3s from the top of the crate using a hammer or crowbar.

2.2.4. Remove the vertical 2x4s from the four corners of the crate using a hammer or crowbar.

2.2.5. Remove the two 2x3s running across the top of the system frame and the two 2x3s running alongside the system frame using a Phillips head screwdriver.
2.2.1. Using a forklift or pallet jack lift the system off the base of the crate. It may be necessary to tip the system slightly towards the back in order to slide the forks under the stainless steel horizontal frame support members.

2.2.1.1. The system weighs in excess of 600-lbs, take extreme caution when lifting or moving the system. Do not attempt this step without adequate help.

WARNING
The system weighs over 600-lbs (275-kg), use a minimum of three people to stabilize the system while moving.

2.2.2. Remove the chiller (in cardboard box) from the second crate.

WARNING
The chiller over 120-lbs, use a minimum of two people or a lift cart when moving the chiller assembly.

2.2.3. Retain the crate and all packing materials for future shipping should the system ever need to be moved to another facility or shipped back to Apeks.
3. System Requirements

3.1. General System Specifications

<table>
<thead>
<tr>
<th></th>
<th>1500-5L Extraction System</th>
<th>Chiller/Heater System</th>
<th>Compressor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel Size (liter)</td>
<td>5-L</td>
<td>15-L</td>
<td>80-Gal</td>
</tr>
<tr>
<td>Max Pressure (psi)</td>
<td>1500-psi</td>
<td>100-psi</td>
<td>125-PSI</td>
</tr>
<tr>
<td>Operating Temperature (°F)</td>
<td>14°F - 122°F</td>
<td>14°F - 122°F</td>
<td>N/A</td>
</tr>
<tr>
<td>Dimensions (in)</td>
<td>45 X 30 X 77</td>
<td>28 X 15 X 23</td>
<td>54 X 29 X 61</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>460-lbs</td>
<td>168-LBS</td>
<td>1000-LBS</td>
</tr>
<tr>
<td>Power (V/A/Phase)</td>
<td>110/15/1PH</td>
<td>230/12/1PH</td>
<td>230/40/3PH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1500-20L Extraction System</th>
<th>Chiller/Heater System</th>
<th>Compressor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel Size (liter)</td>
<td>20-L</td>
<td>45-L</td>
<td>80-Gal</td>
</tr>
<tr>
<td>Max Pressure (psi)</td>
<td>1500-psi</td>
<td>100-psi</td>
<td>125-PSI</td>
</tr>
<tr>
<td>Operating Temperature (°F)</td>
<td>14°F - 122°F</td>
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<td>110/15/1PH</td>
<td>230/12/1PH</td>
<td>230/60/3PH</td>
</tr>
</tbody>
</table>

3.2. Facility

3.2.1. Temperature – The 1500-5L and 1500-20L are designed to run in a climate controlled facility, where the temperature is maintained between 50°F and 85°F.

3.2.2. Dust Control – The 1500-5L and 1500-20L should not be placed in an environment that has excess dust from other manufacturing operations.

3.2.3. Location – The system is designed to be installed on a concrete or similarly stable and flat floor.

3.2.4. Compressed Air – Compressed air must be non-lubricated and should be filtered to between 5μ and 40μ and have a dew point between 0°F and 50°F

3.3. Electrical

3.3.1. The 1500-5L and 1500-20L have three independent electrical requirements; a 110V, 15A, 60Hz, 1 phase NEMA 5-15 male plug for the systems controller, a 220V, 15A, 60Hz, 1 phase NEMA 6-15 male plug for the chiller/heater, and a hardwired 230-V, 3 phase connection for the air compressor. See chiller and air compressor manuals for additional electrical requirements.

3.3.1.1. Note that the air compressors can also be ordered prewired for 440-V to 480-V circuits.

⚠️ WARNING ⚠️

Do not modify the power connections.
3.4. Recirculating Water Chiller/Heater

3.4.1. Recirculating chiller/heater fluid should be a mixture of 50/50 distilled water and propylene glycol.

⚠️ WARNING ⚠️

Do not use Deionized Water

4. Setup and Assembly

1500-5L and 1500-20L system, chiller and air compressor come fully assembled and require only facility hookup and system interconnect installation.

4.1. Leveling Feet

4.1.1. Use a fork lift or pallet jack to raise the system approximately 6-in off the ground, use clamps or tie down straps to secure the system to the forks/jack to prevent it from tipping.

4.1.2. Insert the supplied leveling feet into the four threaded holes on the bottom of the extraction system. Ensure that the leveling feet are not threaded into the scale receiver too far or they will hit the frame and negate scale functionality.

![Figure 7. Extraction system leveling feet.](image)

4.2. Coolant Connections

⚠️ WARNING ⚠️

Never turn on the chiller without the remote temperature probe installed and connected to the chiller.

4.2.1. Connect the blue cooling lines to the back of the chiller.

4.2.1.1. Connect the free end of the coiled heat exchanger blue cooling line to the outlet port on the back of the chiller. Connect the free end of the upper separator #2 blue cooling line to the inlet port on the back of the chiller.
4.2.2. The separator side of the extraction system will be pre-assembled. In the event that adjustments need to be made or the system gets taken apart during use, the water flow path should always be from bottom to top in any vertically oriented vessel.

4.2.2.1. For systems with a 4-in separator upgrade. The collection cup has baffles installed that control the coolant flow path. Therefore either cooling line port on the collection cup can be connected to the inlet or outlet.

4.2.3. The remote temperature probe is typically pre-assembled into the bottom of the 1500-5L and 1500-20L extraction vessels. If it is not installed or it was removed after receipt of the system, install the probe into the tube fitting located off center on the bottom flange of the extraction vessel. The nut on the tube fitting should be tighten 1/8-turn past finger tight or until it is leak free. Additional instructions regarding these tube fittings is available at http://www.swagelok.com/downloads/webcatalogs/EN/MS-13-151.pdf
4.3. **CO₂ Connections**

![Figure 10. Location of remote temperature probe on bottom of extraction vessel](image)

**WARNING**

CO₂ cylinders are under high pressure. Use proper storage and handling procedures to prevent damage and sudden release of CO₂ from the cylinder.

4.3.1. CO₂ used with the 1500-5L and 1500-20L system should be a 99% purity or better (medical or food grade typically suffice), gas feed, 50-lb, 75-lb or 100-lb high pressure cylinder.

4.3.1.1. The CO₂ cylinder connection is a standard CGA-320 and is provided with the system.

4.3.2. The supplied hose should be connected directly to the CO₂ cylinder valve. No regulator is required. A supplied CGA-320 plastic gasket is required to seal the connection between the hose and the CO₂ cylinder.

![Figure 11. CO₂ cylinder connection](image)

4.3.3. The CO₂ line is typically preassembled on the 1500-5L and 1500-20L systems. If the line was not connected or was removed for cleaning/shipping, reconnect the line to the tube fitting located on top of Valve 12. The connection is a metal-to-metal seal and does not require any thread sealant. Tighten 1/8 turn past finger tight or until leak free. Additional instructions regarding these tube fittings is available at [http://www.swagelok.com/downloads/webcatalogs/EN/MS-13-151.pdf](http://www.swagelok.com/downloads/webcatalogs/EN/MS-13-151.pdf).
4.4. **Air System Connections**

4.4.1. The air filter and solenoid valve assembly is typically preassembled on the system. If the assembly was not connected or was removed for cleaning/shipping, reconnect the assembly using two large crescent wrenches. The fittings are brass metal to metal seals. Do not over tighten.

4.4.2. Connect the air compressor to the blue filter using a ½-in male NPT fitting.

4.4.2.1. **CO₂** system air connection is ½” NPT female. Connection to compressed air should be made through a minimum ½” inner diameter pipe or flexible hose. Runs longer than 20 feet should be ¾” minimum inner diameter.

4.4.2.2. Always follow the air compressor manufacturer’s operating instructions to insure proper performance of the compressed air system.

4.5. **Electrical Connections**

4.5.1. Hardwire the compressor in accordance with the manufacturer's specifications.

4.5.1.1. Ensure that both the compressor and the refrigerant drier are wired correctly.

4.5.1.2. The compressor will typically be 230-V or 460-V, 3-Phase. The refrigerant drier is typically 110-V, 1-Phase.

4.5.2. Plug the extraction system control panel into a 110-V, 15-A standard outlet.

4.5.3. Insert and tighten the remote temperature probe’s RS232 connection into the back of the chiller in the Remote Probe port.

4.5.3.1. The remote temperature probe and the chiller must be connected whenever the chiller’s main circuit breaker switch is on. Failure to connect the thermocouple probe will cause the chiller to stop working and require
maintenance from the manufacturer. Damaged caused by operating the chiller without the remote temperature probe installed and connected will not be covered by warranty.

**WARNING**

Do not turn plug in or turn on the chiller with remote probe disconnected or disconnect the probe while the chiller is under power.

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**4.6. Chiller/Heater Setup**

4.6.1. Attach the supplied cord to the back of the chiller. See Figure 14.

4.6.2. Plug the chiller into a 220-V, 15-A outlet.

4.6.3. It may be necessary to adjust the chiller settings for Remote Probe Control mode.

4.6.3.1. To verify chiller is in Remote Probe Control mode, press the Menu button 5 times until the left display shows “P1” or “P2”.

4.6.3.2. If left display shows “P1”, then chiller is in Remote Probe Control mode and no other adjustments are necessary. Press menu 1 time so the left display shows water pressure in “psi”.

4.6.3.3. NOTE: When “P1” is displayed on the left screen, the temperature of the water inside the chiller displayed on the right screen.

4.6.4. If left display shows “P2”, then press and hold menu button for ~3 seconds, press menu button 6 times until “rP” is displayed on the left, and use the temperature control knob to adjust the right display setting to “rPC”. Wait for 10 seconds for the chiller to reset out of the menu mode.

4.6.5. Coolant fluid (50/50 mix of distilled water and propylene glycol) is added to the system through the reservoir cap on the top of the chiller.

4.6.5.1. After the system is operational, recheck the coolant level (while the system is running) and add more coolant as necessary.

4.6.6. More detailed operating instructions for the heater/chiller can be found in the manufacturer’s operating instructions.
5. System Operation

The following operating instructions are for the 1500-5L and 1500-20L CO₂-based Botanical Oil Extraction systems. Instructions assume that chiller and CO₂ Booster Pump are OEM supplied. Failure to follow the instructions provided below may void the warranty of the 1500-5L and 1500-20L systems.

5.1. 1500-5L and 20L Overview
5.2. Automation Systems Overview

5.2.1. The Human Machine Interface (HMI) is a touch screen. Almost all of the inputs, outputs and human/machine interactions are managed through the HMI. The features not controlled or reported through the HMI are the Air Compressor maintenance schedule and the chiller/heater temperature setting. Refer to their respective owners manuals for additional operational instructions.

5.2.2. The HMI has two functions; 1) to provide information and 2) to accept inputs from the operator. The ways to determine if an action is required by the user are defined below.

5.2.2.1. If a display value or message is colored Red or Orange, an operator must take and action before progressing forward.

5.2.2.1.1. Red indicates messages indicate that a component of the system has either failed to reach the minimum operating pressures or temperatures or that it exceeded the programmed operating limits.

5.2.2.1.2. Orange indicates that an operator activity is required before the Start button can be depressed. Typically, messages highlighted Orange are indicative of a scheduled maintenance interval being reached.

5.2.3. Any variable or message that needs to be (or can be) controlled by the operator are graphically raised to illustrate that the “message” is a button. An example of the different graphical representations is shown below.

![Figure 15. Chiller/Heater Remote Temperature Probe Connection](image)

5.2.1. The controller has safety interlocks preprogrammed into it. These safety interlocks prevent unsafe operations from occurring by always monitoring the systems parameters and by removing unsafe action/input control buttons from the HMI. When buttons appear to be missing from the home screen, it is because the system is performing an operation that would be unsafe in combination with the missing button/action.

5.2.2. The HMI will provide message popups (in yellow boxes) to instruct the operator what steps are required next in order in to complete any action selected. Most message popups are also acknowledgement buttons that must be pressed before any further action can be taken.

5.2.3. The primary operating valves on the 1500-5L and 1500-20L are air actuated valves controlled by the systems controller. In the event of an air compressor failure or a power failure all air actuated valve will close automatically.

5.2.4. Each air actuated valve has an indicator on the top to inform the operator which valves are open and which ones are closed. The indicator lines correspond with the flow direction. The following figure illustrates both and open and closed valve. Note that it does not matter which way the air actuator is oriented, rather the direction of CO₂ flow is important.
5.3. Pre-Cleaning

5.3.1. The 1500-5L and 20L systems are constructed from 304 and 316 stainless steel and can be cleaned with any cleaner that is compatible with both stainless steel and your extracted product. Simple Green cleaner, ethanol and acetone work well for most applications.

5.3.2. The system should be cleaned to the appropriate level (determined by your application and corresponding regulations) prior to processing each batch of botanical material.

5.3.2.1. Apeks takes great care to clean all systems prior to shipping, however, it is the user's responsibility to ensure that the system meets their required level of cleanliness.

5.4. Opening Extraction Vessel

**WARNING**

DO NOT ATTEMPT TO OPEN A VESSEL UNDER PRESSURE!

Always make sure a vent path for the vessel is opened and the corresponding pressure gauge(s) reads zero prior to loosening the vessel closure bolts.

5.4.1. This operation cannot be performed during an extraction. The extraction must be stopped prior to opening the Extraction vessel

5.4.2. From the home screen (see Figure 29), press “Go To Manual Screen” button.

5.4.3. From the manual screen (see Figure 30), press the “Open Extractor Vessel” button.

5.4.3.1. If the extractor is under pressure, the system will require the operator to acknowledge that they want to vent all the CO₂ in the extractor.

5.4.4. When the extractor vessel gauge on top of the vessel and on the home screen both read zero, it is safe to move to the next step.

5.4.5. Used the supplied impact wrench to remove the bolts from the top or bottom flange.

5.4.6. Pivot the flange toward the back and let it rest on the integral hinge stops.

5.4.6.1. Use caution not to scratch or otherwise damage the O-ring sealing surfaces on the flanges.
5.5. Loading Botanical or Other Media

5.5.1. Material to be extracted is loaded directly into the extraction vessel. The supplied funnel can be used to help minimize spillage.

5.5.1.1. Typically botanicals perform best in CO₂ extractions when ground to a particle size between 50 µm and roughly the consistency of coffee grounds.

5.5.1.2. Any amount of material can be loaded into the Extraction Vessel – the vessel does not have to be full in order to operate correctly.

5.5.2. Gentle compression or packing can be used to increase the amount of material loaded in the vessel, however heavy compaction should be avoided because it will cause channeling of CO₂ during the extraction process.

5.6. Closing Extraction Vessel

5.6.1. Ensure all sealing surfaces are clean and free of debris.

5.6.2. Check the O-ring for any visible damage or defects. Replace as necessary.

5.6.2.1. The O-ring does not require any lubrication.

5.6.3. Close the vessel flange and install each of the closure bolts hand tight.

5.6.4. Using the supplied impact wrench and socket, tighten the bolts in a star pattern. Use the supplied impact wrench with 1-2 second bursts to deliver approximately 50 ft-lbs of torque to each bolt. Heavy torqueing of the bolts is not required.
5.7. **Chiller Start Up**

5.7.1. Verify chiller’s cooling lines are connected to the extraction system.
5.7.2. Turn chiller on
   - 5.7.2.1. The main power switch is located on the back of the chiller see Figure 14
   - 5.7.2.2. The operations power button is located below the black knob on the front of the chiller
5.7.3. Set the target temperature to 65°F by quickly depressing the control knob on the chiller and turning it to the appropriate temperature.
   - 5.7.3.1. In the event that the chiller is displaying temperatures in Celsius, turn off the main power switch, press and hold the menu button on the front of the machine and turn on the main power. Then let off the menu button. The chiller will briefly display dF indicating it is set to display temperature in degrees Fahrenheit.

5.8. **Evacuating the System**

5.8.1. From the Home Screen (see Figure 29), click the Manual Screen Button.
5.8.2. From the Manual Screen (see Figure 30), click the Evacuate Button.
5.8.3. Verify that all the gauges on the system display zero pressure.
5.8.4. Verify that the supplied vacuum pump is filled with the appropriate oil.
   - 5.8.4.1. Refer to the vacuum pump owners manual for more detailed information.
5.8.5. Connect the vacuum gauge, blue vacuum hose and vacuum pump to Valve 10 on the bottom of Separator #2.

![Figure 19. Appearance of correctly connected vacuum gauge, blue vacuum hose and vacuum pump](image)

5.8.2. Turn on the vacuum pump.
5.8.3. Allow the pump to run for approximately 10-min.
   - 5.8.3.1. If the vacuum gauge does not reach -20 in.Hg, either the pump is faulty or there is a leak in the system.
5.8.4. Close Valve 10.
5.8.5. Turn off the vacuum pump.
5.8.6. Disconnect the vacuum gauge, blue vacuum hose and pump.
5.8.7. Press the message button acknowledging that the evacuation is complete
   - 5.8.7.1. The acknowledgement message button will appear on the Manual Screen after pressing the Evacuate Button.
5.8.8. Press the Blue Arrow Buttons to select the Go To Home option on the Manual Screen and press the Return button “enter”.

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5.9. Conducting an Extraction

5.9.1. Press the Go To Auto Mode Button on the upper left hand corner of the Home Screen.

5.9.1.1. This resets the controller and enables it to start a new cycle/extraction.
5.9.1.2. The first time you run the system, immediately following a loss of power, or after any abnormal run conditions the system will default to Manual Mode for safety.

5.9.2. Verify the chiller is on and target temperature is set to 65°F.

5.9.3. Verify that a 50-lb, 75-lb or 100-lb cylinder of CO₂ with a sufficient amount of CO₂ is connected to the system.

5.9.4. Verify that material is loaded into extraction vessel and extraction vessel is properly closed

5.9.4.1. The system can be run with no material in the extraction vessel. This can be used as a way to clean the stainless steel tubing upstream of the separation vessel.

5.9.5. Verify that the Separator vessels are both closed and sanitary clamps are tight (clamps are considered tight when there is a 1/16-in to 1/8-in between opposing sides of the clamp)

5.9.6. Press the Start button on the home screen, Figure 29.

5.9.7. After pressing start the system will prompt the operator to;

5.9.7.1. Set Extractor Pressure (between 900-psi and 1400-psi)

5.9.7.1.1. The recommended starting extractor pressure is 1200-psi

5.9.7.2. Set the System Run Time (between 1-hour and 48-hours)

5.9.7.2.1. The recommended run time is 2 hours per pound of botanical

5.9.7.3. Verify the Extractor is properly closed

5.9.7.4. Verify the Separator is properly closed

5.9.7.5. Close Valve 10

5.9.7.6. Open the CO₂ Bottle

5.9.8. The system will start filling the vessels with CO₂ to the target extractor pressure.

5.9.8.1. During the filling stage the Home Screen will display a blue box labeled “Filling” to inform the operator of the systems current activities.

5.9.9. Once the target extractor pressure is reached, the system information box will change from “Filling” to “Running”. An additional information box will appear indicating the direction of the flow, either “Forward Flow” or “Reverse Flow”.

![Figure 20. Appearance of tight sanitary clamp](image-url)
5.9.9.1. The system routinely switches the flow direction to keep the filters from clogging with plant material and to prevent the CO\textsubscript{2} from forming flow channels inside the plant material.

5.9.10. The system will continue in run mode until it reaches the target run time, at which point it will begin recovering the CO\textsubscript{2} into the CO\textsubscript{2} cylinder. The information box will switch from "Running" to "Recovering".

5.9.10.1. The system will prompt the operator to turn up the chiller/heater to 110-F. This helps to speed up the recovery process.

5.9.10.2. It is not a required step, the system will recover without turning up the temperature or acknowledging the message.

5.9.10.2.1. Note that increases the chiller/heater temperature also increases the temperature of the oil in the collection cup.

5.9.11. At the end of recovery the system will have approximately 70-psi in all the vessels. The system will provide message boxes to instruct the operator through the final shut down process. The prompts are;

5.9.11.1. Close the CO\textsubscript{2} cylinder
5.9.11.2. Open Valve 10.

5.9.12. Once the operator acknowledges that the CO\textsubscript{2} cylinder and Valve 10 are closed, the system will open all valves, vent any trapped CO\textsubscript{2} and wait for the next command.

5.10. Removing Spent Botanical

5.10.1. From the home screen (see Figure 29), press “Go To Manual Screen” button.

5.10.2. From the manual screen (see Figure 30), press the “Open Extractor Vessel” button.

5.10.2.1. If the extractor is under pressure, the system will require the operator to acknowledge that they want to vent all the CO\textsubscript{2} in the extractor.

5.10.3. When the extractor vessel gauge on top of the vessel and on the home screen both read zero, it is safe to move to the next step.

5.10.4. Used the supplied impact wrench to remove the bolts from the top or bottom flange.

5.10.5. Pivot the flange toward the back and let it rest on the integral hinge stops.

5.10.5.1. Use caution not to scratch or otherwise damage the O-ring sealing surfaces on the flanges.

5.10.6. Once the extraction vessel is open, the spent botanical material can be removed with a dust collector or stainless steel vacuum.

5.10.6.1. Alternatively, the bottom vessel closure can be opened using the same instructions provided above. With the bottom closure open the botanical will fall out of the vessel and can be collected in a bag or other collection device.

5.11. Oil Collection

**WARNING**

DO NOT ATTEMPT TO OPEN A VESSEL UNDER PRESSURE!
Always make sure a vent path for the vessel is opened and the corresponding pressure gauge(s) reads zero prior to loosening the vessel closure bolts.
5.11.1. Verify that both Separator vessel gauges read zero and that Valve 10 is open.
5.11.2. Remove the flexible metal lines from the top of the separators. Use two wrenches to prevent the NPT fittings from loosening in the separator cap.

![Image](image.png)

**Figure 21. Illustration of using two wrenches to remove flexible metal lines**

5.11.3. Remove the yellow wire connected to the Separator #1 thermocouple.
5.11.4. Use the 5/8-in ratchet wrench to remove the high pressure sanitary clamps from the top of both the separator vessels.
5.11.5. Remove the caps from the top of both separator vessels.
5.11.6. Collect any available oil from the separator caps.
5.11.7. Use acetone or alcohol to clean the caps and orifice tube.
   5.11.7.1. Separator caps must be cleaned every run.
5.11.8. Use the supplied round squeegee to push any residual oil from the sides of the separators down to the bottom of the separators.
5.11.9. Use the 5/8-in ratchet wrench to remove the high pressure sanitary clamps from the bottom of the separator vessels.
5.11.10. Turn off the chiller/heater
5.11.11. Disconnect the two blue water line quick connects on the back of the collection cup.
5.11.12. Remove the collection cup from Separator #1 and the bottom cap from Separator #2
5.11.13. Collect the oil from inside the collection cup.
   5.11.13.1. Note: there is typically residual dry ice in the collection cup mixed in with the oil. The dry ice will sublimate without any additional heat. It is sometimes more efficient to remove the dry ice/oil mixture and place it in collection device (like a Pyrex dish).
5.11.14. Use the round squeegee and alcohol or acetone to thoroughly clean the inside of the separators and collection cup.

5.11.15. Both separators and the collection cup must be cleaned after each extraction.

5.11.16. Reassemble both separators by reversing the steps above.

5.11.16.1. Reconnect the water lines before turning on the chiller/heater.

5.11.17. Verify that the system is in its waiting mode and all valves are in the open position.

5.11.17.1. If Valve 11 is not open, skip to the next section.

5.11.18. Disconnect the separator outlet line from the cap of Separator #2.

5.11.19. Disconnect the pump inlet line at the tee immediately in front of the pump. Loosen the fitting in the same line (closer to the front of the system so the bent tubing can be pointed downward.)
5.11.20. Pour alcohol or acetone into the separator outlet line until the solvent is colorless coming out the end that was connected to the pump inlet. After which use compressed air to blow out the line ensuring that no residual alcohol or acetone remains in the line between the separator and the pump.

5.11.21. Reconnect the separator outlet line and pump inlet line.

5.11.22. The separator outlet line must be cleaned after each extraction.

6. Troubleshooting

6.1. Ice On Separator
It is normal for the high pressure clamps and flexible metal lines on the top of the separator to form ice during operation. If ice is forming on the outside of the separator vessels that is an indicator that either the chiller/heater was not connected properly/turned on, the collection cup water lines were not reconnected, or that the CO₂ cylinders were too cold. If the bottles are below approximately 50°F, it is possible for the chiller/heater to have difficulty maintain system temperature. If ice forms on the outside of the separator vessel, it suggests that the coolant cannot keep up and may be freezing inside the cooling jacket. In either event, the system should be shut down by pressing the Recover CO₂ Button on the Manual. This will put the system into recovery mode so that the cooling system can be inspected or the bottle can warm up. It will take several hours for the ice to thaw if it froze inside the collection cup cooling jacket.

Do not attempt to work on the cooling system while the system is running.

6.2. Opened Bottle Too Early
If the bottle was accidently opened while the system was in stand by (waiting after previous extraction was completed) there is no way to recover the 100% CO₂. The only way to correct this event is to slowly open Valve 10 until the separator pressure is below 300-psi. At which point the system can be started and it will operate as normal.

6.3. Low Extractor Pressure
If the extractor pressure is unable to meet the target pressure, first verify that the CO₂ cylinder has sufficient CO₂. If yes, this is an indicator that the pump seals have reached the end of their life. If the extractor is above 1000-psi, the system will continue producing oil. Adjust the target pressure to 1000-psi and alloy it system complete its target run time, it is recommended that the run time be increased by 10% to make up for the reduced extractor pressure. After the system completes the cycle, either rebuild the pump or send it out for a rebuild. Apeks can provide contact information for pump rebuild if it is going to be sent out.

6.4. Extractor Overpressure – Orifice Clog
The valveless expansion technology uses a small orifice to regulate pressure. This orifice can become plugged when foreign material is entered into the plumbing between the extraction vessel and separator vessel. Typically, the foreign material is a piece of Teflon tape from the NPT fittings near the orifice.

In the event that separator pressure decreases or extractor pressure increases causing an extractor high pressure fault, it is most likely a plugged orifice. Follow the steps below to clear an orifice clog.

6.4.1. From the Home Screen, Press the Manual Screen Button.
6.4.2. From the Manual Screen, Press the Clear Clogged Orifice Button.
6.4.3. Wait for the system to provide a message popup indicating it is safe to Open Valve 10 and clean the orifice.
6.4.4. Open Valve 10
6.4.5. Verify that both Separator vessel gauges read zero.
6.4.6. Remove the flexible metal lines from the top of the separators. Use two wrenches to prevent the NPT fittings from loosening in the separator cap.
6.4.7. Remove the yellow wire connected to the Separator #1 thermocouple.
6.4.8. Use the 5/8-in ratchet wrench to remove the high pressure sanitary clamps from the top of Separator #1.
6.4.9. Remove the cap from the top of Separator #1.
6.4.10. Remove the orifice from the orifice tube using two wrenches to prevent the 45-deg fitting from rotating.
6.4.11. Clean the orifice by soaking it in acetone or alcohol and blowing it out with compressed air. Verify the orifice is clear by looking through it.
6.4.12. Reassemble the orifice using Teflon tape. Use caution to prevent excess Teflon tape from getting into the orifice. Tighten the orifice assembly such that the orifice is between tangent and +30 degrees from tangent to the separator wall as shown below. This facilitates cyclonic separation and minimizes oil carryover.

![Figure 25. Orifice orientation A) Tangent and B) 30-Deg off tangent](image)

6.4.13. Replace the separator cap and tighten the clamp bolts.
6.4.14. Reinstall the flexible metal hoses and the thermocouple connection.
6.4.15. Close Valve 10.
6.4.16. Press the popup message button when orifice is reinstalled, the high pressure clamps are tight and the flexible hoses are reconnected.

6.5. **Low Separator Pressure – Orifice Clog**
Low Separator pressure is typically caused by one of two things (an orifice clog or the wrong orifice installed). If the system has been operating with the current orifice and consistently maintained a separator pressure between 250-psi and 350-psi, this suggests that the orifice is clogged. To correct an orifice clog refer to the instructions in the section above (Extractor Overpressure).

6.6. **Low Separator Pressure – Wrong Orifice Size**
Low Separator pressure is typically caused by one of two things. If the orifice was recently changed or the system was moved to a new location, the low separator pressure is typically an indicator that the installed orifice is too small. To install the correct orifice;
6.6.1. From the Home Screen, Press the Manual Screen Button.
6.6.2. From the Manual Screen, Press the Clear Clogged Orifice Button.
6.6.3. Wait for the system to provide a message popup indicating it is safe to Open Valve 10 and clean the orifice.
6.6.4. Open Valve 10
6.6.5. Verify that both Separator vessel gauges read zero.
6.6.6. Remove the flexible metal lines from the top of Separator #1. Use two wrenches to prevent the NPT fittings from loosening in the separator cap.
6.6.7. Remove the yellow wire connected to the Separator #1 thermocouple.
6.6.8. Use the 5/8-in ratchet wrench to remove the high pressure sanitary clamps from the top of Separator #1.
6.6.9. Remove the cap from the top of Separator #1.
6.6.10. Remove the orifice from the orifice tube using two wrenches to prevent the 45-deg fitting from rotating.
6.6.11. Use the graphs below to determine which orifice best fits the operating conditions of the system.
   6.6.11.1. Note that it is best to run the largest orifice possible to produce the target extractor pressure while maintaining a separator pressure under 350-psi.
   6.6.11.2. The graphs are baseline recommendations only, temperature, elevation, and humidity all impact air and CO₂ density—which impact orifice size optimization and selection.

Figure 26. Orifice selection guide for a 15-hp compressor
6.6.12. Install a larger orifice using Teflon tape. Use caution to prevent excess Teflon tape from getting into the orifice. Tighten the orifice assembly such that the orifice is between tangent and +30 degrees from tangent to the separator wall as shown below. This facilitates cyclonic separation and minimizes oil carryover.

![Orifice orientation A) Tangent and B) 30-Deg off tangent](image)

6.6.13. Replace the separator cap and tighten the clamp bolts.
6.6.15. Close Valve 10.
6.6.16. Press the popup message button when orifice is reinstalled, the high pressure clamps are tight and the flexible hoses are reconnected.

### 6.7. High Separator #1 Pressure (>350-psi) and Low Separator #2 Pressure

High Separator #1 pressure is most often caused by a clog (dry ice or oil) in the flexible line between Separator #1 and Separator #2. Follow the steps below to clean the flexible line.

6.7.1. From the Home Screen, Press the Manual Screen Button.
6.7.2. From the Manual Screen, Press the Clear Clogged Orifice Button.
6.7.3. Wait for the system to provide a message popup indicating it is safe to Open Valve 10 and clean the orifice.

6.7.4. Open Valve 10

6.7.5. Verify that both Separator vessel gauges read zero.

6.7.6. Completely remove the flexible metal lines from the top of both separators. Use two wrenches to prevent the NPT fittings from loosening in the separator cap.

6.7.7. Thoroughly clean the flexible metal lines with alcohol or acetone to remove any debris that might be clogging the lines.

6.7.8. Blow the flexible metal hoses out with compressed air to verify the clog has been removed.

6.7.9. Reinstall the flexible metal hoses.


6.7.11. Press the popup message button when orifice is reinstalled, the high pressure clamps are tight and the flexible hoses are reconnected.
7. System Maintenance
Maintenance on the system is critical to proper operation. Failure to follow these maintenance items can cause premature system failure and void the warranty. The maintenance items below pertain to the CO₂ system only. Follow the manufacturer’s recommended maintenance plan for the chiller/heater unit.
We include a small squeeze bottle to help with proper maintenance and cleaning of your systems CO₂ lines. We recommend acetone to clean the lines. Please label the bottle accordingly.

![Figure 29. Front and back of chemical squeeze bottle](image)

This maintenance schedule is based on the maintenance timer on the Maintenance Screen (see Figure 31).

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Maintenance Item</th>
</tr>
</thead>
</table>
| After Each Extraction | • Remove spent material from the extraction vessel by vacuuming it out through the top flange.  
  • Verify the extractor filters are clear and free of debris  
  • Check extraction vessel O-rings and O-rings groove sealing surfaces for damage – replace if necessary  
  • Remove extracted oil from separator vessels and clean entire vessel and cup with acetone or alcohol.  
  • Clean the separator outlet line/pump inlet line with acetone or alcohol.  
  • Check separator vessel gaskets for damage – replace if necessary |
| Every 48 hours  | • Lubricate CO₂ pump spool valve O-rings. Replace if necessary.  
  • Clean all flexible metal lines going into and out of both separators  
  • Check chiller/heater water level is between min and max  
  • Clean CO₂ flow lines between the pump and the coiled heat exchanger with acetone or alcohol. Flowlines must be disconnected from pump and extraction system to thoroughly clean. |
| Monthly         | • Remove the CO₂ pump heads and clean with alcohol or acetone. Do not remove the seals from the head unless they show visible signs of wear. In which case, replace the seals before reassembly. |
| Every 500-1000 Hours | • Replace all seals on the CO₂ Pump. The pump seal life is highly dependent on cleanliness. Lack of performing scheduled maintenance will decrease seal life.  
• Signs that your pump needs new seals is when your pump can't reach desired extractor pressure. |
## 8. Replacement and Spare Parts List

<table>
<thead>
<tr>
<th>Part / Component</th>
<th>Vendor</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balston Air Filter Assembly</td>
<td>Parker</td>
<td>2104N-1B1-DX</td>
</tr>
<tr>
<td>Balston Replacement Filter Cartridge</td>
<td>Parker</td>
<td>100-18-DX</td>
</tr>
<tr>
<td>Coolant Line Male Quick Connect</td>
<td>Quickcouplings.net</td>
<td>PLCD29006</td>
</tr>
<tr>
<td>Coolant Line Female Quick Connect</td>
<td>Quickcouplings.net</td>
<td>PLCD14006</td>
</tr>
<tr>
<td>3/8-in Polyethylene Coolant Line</td>
<td>McMaster Carr</td>
<td>5384K55</td>
</tr>
<tr>
<td>3-in Separator Gaskets (Silicone)</td>
<td>McMaster Carr</td>
<td>4520k47</td>
</tr>
<tr>
<td>4-in Separator Gaskets (Silicone)</td>
<td>McMaster Carr</td>
<td>4520k48</td>
</tr>
<tr>
<td>5-Liter Flange O-Ring – DASH 252</td>
<td>McMaster Carr</td>
<td>5308T597</td>
</tr>
<tr>
<td>20-Liter Flange O-Ring – DASH 264</td>
<td>McMaster Carr</td>
<td>5308T319</td>
</tr>
<tr>
<td>5 &amp; 20-Liter Flange Bolts – 1-8 UNC x 3-in</td>
<td>McMaster Carr</td>
<td>92620A957</td>
</tr>
</tbody>
</table>
Appendix A.
1500-5L and 20L Automated System Screen Shots
Figure 29. Home Screen

Figure 30. Manual Screen
Figure 31. Maintenance Screen

Figure 32. Logo Screen
Figure 33. I/O Screen

Figure 34. Alarm Screen
Appendix B.
1500-5L and 1500-20L Piping and Instrumentation Diagram
Apeks Supercritical - www.apekssupercritical.com
1500-5L and 1500-20L
Fully Automatic CO2 System
for Botanical Oil Extractions
Appendix C.
CO₂ Phase Diagram
Pre-Training Checklist

As soon as you receive your system, please read the manual for unpacking and setup instructions. Below is a checklist of what needs to be purchased and completed before an Apeks representative arrives on site for training. Failure to have everything on checklist completed before an Apeks representative arrives on site may result in charges to reschedule training. Apeks representative needs 2 weeks notice to book travel.

- Print off complete Apeks manual and have on site the day of training, along with the manual to the chiller.
- System is unpacked and in its location of operation with leveling feet properly installed. Refer to unpacking instructions in the manual
- Air Compressor is hardwired and ready for operation (Contact Ingersoll Rand regarding any questions) **Please have this complete before scheduling training**
- Insure the air compressor exhaust is properly vented to prevent overheating.
- Insure you have a hose and fittings to connect air compressor to the blue filter. Order hose and fittings from McMaster.com part numbers below
  1- ¾” Safety Air-Exhaust Brass Ball valve 4628K84
  1- Push to connect socket ¾” NPTF female ¾” coupling size 6534K24
  1- ½” NPTF Male, ½ coupling size 1077T23
  1- Air Hose ¾”x ¾” NPTF Male 5304K151
  2- ¾” pipe fully threaded nipple 9171K115
  1- ¾”x 3/8” x ¾” Inline reducing tee 4429K333
  1- Push to connect Socket 3/8” NPTF Male 3/8” coupling size 6534K82
  1- Hose Plug 3/8” NPTF female 3/8” coupling size 1077T22
  2- 3/8” hose with 3/8” male threads on each end 5405K188
  1- Teflon Tape ½” 6802K33
- Insure you have a 220V, 15A, 60Hz, 1 phase NEMA 6-15 female plug for the chiller/heater (Consult with Electrician)
- Insure you have an independent 110V, 15A, 60Hz, 1 phase NEMA 5-15 female plug for the systems controller (Consult with Electrician)
- Chiller is filled with a 50/50 Propylene glycol water mixture. Can be purchased on Amazon or at most auto parts stores. Considered a Low Tox antifreeze, commonly used in RVs for winterizing the lines.
- Purchase and have on site a 50lb Bottle of CO2, gas feed, food grade or better. For 20-Liter systems have 2-50lb bottles, and for systems larger than 20-Liters have 3-50lb bottles of CO2.
- Supplies to purchase and have on site: Can of Acetone (Home Depot), a small bottle to dispense the acetone as shown in the figure to the right (Amazon.com), and a crescent wrench with an opening greater than 1-1/4”
(Air Hose ¾” x ¾” 5304K151) This hose will connect the air compressor to the system as shown. Choose length depending on distance between your air compressor and system.

(3/8” hose with male threads on ends 5405K188) This hose will be used as an additional source of air for cleaning lines and performing maintenance on system. Choose the length you will need to reach system.

McMaster parts number list and quantity of each
1- ¾” Safety Air-Exhaust Brass Ball valve 4628K84
1- Push to connect socket ¾” NPTF female ½” coupling size 6534K24
1- ½” NPTF Male, ½ coupling size 1077T23
1- Air Hose ¾” x ¾” NPTF Male 5304K151
2- ¾” pipe fully threaded nipple 9171K115
1- ¾” x 3/8” x ¾” Inline reducing tee 4429K33
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