2 – 5 LB Icarus Operating Manual

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Best Value Vacs™

The #1 Source for Concentrate and Extraction Purging Equipment

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Introduction:

The Icarus True Dewax closed loop is intended to perform hydrocarbon botanical extraction within a sealed system. Rack mounting provides ease of work, eliminating heavy lifting associated with operating large capacity units of the past.

Here are some features that make running the Icarus so user-friendly.

- 3 stage setup
  - 2 part modular material column (2.5 or 5lb capacity)
  - Separated dewaxing chamber with filters
  - Separated Collection Base for easier recovery
- Rack Mounting
- Manifold setup to remove and add pressure to system
- Polycarbonate sight window on dewax and collection chambers.

General Uses and Extraction Information

Hydrocarbon extraction is performed by passing a hydrocarbon solvent over an organic material to separate terpenes and other hydrocarbon compounds. Solvent is then distilled to leave the extracted compounds behind. The Icarus is a passive closed loop, so moving the solvent through the system is dependent upon the manipulation of temperature and pressure. This system is intended to be run with 100% butane (R-600) or iso-butane (R-600a). Solvents always seek the lowest pressure in the system. By chilling the receiving vessel below the boiling point of the solvent used, the liquid solvent will seek that vessel to reduce its pressure.

General Safety Information

When operated and maintained according to the directions in the manual common and safety procedures, the Icarus system should provide a safe and reliable extraction process. This unit should be run only in extremely well ventilated areas. If running the unit indoors, it must be operated in areas approved by local fire marshal, in accordance to local and state laws/ordinances. Always pressure check system prior to every use. Make sure all gasket seals are cleaned with compatible solvents, and checked for wear before each use.

The Icarus system uses flammable solvents. Use EXTREME caution while operating unit.
ALWAYS OPERATE IN EXTREMELY WELL VENTILATED AREAS

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Getting Started

Before you begin, you are going to want to make sure you have the necessary supplies to run the unit. Here is a list of some things that will be needed to operate the unit.

- Large containers for Ice and temperature control fluids
- Alcohol or Glycol for dewaxing chamber
- Butane
- Nitrogen gas cylinder with regulator
- Refrigerant scale
- Combustible Gas Leak Detector (recommended)
- Explosion-proof exhaust fan (recommended)
- Cleaning solvent (D-limonene is recommended)

Solvent	Boiling Point
n-Butane (R-600)	30.2 °F

Once the machine is packed with material and assembled, always pressure test the gasket and clamp connections. Pressurize the entire unit to 90 PSI with nitrogen gas using the manifold setup. Allow pressure to sit for at least 10 minutes, checking to make sure no pressure is lost. If the unit is sealed, connect vacuum pump to manifold and pull a full vacuum.

Always tighten clamps evenly on each side. Unit MUST be pressure tested to 90 PSI before each use. Failure to do so could result in solvent leaks.

Manipulating Thermals

In order to move the solvent through the system, you must ensure that the supply vessel is of higher pressure than the receiving vessel. This can be achieved by making sure the receiving vessel is colder than the supply vessel.

If you refer to (fig. 1), you can see that solvent pressure is directly related to its temperature. As the solvent increases in temperature above the boiling point (*fig.2),* pressure will increase. Alternatively, since we are working in a system that is at a full vacuum, as the solvent gets colder than the boiling point, pressures will start to go into the negative.

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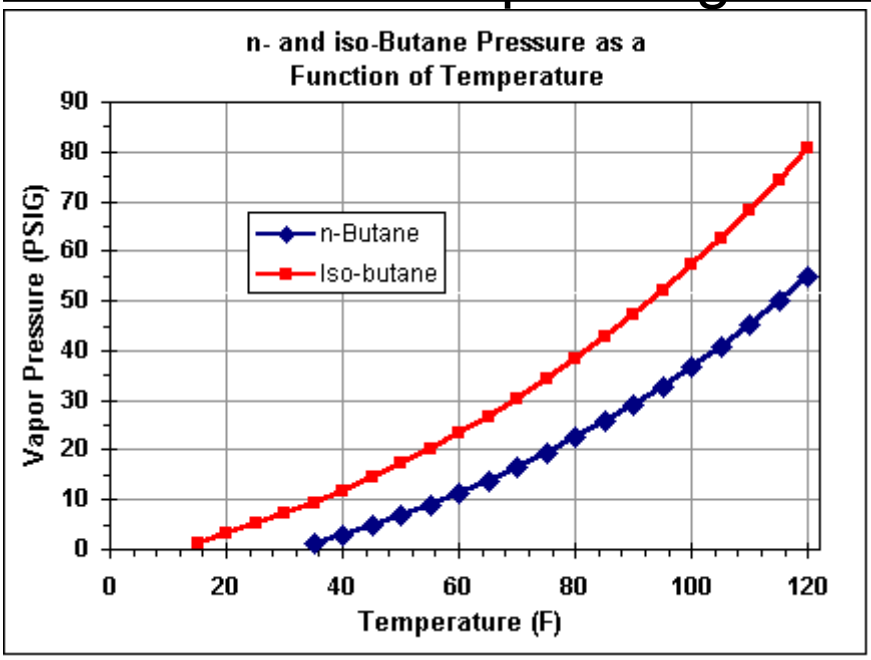

FIG. 1

	(-1 °C)
Isobutane (R-600a)	10.94 °F (-11.7 °C)

FIG. 2

For the best results, it is recommended to chill the solvent. It is important to not chill the solvent below the boiling point of the chosen solvent, removing any pressure from the supply. Chilled solvent will aid in the dewaxing process, however, since there is a separated dewaxing chamber, there is no need to go overboard on chilling the solvent initially.

When distilling the solvent in the collection, it is important to note the boiling point of the most delicate compound in your extract; *i.e. when extracting hops or rosemary, your recovery temperature should not exceed the boiling point of your lowest boiling terpene, Beta-caryophyllene. It is important to note that boiling points decrease as the level of vacuum increases. The change in boiling points can be calculated using the Clausius Clapeyron Equation. For B-caryophyllene,*

- *[246.2°F @760torr (-0.00in.hg) 0% vac]*
- *[180.00°F @100torr (-25.98 in.hg) 87% vac]*
- *[159.99°F @50torr. (-27.95 in.hg) 93.5% vac]*
- *[138.82°F @23.4torr (-29 in.hg) 96.9% vac]*
- *[109.44°F @7.6torr. (-29.62 in.hg) 99% vac]*

By keeping the warm water bath below the boiling point of the lowest boiling compound, you are able to preserve the full spectrum of your extract.

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Controls and Components

The valve layout and hose configuration is listed in the diagram below (*fig.3).* Hoses diameters are listed below.

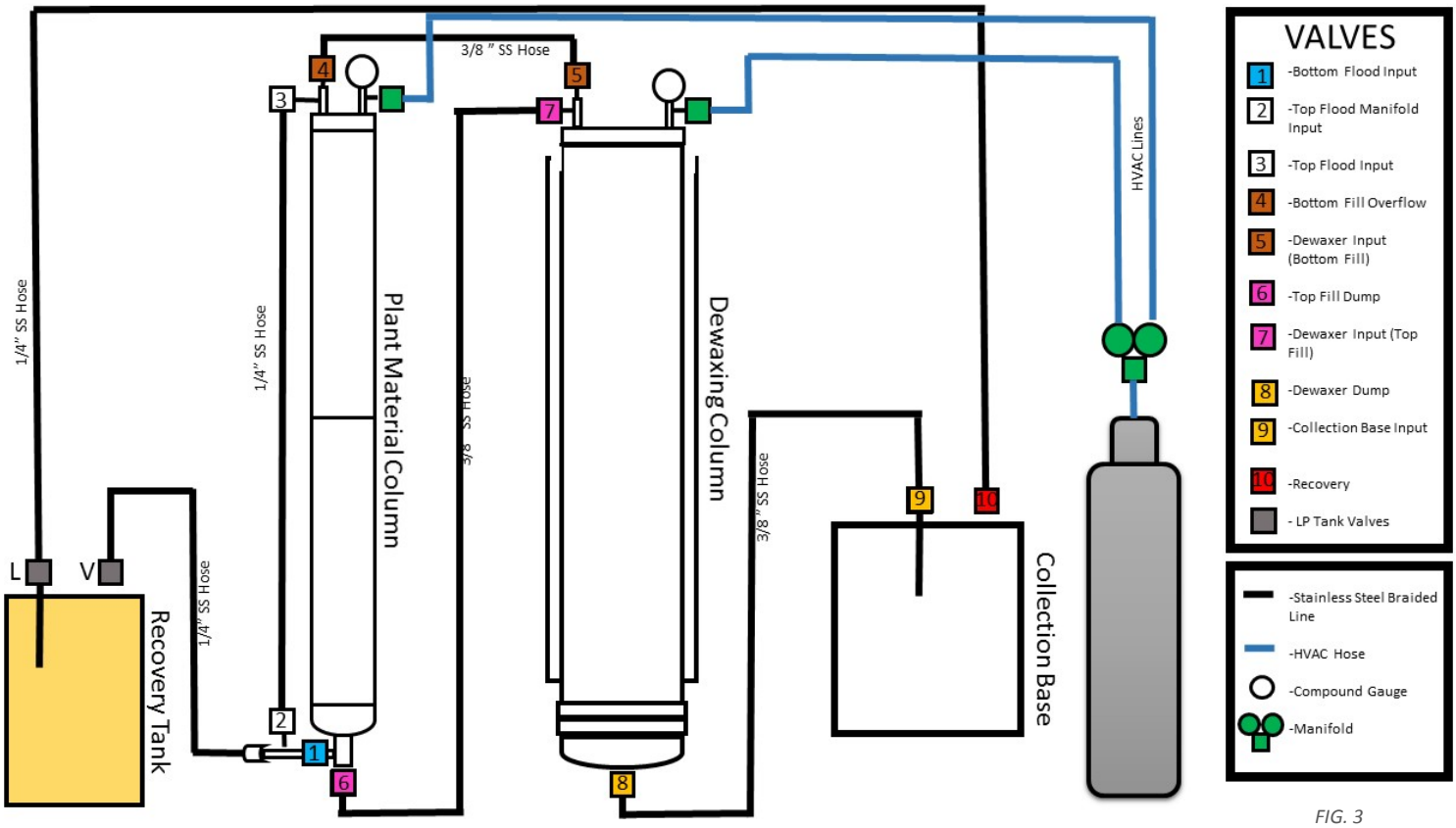

FIG. 3

Start-up and Operation:

In this section, we will cover pre-run procedure and the operation of the Icarus True Dewax system. It is important to have your tools on hand at all times (wrenches, scales, buckets). When setting up the unit, it is recommended to position all clamps with the same positioning, if possible. This ensures continuity if adjustments are needed during operation.

Always make sure your system is positioned on a level surface with adequate air flow. Butane is known to pool in cool areas, so it is important to ensure no areas of stagnant air flow exist in the workspace. If operating indoors, it is important that your workspace meets the criteria for a Class I, Division 1 work environment. Please consult your local fire marshal to ensure workspace is in accordance to local laws/ordinances.

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Icarus Material Column

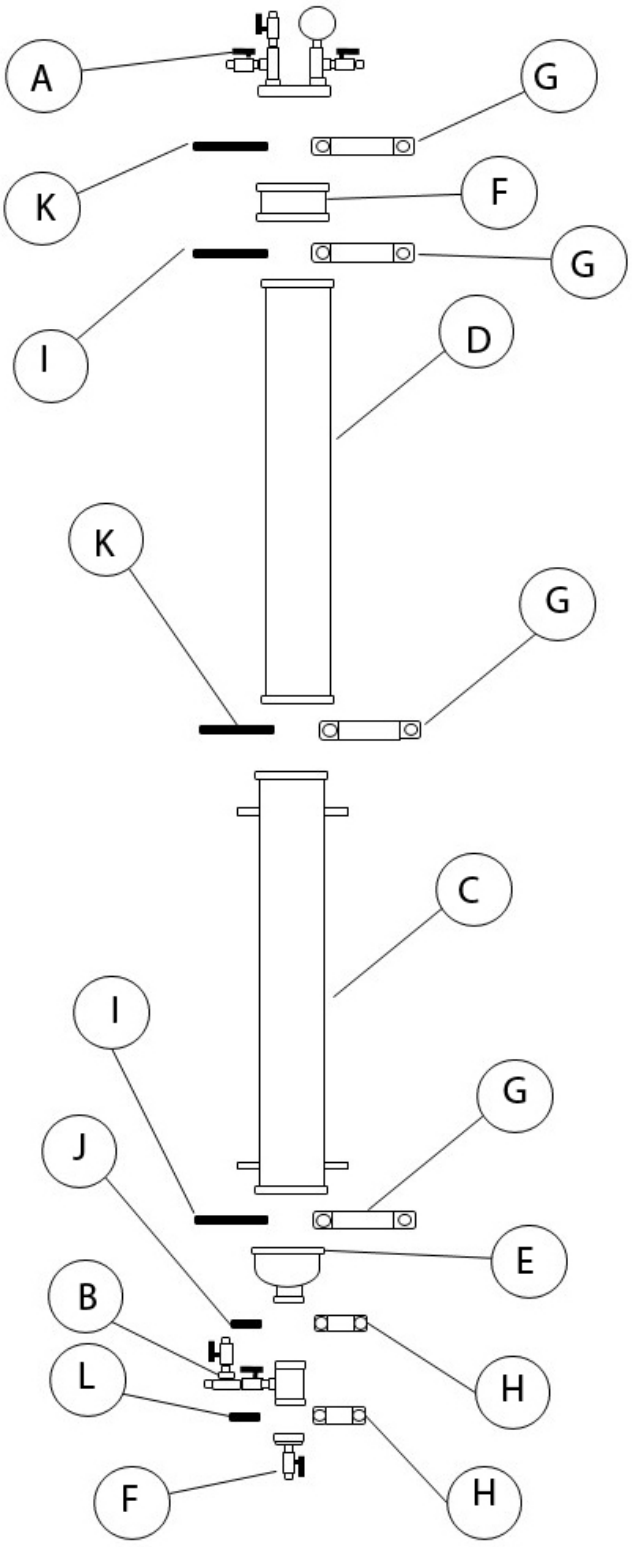

Table	
A	Material Column Cap
B	Solvent Input Manifold
C	Bracketed 4" x 24" Spool
D	4" x 24" Spool
E	4"-2" Hemispherical Reducer
F	4" Filter Plate
G	4" High Pressure Clamp
H	2" High Pressure Clamp
I	4" 100 Mesh Screen Gasket
J	2" 150 Mesh Screen Gasket
K	4" Gasket
L	2" Gasket

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Icarus Dewax Column

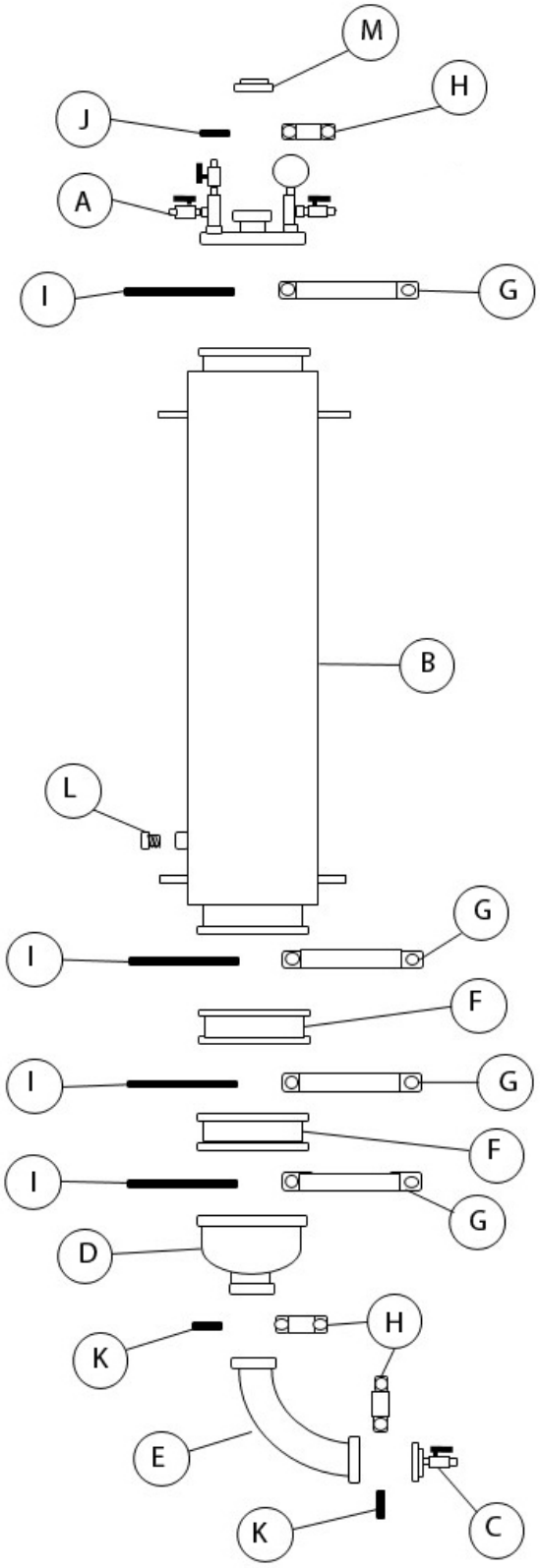

Table	
A	Dewax Column Lid
B	Bracketed 6″ x 36″ Spool
C	1.5″ Endcap w/ Valve
D	6″ - 1.5″ Hemi. Reducer
E	1.5″ 90 ° Elbow
F	6″ Filter Plate Kit
G	6″ High Pressure Clamp
H	1.5″ High Pressure Clamp
I	6″ Buna-N Gasket
J	1.5″ Buna-N Gasket
K	1.5″ 150 Mesh Screen Gasket
L	1/4″ MNPT Plug
M	1.5″ Lexan Sight Glass

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Icarus Collection Base

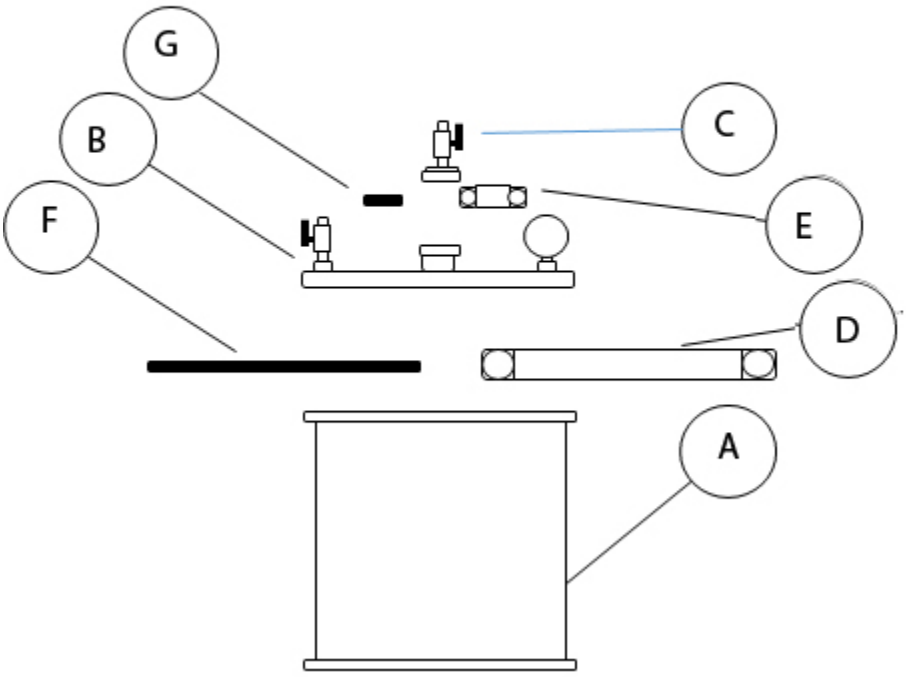

Table	
A	12" X 12" Collection Base
B	12" Collection Base Lid
C	2" Endcap w/ Valve
D	12" High Pressure Clamp
E	2" High Pressure Clamp
F	12" Gasket
G	2" Gasket

Pre-run Testing And Procedure

Assemble each column as pictured in diagrams. Always check that fasteners on rack are tightened before each use. Make sure all filter screens are in place and filter plates have a coffee or lab filter in place. *(Coffee filters are 20micron)*. Once unit assembled, pack material column with your chosen organic material.

The Icarus is intended to be packed with dry material. This system capacity is figured at 4.2 g/in3. *Capacity may vary depending on material/packing density*. It is recommended to give a firm pack; a loose fill of the column will allow solvent to pass over the material too easily. Once the material column is packed, install remaining clamps and connect hoses.

After unit is fully packed and assembled, attach nitrogen cylinder to manifold and perform pre-run pressure testing.

Every time you assemble your Icarus system, it is vital that the system is pressure tested to **90 PSI with nitrogen gas**. This ensures all clamps/gasket and hose connections are sealed. Make sure all valves are in open position during testing. Allow pressure to sit for at least 10 minutes before releasing pressure and pulling system to a full vacuum.

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Release pressure when no loss in pressure is observed. Disconnect nitrogen cylinder from manifold and connect vacuum pump. Turn on vacuum pump and open both sides of the manifold. Allow unit to be pulled to a full vacuum, using the multiple pressure gauges to ensure full negative pressure is achieved. When completed, the vacuum pump can be put away until next use.

Before you begin adding solvent into the system, fill the sleeve on the dewaxing column with a dry ice and alcohol/glycol mixture. This allows column to be chilled, ensuring pressures cannot build when dumping solvent from the material column, and begin dewaxing immediately.

It is recommended to use two wrenches when tightening and loosening hoses. Failure to do so could result in the loosening of fittings. Use one wrench on hose and one on flare fitting.

Adding Solvent to the System

Before inputting solvent into the system, it is important to pre-weigh solvent in the LP tank to ensure the system is not overfilled. This also enables solvent to be re-weighed post extraction, ensuring all solvent has been recovered. It is recommended that solvent be chilled to ~40°F prior to running. This ensures a total dewaxing of the final product.

The solvent capacity of n-Butane in the Icarus is 18.9 lbs. This is the maximum fill of the Dewaxing column.
Solvent capacity at 80% fill*

Connect LP tank to the solvent input manifold (*please refer to assembly diagram)* using the short ¼" SS line. It is recommended to connect the vapor valve (blue handle) to the manifold. This port contains no dip-tube, so the cylinder must be inverted to empty liquid solvent.

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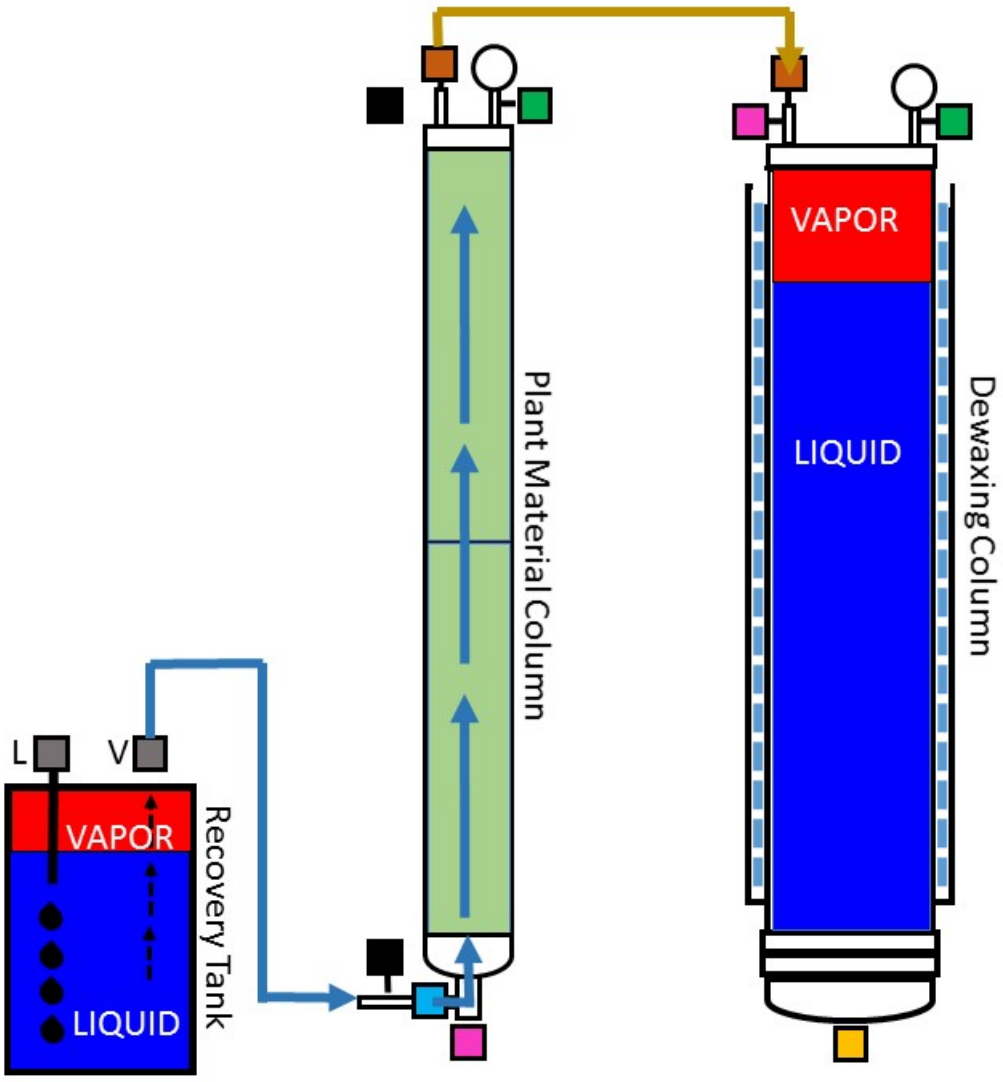
a) Bottom Flood Input:



The first pass of solvent is recommended to be done from the bottom flood input (both valve handles on manifold are in the horizontal position). This ensures that all material is exposed to solvent. The bottom flood overflow and the dewaxer input (bottom flood) valves are open. As solvent is entering column, place hand on the 3/8" overflow line. When solvent reaches the top of the material column, the overflow line will vibrate as liquid flows through. This indicates the entire material column is full of solvent; at this point, close off the overflow valve and allow a slight saturation of the material.

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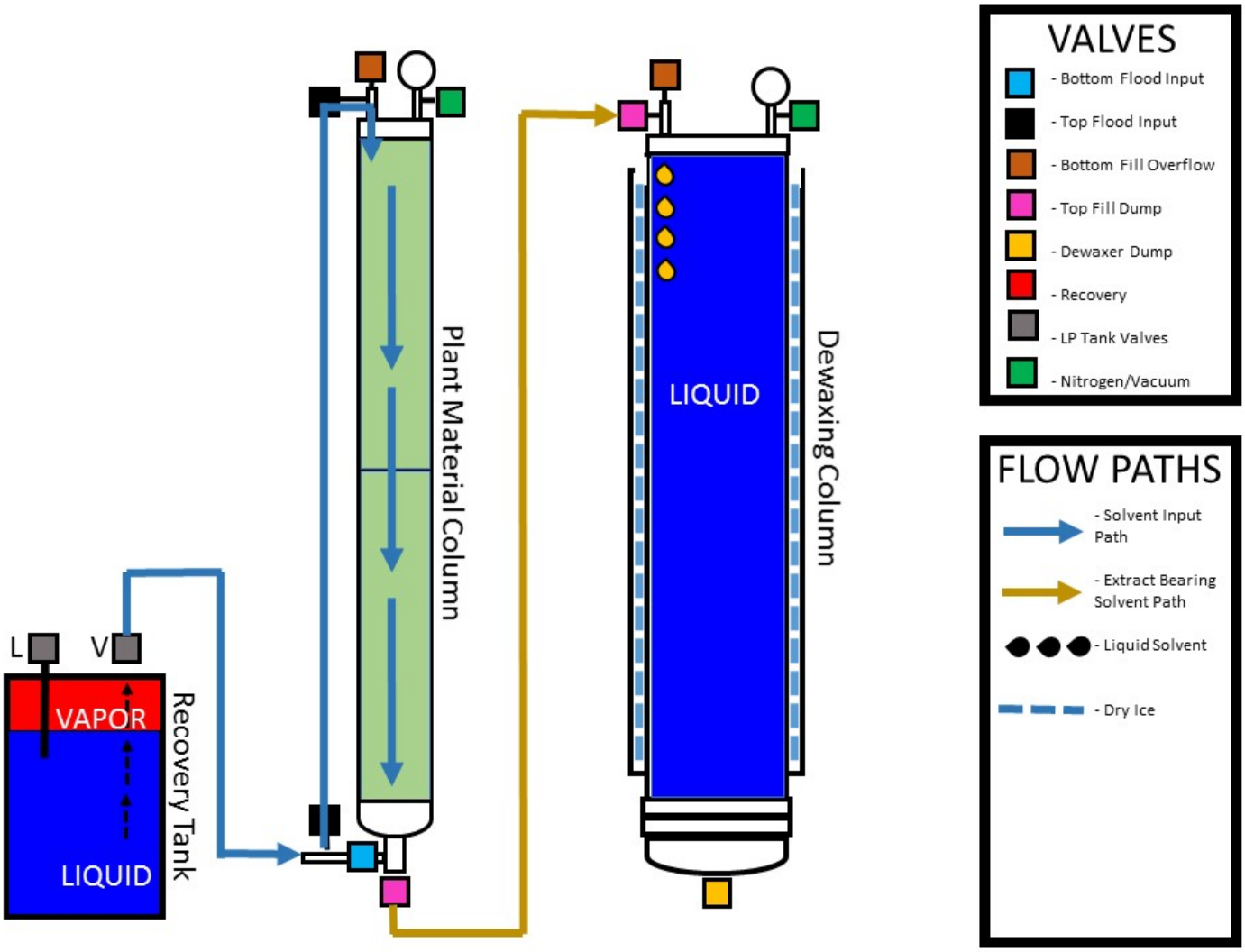
b) Top Flood Input:



After the bottom fill overflow valve has been closed, switch the solvent input manifold to the top flood position (valve handles both in vertical positioning). Open the dewaxer input (top fill) valve, then open the top fill dump valve. Extract bearing solvent will flow from the material column into the dewaxing column. Leave the dump valve and dewaxer input valve open until both columns return to negative pressure.

Operating the Dewaxing Column:

One of the main features of the Icarus unit is the separated dewaxing chamber. Extract bearing solvent is dumped into this chamber, which has an outer sleeve that is packed with dry ice slurry (*Outer sleeve should be packed with dry ice slurry prior to beginning the run)*.

The dewaxing column filter assembly should have coffee or lab filters secured in the filter plates, filter gaskets in place, as well as the ball bearings to be packed into the elbow and reducer.

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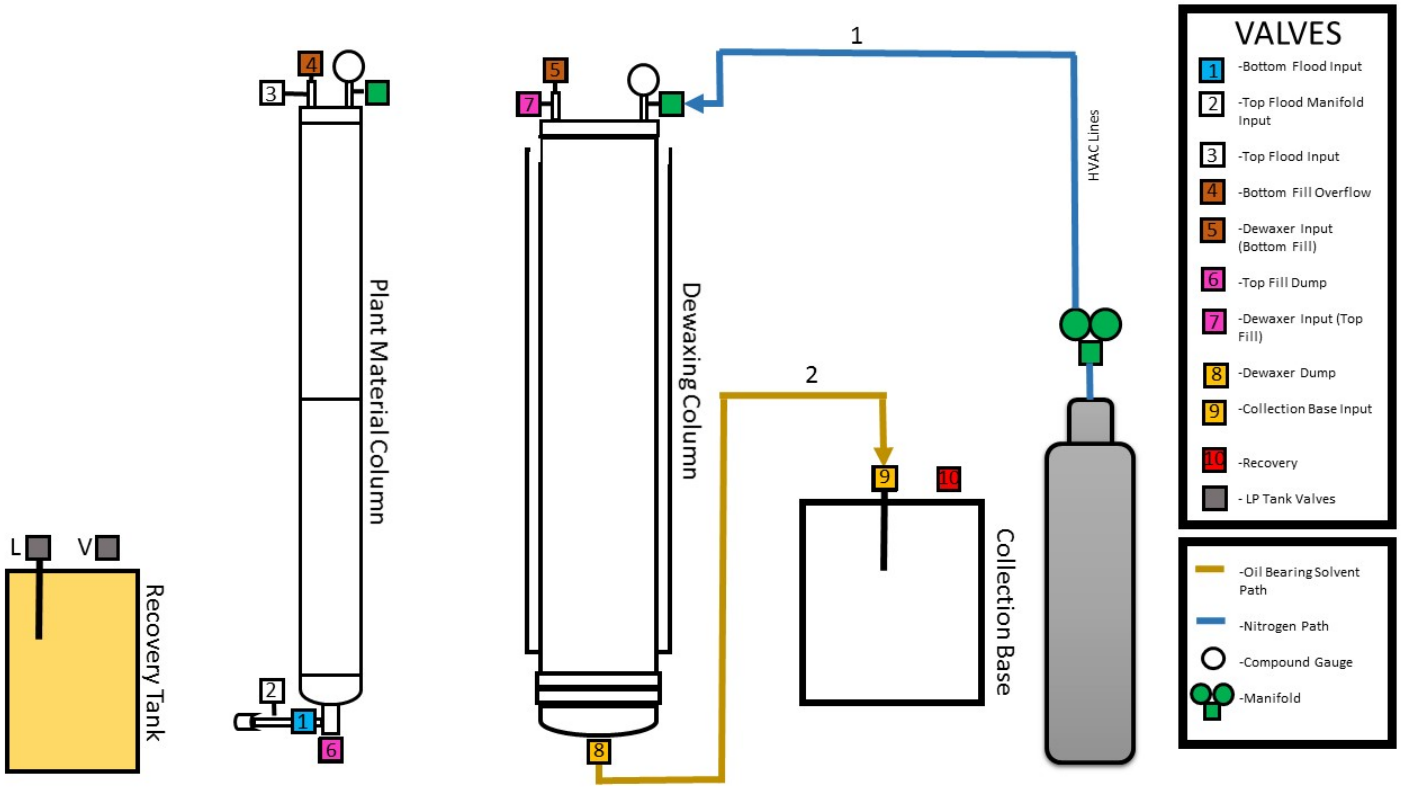
Solvent is chilled within the dewaxing chamber, causing pressures to be lowered. As solvent temperature reaches ~10°F, paraffin waxes will start to coagulate and fall out of the extracted solution. Solvent temperatures can reach ~-40°F if given time. When this occurs, all extracted waxes, as well as lipids, would have fallen out and the solution is now ready for filtration.

(Solvent temperatures can be determined with either a thermocouple or by using pressures as a guide; see pressure chart on pg. 5)

a) Draining the Dewaxing Chamber/Using Nitrogen Assist:

Since the solution inside of the dewaxing chamber has been chilled well below the boiling point of either compatible solvent, the solution will have no pressure. As stated in the introduction, to move solvent through a passive system, the supply vessel (in this case the dewaxing chamber) must be at a higher pressure than the receiving vessel.



In order to accomplish this, the nitrogen assist feature of the Icarus must be used. It is also important to have the collection base in a cold bath. This will prevent pressures from building in the collection chamber.

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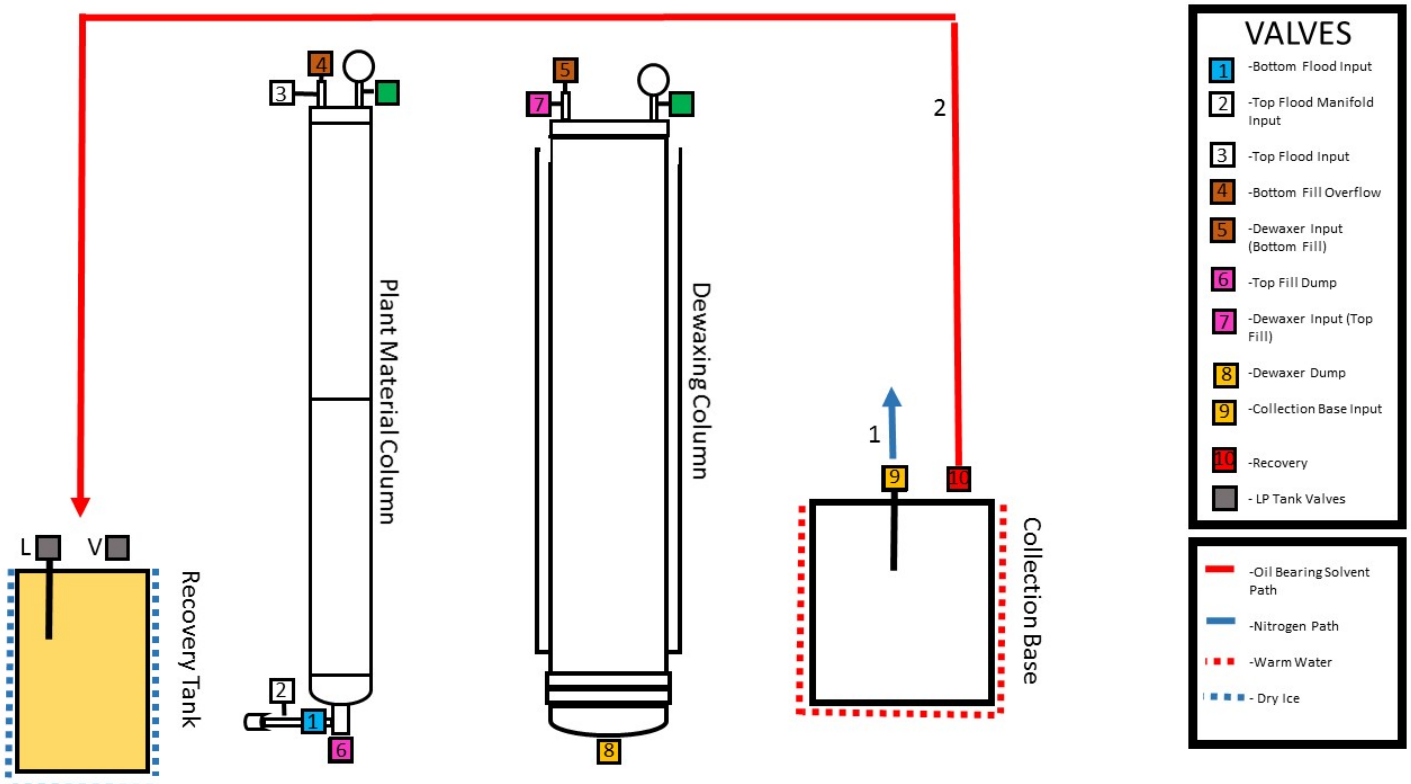
To start draining the dewaxer:

1. Open nitrogen cylinder (MUST HAVE REGULATOR). Open the regulator to allow ~25psi of nitrogen to build. Open the nitrogen assist valve on the dewaxing column lid. Allow dewaxer to build to 25 PSI. Close off both cylinder and assist valve.
2. Open both the dewaxing column dump and the collection column input valve. Allow solvent to flow. (Solvent flow can be monitored by the polycarbonate sight windows on each vessels top cap). If flow stops before dewaxing column has emptied, close dump valve and apply ~10 psi extra nitrogen pressure. Re-open dump and finish draining dewaxer.
3. Once dewaxer has emptied, close off both dewaxer dump valve and the collection chamber input. It is important to see that solvent flow has stopped flowing into the collection chamber (*collection chamber should appear to be 80% full)*, as well as solvent has passed through the filter assembly.
   NOTE: Using the dewaxer sight window alone is not adequate for determining whether or not the dewaxer is drained. Solvent can still be in the dewaxer once passed the top filter. It is recommended to allow time to ensure the dewaxer has been drained.*

Recovery:



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Once the dewaxer has finished draining, it is now time for recovery. Recovery is the distillation of the solvent in the collection chamber. By distilling, the impurities in the gas will be left behind (in this case, extract) as the gas moves to the LP tank.

In order to efficiently recover without damaging the extract, a few factors must be acknowledged.

First, we need to note the boiling point of the solvent. This must be noted as the LP tank must be chilled below this temperature. It is recommended to get the LP tank as cold as possible, as lower temperatures will ensure gas is instantly liquefied. Colder temperatures allow faster recoveries.

Second, the compounds being extracted must be acknowledged. It is important that the distillation temperature does not exceed the boiling point of the lowest boiling compound in the extract. In order to achieve a full extract, it is important that none of the extracted compounds are evaporated during distillation.

*Please refer to page 5 for information on boiling points in relation to vacuum level**

Nitrogen pressures MUST be bled off before recovery. Some flammable gas may escape while bleeding nitrogen pressures

ALWAYS OPERATE IN EXTREMELY WELL VENTILATED AREAS

a) Pre-Recovery Procedure:

Since a nitrogen assist was used, nitrogen pressures MUST be bled off before recovery can happen. . The temperature range of operation within the unit do not get cold enough to depressurize nitrogen. If pressures are not bled, recovery can be significantly slowed or even locked.

The following steps will help ensure an efficient recovery occurs

1. Once dewaxer has drained, cover LP tank in dry ice and alcohol/glycol. This ensures tank is brought down to temperature before recovery begins. (it is important that the entire tank is covered, failure to do so can result in inefficient recovery rates)
2. Prepare recovery by preheating water bath to ~105°F.

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(**This temperature is a recommended recovery temperature when dealing with compounds with low boiling terpenes. Adjust water bath temperature according to the needs of your chosen extract)*

3. Bleed off nitrogen by disconnecting the dewaxer dump line on collection base. The now open valve on the collection is opened to relieve nitrogen pressures
   (NOTE: It is important to take temperature of collection chamber. This will help determine the pressures of our solvent mixture. When valve opens, nitrogen will escape first. Gas pressure leaving the bleed off valve will drop when nitrogen has been evacuated. Check pressure in collection base when completed to verify nitrogen is gone. ALWAYS BLEED NITROGEN IN A WELL VENTILATED AREA. Some flammable solvent may escape.)
4. Place collection base in warm water bath.
5. Open recovery valves on collection base and LP tank
6. Check completion of recovery via LP tank weight and sight windows.

b) Recovery to Vapor Port (blue):

Recovery to the vapor port is the most straight forward method. Solvent vapors from the collection chamber are emptied into the headspace of the LP tank. As the vapor is chilled within the tank, pressures drop until the gas is condensed. In order to efficiently recover using the vapor port, it is essential that the LP tank be completely covered in dry ice. The ultimate goal is to ensure the top portion of the tank remains as cold as the bottom. Failure to keep the top half of the LP covered can result in slow recovery, potentially a vapor lock on the end of recovery.

Vapor port recovery requires less attention to pressures as it is difficult for recovered gas to flow in reverse.

c) Recovery to the Liquid Port (red):

Recovery to the liquid port tends to give increased recovery speeds. The liquid port has a siphon tube that will push solvent vapors to the bottom of the LP tank. Once liquid levels reach the siphon tube, solvent vapors will percolate through the condensed liquid, given the pressures entering the LP exceed the pressure of the LP tank. As vapor percolates in the condensed liquid, vapor pressures are instantly eliminated. This method of recovery tends to require less dry ice being that it is not as essential to keep the very top of the LP covered.

Liquid port recovery is typically faster, however attention must be paid to vapor pressures on both the collection chamber and LP. It is essential that the collection chamber be at a higher pressure than the LP. Failure to maintain this pressure gradient will result in solvent flow being reversed.

Note: Liquid will siphon from the LP into the collection until pressures equalize IF the LP pressures drop below that of the collection.*

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Post Run Procedure:

Once recovery has finished, close recovery and LP valves, then shut down warm water circulation. It is recommended to allow recovery to happen until collection base hits negative pressure, ensuring that all gas has recovered.

Before the base can be opened, positive/negative pressure must be relieved. Open the nitrogen bleed off valve [illegible] pressure in collection base. Remove the collection base from the warm water bath. Once the ba[illegible]he li[illegible] before[illegible]

DO NOT LEAVE LIQUID SOLVENT IN COLLECTION CHAMBER. FAILURE TO FULLY RECOVER WILL EXPOSE ATMOSPHERE TO FLAMMABLE GAS.

Removing the Extract:

After opening the system, it is time to remove the extract. It is important that the utensil used to remove the extract is chemically compatible with the solvent used. A PTFE scraper is recommended. If using a metal scraper, avoid using excessive pressure and scratch the platter.

Being that the base and extract should still be warm, the consistency should still be semi runny. Run the scraper in a circular motion from the outsides to the middle; the extract should pool in the center of the base. Scoop the extract out from center.

Cleaning and Gear Maintenance:

Once the extraction process is completed, it is important to break down and clean the gear. This will prevent contamination of future runs, as well as keep gaskets fresh. We recommend cleaning the gear with d-limonene, however isopropyl alcohol can be used. It is important to wipe gaskets clean rather than soak them in solvent. If using alcohol to clean gaskets, it is important to wipe them dry to prevent the gaskets from breaking down.

The dewaxing column and filters will be covered in lipids. It is important to clean this in between every run to prevent clogging. Some users save the extracted waxes for further refinement, as oil occlusion in the extracted wax is possible. Ball bearings can be soaked in cleaning solvent, then dabbed dry with a towel.