



AutoVap15 Operating Manual

Version: 1.2

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SECTION I: AUTOVAP OPERATING PRINCIPLE

How the AutoVap15 Falling Film Evaporator Works:

The AV15 Falling Film Evaporator is designed to recover at least 15 gallons of saturated solvent while recovering over 95% solvent. The AutoVap15 system works by moving saturated solvent through a heated exchange path where the solvent is evaporated from the desired “crude” material. The AV15 separately discharges the crude material and recovered solvent into 2 separate, 10-gallon vessels.

The AV15 is manually operated and requires an operator to determine if there is material in the feed tank to supply the feed pump. Please note, allowing the feed pump to run dry will destroy the pump.

It is important to note that the AutoVap15 through puts are based on the ancillary equipment supplied by TruSteel. This includes the cooling unit, water heating system, and vacuum pump. Any changes in equipment specifications or placement of equipment out of the scope of TruSteel’s Pre-Installation Manual may causes losses in efficiency of recovery.

TruSteel suggests operation of the AutoVap15 inside of a C1D2 compliant work space with all non-C1D2 compliant equipment operating outside of the work space.

Upon installation of the AutoVap15, TruSteel will train the staff who will be operating the system. This operating manual can also be used as a guide.

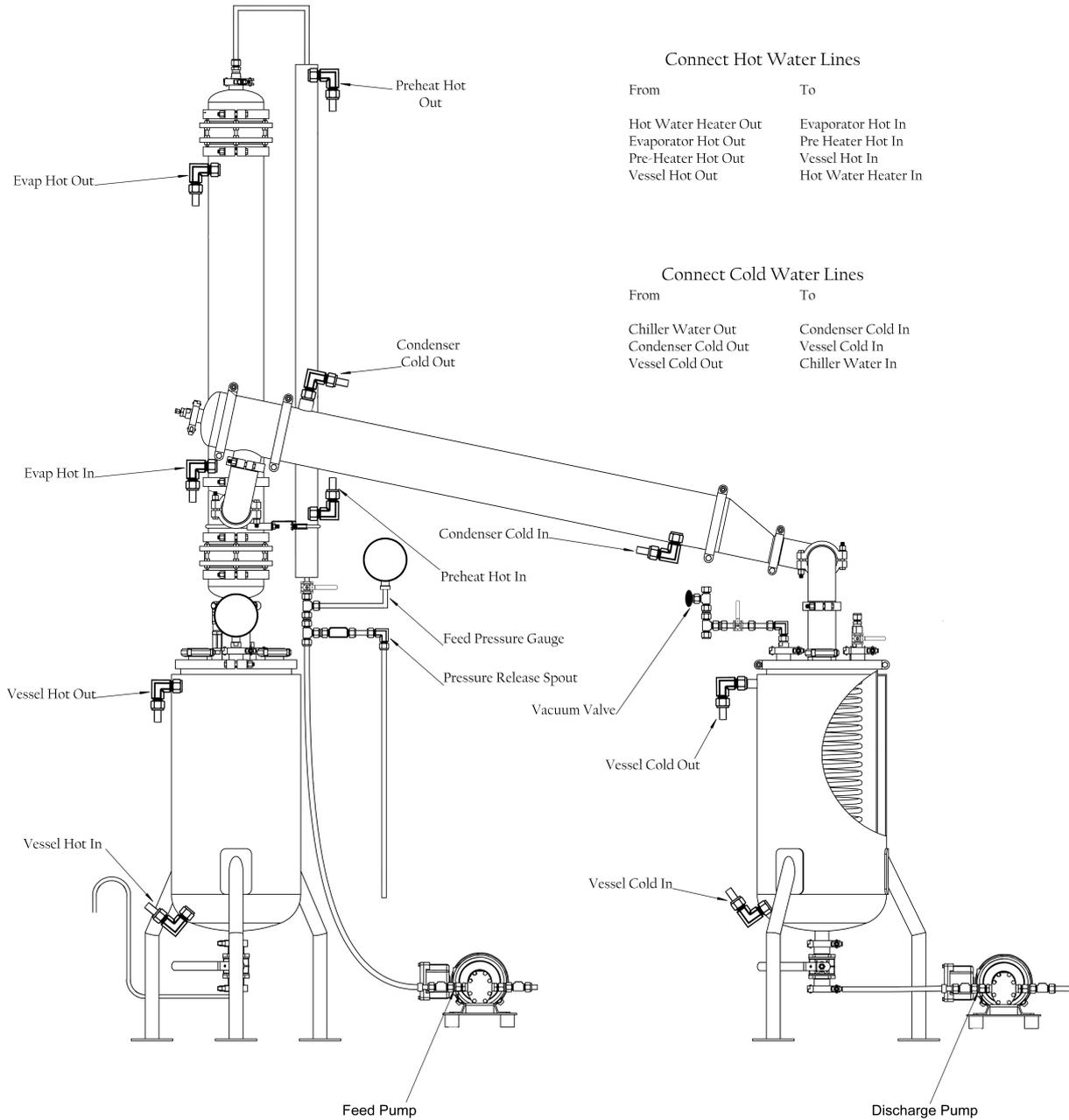
SECTIONII: AUTOVAP15 SYSTEM EQUIPMENT

Materials	Stainless Steel, PTFE, & Borosilicate
Throughput	15+ gallons per hour
Plumbing Connections	1”
Compatible With:	Ethanol, Methanol, Heptane, Hexane, Acetone, Acetonitrile

The AutoVap15 system requires ancillary equipment to work with the AutoVap15 machine. The main components to the system are:

- 1) The AutoVap15, including (3) main heat exchangers [1 preheater, 1 evaporator, 1 condenser], (2) pumps [feed pump, solvent discharge]
- 2) Cooling System – an HVAC chiller unit; includes Chiller Bypass Manifold
- 3) Heating System – Recirculating Hot Water Heater; includes Heater Manifold which includes an inline water pump to recirculate water
- 4) Vacuum Pump
- 5) VFD Controller – Power supply and controls for feed pump and solvent discharge pump





SYSTEM REQUIREMENTS

WATER HEATING (Gas or Electric)		
Electric Water Heater	minimum 18kw; minimum 8 gpm flow rate; distilled water only; 1" plumbing	
Gas Water Heater	minimum 200 BTU; minimum 8 gpm flow rate; distilled water only; 1" plumbing	
COOLING	minimum 5 tons of cooling; 1" plumbing	
VACUUM	suggested: 6.1 cfm / 174 L/min	

SECTION III: STARTUP PROCEDURES

In order to operate the AutoVap15 at correct capacity, the system requires the ancillary equipment to be turned on and set at the correct parameters. Operators shall follow the following procedures and verify all equipment is functioning properly before proceeding to the next steps of operation

CHILLER STARTUP

START CHILLER

Procedure For First Time Operating Chiller

1. **TURN ON DISCONNECT BREAKER**
Locate chiller system and find the disconnect breaker (should be within 10 feet of the chiller unit)
Lift the handle to the "ON" position
2. **TURN ON CHILLER**
Locate the red handle on the chiller unit
Turn the red handle to the "ON" position
The display on the Chiller should read "STANDY"
If it does NOT read "STANDY", press and hold the snowflake button for 1-2 seconds
You will see a green snowflake on the digital display panel indicating the chiller is about to start.
3. **ALLOW CHILLER TO RUN 15-20 SECONDS**
The compressor and fans will kick on and the chiller will start to bring down the temperature to the programmed setpoint.
4. **ALLOW TEMPERATURE TO DROP**
Wait for the chiller to reach the ideal operating temperature for the AutoVap System (41-44°F) before operating your AutoVap.

Procedure For Daily Startup

For daily startup, the chiller should already be on (breaker disconnect AND the red handle on the chiller unit).

The Chiller should be in Standby mode at the start of every shift.

1. **TAKE CHILLER OUT OF STANDBY MODE**
Press and hold the "SNOWFLAKE" button for 1-2 seconds
You will see a green snowflake on the digital display panel indicating the chiller is about to start.
2. **ALLOW CHILLER TO RUN 15-20 SECONDS**
The compressor and fans will kick on and the chiller will start to bring down the temperature to the programmed setpoint.
3. **ALLOW TEMPERATURE TO DROP**
Wait for the chiller to reach the ideal operating temperature for the AutoVap System (41-44°F) before operating your AutoVap.

NOTE: When shutting down the machine after operation it is very important to turn off the machine properly. Press and hold the "snowflake" button and the chiller will go into standby mode. Leave the chiller in standby and DO NOT TURN OFF RED HANDLE. It is important to let the chiller complete its shutdown operation. Turning the Red Handle to "OFF" after operation can damage chiller.

WATER HEATER STARTUP

Most AutoVap15 Systems from TruSteel are paired with a Hubbel Water Heater. For common operating procedure, the Hubbel Water Heater is used throughout this startup procedure. TruSteel also provides the manifold for the water heater which includes the water circulating pump (normally a TACO brand pump).

START WATER HEATER

Procedure

1. **TURN ON RECIRCULATING PUMP**
Locate the power switch for the recirculating pump and power “on”.
2. **TURN ON THE WATER HEATER**
If the power to the water heater is disconnected, power on the breaker disconnect to the water heater.
3. **SET HEATER TEMPERATURE**
For first time setup, you will need to set the temperature of the water heater. For daily use, the temperature should be set at the ideal temperature already.
Simply press the up or down arrows on the water heater to set the temperature.
4. **CHECK WATER HEATER DIAGNOSTICS (Electric Heater Models Only)**
This is an important step to check each day of operation to be sure the flow is high enough.
Press and Hold both the UP and DOWN arrows simultaneously for 1-2 seconds and release.
You should not be in diagnostic mode.
Numbers will begin “flashing” on the water heater screen.

1st number is the heater temperature setpoint
2nd number is the temperature “OUT” of the heater to the AutoVap
3rd number is the temperature “IN”, back from the AutoVap
4th number is the “Flow Rate” in gallons/minute

The Flow Rate is very important

You must have a flow rate above 10 gallons/minute.
If the flow rate is below that, the AutoVap may not operate efficiently.
The flow rate should be between 5-10 GPM for optimal operation.

If the flow rate is below 5 gallon per minute you must refill the heater with water. Do this when the before the heater is turned on. You must refill the heating system while the system cold.

VACUUM PUMP STARTUP

Most AutoVap15 Systems from TruSteel are paired with a Welch vacuum pump. For common operating procedure, the Welch vacuum pump is used throughout this startup procedure.

START VACUUM PUMP

Procedure

1. **POWER ON VACUUM PUMP**



Locate the vacuum pump and verify it is plugged into an outlet.
Locate the power switch on the vacuum pump and switch to "ON".

Note: Some facility setups could have a wall switch that controls power to the vacuum pump. In this case, locate the wall switch and power on the vacuum pump.

#VERIFY VACUUM

You can verify the system is pulling vacuum from the AutoVap itself. Open the vacuum valve on the vacuum manifold on the AutoVap. Open the vacuum fine tune adjustment. There should be vacuum flow.

VARIABLE FREQUENCY DRIVE STARTUP

Most AutoVap15 Systems from TruSteel are paired with Lenze Variable Frequency Drives. If you are operating an AutoVap15 with Auto Discharge for the Solvent Recovery, you will have 2 Variable Frequency Drives to turn on.

1. **Turn** on the VFD by locating the disconnect near the VFD or at the main breaker.

****Note: The VFD will now light up and display the speed of the motor measured in Hertz.

****Note: Hertz is measured from 0-60. This means at 0Hz the motor will not spin at all and at 60Hz the motor will spin at maximum speed.

****Note: Since hertz translates to how fast the motor will spin it also translates to how much pressure it can create in the AutoVap feed system.

****Note: Starting Hertz is between 15-20

****Note: Operating pressure in the feed system 30 60- PSI

2. **Press** the up or down arrows to set start-up speed
3. For Auto Discharge Only: Power on the VFD for AutoDischarge.

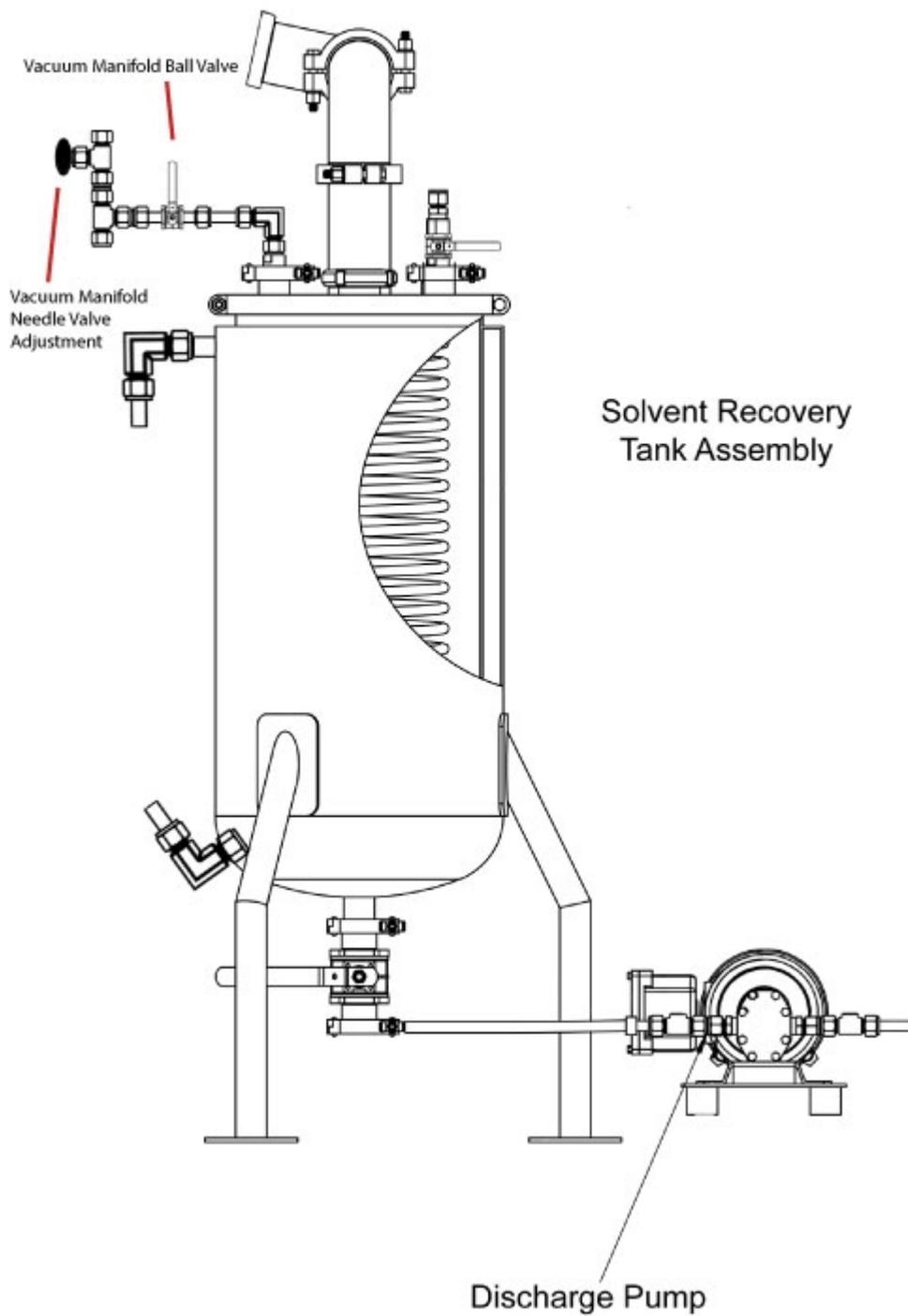
Before pressing Run on the VFD see the AutoVap Operating Procedures.

SECTION IV: OPERATING PROCEDURES

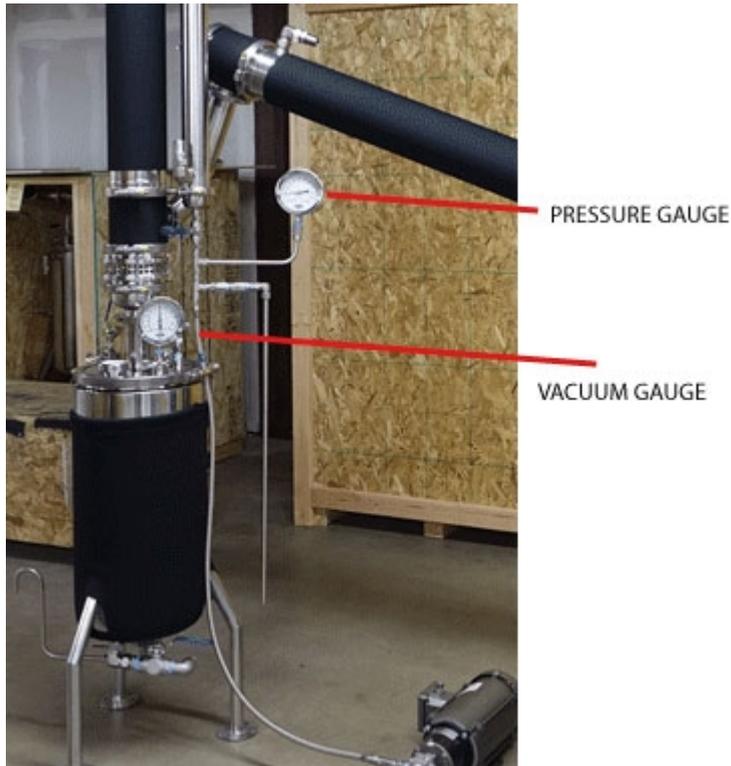
These are the suggested operating procedures by TruSteel to ensure your system runs efficiently and recovers at least 15 gallons per hour. As you become more familiar with your system and your specific material you are recovering, you may want to set your own parameters.

In any case, each step of this process should be closely reviewed, especially the cleaning cycle.

STEP 1: PULL VACUUM ON SYSTEM



1. **Close all ball valves** on the AutoVap: residue(crude) vessel, recovery (solvent) vessel, below the preheater.
2. Find and Open the Vacuum Manifold Ball Valve.
3. Locate the vacuum gauge on the residue vessel.



4. Using the Vacuum Needle Manifold Valve Adjustment, adjust the vacuum pressure to between 21-24 Hg.

****Note:Screwing in the needle valve (clockwise) will pull a deeper vacuum and unscrewing (counterclockwise) will let more air into the system pulling less vacuum.

5. Double Check the following:

Water Heater is set between 130-190F
Chiller is set between 40-44F

Now the AutoVap is ready to start processing

****Note: the vacuum gauge reads 30in Hg to 15 PSI.

4. Using the Black needle valve on the vacuum manifold, **adjust** vacuum pressure bewtween 21-24in Hg.

****Note:Screwing in the needle valve (clockwise) will pull a deeper vacuum and unscrewing (counterclockwise) will let more air into the system pulling less vacuum.

STEP 2: PRIME FEED PUMP

Before turning your feed pump on, it is important to first prime the feed pump by allowing the vacuum to "pull" your tincture through the pump and up through the preheater.



1. Locate the Feed Line and either attach it to your feed vessel or, using a dip stick, place the feed line into your barrel.
2. Open the Feed Line Ball Valve

Tincture will now flow through the feed line and up through the preheater.

Note: After a 10-15 seconds the feed line and feed pump should be primed and the feed pump can be turned on.

STEP 3: START FEED PUMP

Now that the feed pump is primed, you are now ready to start the feed pump and adjust the preheater pressure.

1. Locate the Feed Pump Variable Frequency Drive Remote Control (if you are not using a remote you can control the pump from the VFD)
2. Using the Up and Down arrows, adjust the speed of the pump. You will be referring to the Pressure Gauge to determine the speed of the pump, but for starting, set the VFD at 15-20 Hz.
3. Press RUN on the VFD Remote. The feed pump will slowly "ramp up".

Note: As the feed pump is ramping up, it is filling up the preheater and release air pressure built. This will take 1-3 minutes. Once the preheater is filled, you will start to see the pressure rise on the pressure gauge located near the preheater.

The recommended operating PSI is 42 PSI. This may be adjusted to as low as 30 and as high as 60 PSI.

4. Adjust the feed pressure using the VFD Remote Control.

The AutoVap is now running and recovering your solvent. **IMPORTANT:** Be sure to monitor your feed vessel to be sure you do not run out of tincture leaving the pump to run dry.

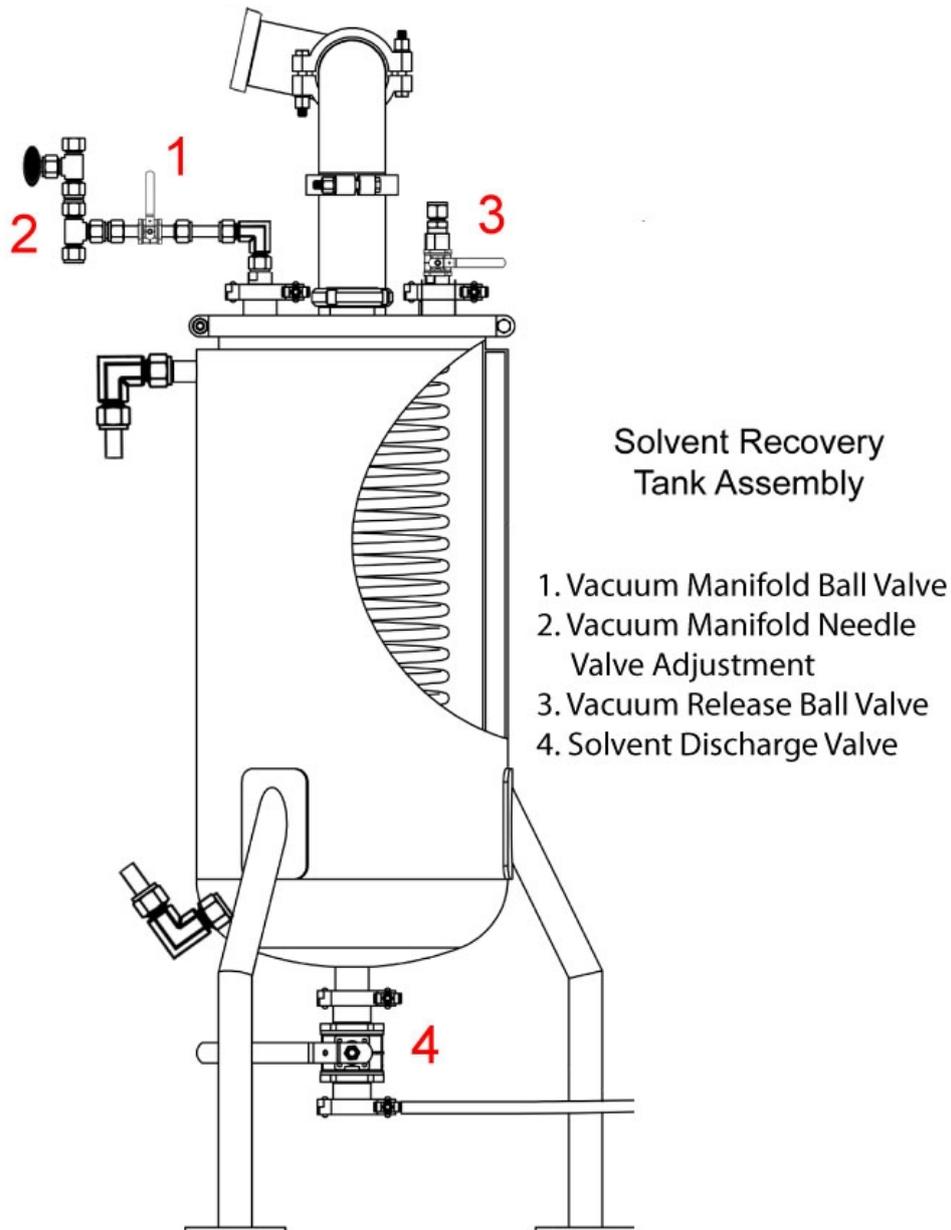
IMPORTANT NOTE: There are 4 very important procedures to perform to ensure the longevity of your feed pump:

1. Never run the pump dry: Always have tincture in your feed vessel while the feed pump is running.
2. Do not forget to open the preheater ball valve. Failure to open the valve can "dead head" the pump and will compromise the pump.
3. Always prime your feed pump before turning on the VFD.
4. Always run cleaning cycles at the end of operating shifts.

STEP 4: SOLVENT DISCHARGE

As the AutoVap is running, you will be recovering solvent faster than you will be collecting residue.

IMPORTANT: If you are running the AutoVap15 Plus system, with Auto Discharge, you can skip this step.



To Discharge Solvent:

1. Set up Solvent Recovery Collection

Make sure you have your collection vessel either connected to the Recovery Tank, or place your discharge line into a vessel

If using the silicone hose, connect one end of the silicone hose to the ball valve/hose barb assembly on the bottom of the solvent recovery tank.

Connect or insert the other end to your solvent recovery collection vessel.

2. Turn off the Feed Pump

Press STOP on the VFD Remote Control

3. Close the Feed Line Ball Valve

4. Close the Vacuum Manifold Ball Valve
5. Release Vacuum from the entire AutoVap System

SLOWLY, open the vacuum release ball valve until the vacuum gauge reaches 0 HG.

CAUTION: You must open the valve SLOWLY while looking at the vacuum gauge. If you open the ball valve too quickly you risk pulling over crude oil into your nicely recovered solvent.

6. Close the Vacuum Release Ball Valve
7. Open the Solvent Discharge Valve (See "4" on the figure above)
8. Locate the Air Chuck Assembly on the Residue Recovery Tank. The Ball Valve should be closed.
9. Attach an air compressor or N₂ Generator to the Air Chuck Assembly [Located on the Residue Recovery Tank]

If there is a pressure regulator on the compressor, set it between 5-15 PSI. You will not be using more than 5 PSI for this operation.

CAUTION: The Residue Recovery Tank is HOT, use caution when working near/around it.

10. Introduce Pressure to the system

Slowly open the Air Chuck Assembly ball valve to introduce pressure. Start with 1-3 PSI while monitoring the pressure gauge.

WARNING: Do NOT pressurize the system above 15 PSI. If you do, the 15 PSI Pressure Relief Valve will trigger. Be sure to have a collection vessel under the PRV blow off assembly. A suggestion to ensure you do not over pressurize the system, is to toggle the Ball Valve on the Air Chuck Assembly so that the system can only reach a maximum of 5 PSI.

The solvent should now be discharging from the Solvent Discharge Valve.

11. Verify the Solvent Recovery Tank is empty (view through sight glass)
12. Close the Ball Valve on the Air Check Assembly
13. Close the Solvent Discharge Valve.

STEP 4.1: RESTART THE SYSTEM

Now that you have discharged your solvent, you can restart the system.

1. Pull Vacuum on System

Open the Vacuum Manifold Ball Valve
Wait until the vacuum pressure reaches the desired setpoint (21-24 HG). You may need to adjust the Vacuum Manifold Needle Valve Adjustment

2. Open the Feed Line Ball Valve
3. Start the Feed Pump
Press "Run" on the VFD Remote Control

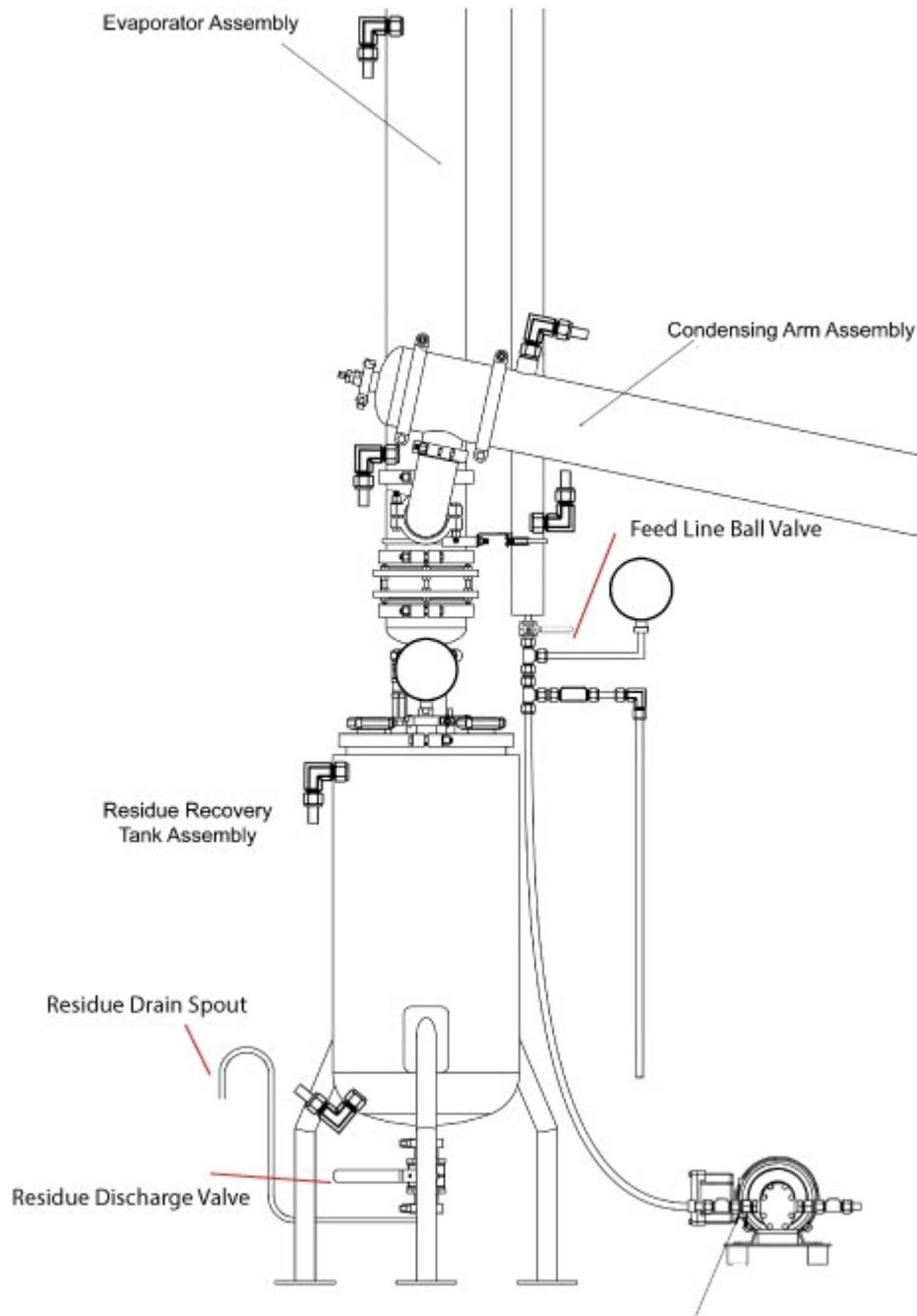
STEP 5: RESIDUE DISCHARGE

You will continue to repeat STEP 4: SOLVENT DISCHARGE while monitoring your Residue Recovery Vessel. When the Residue Recovery Vessel is filled to your desired capacity (be sure not to overfill), you are ready to discharge the residue material.

Note: AutoVap1 Plus will also need to manually discharge residue

NOTE: This process is similar to STEP 4: SOLVENT DISCHARGE, except you will be opening the Residue Discharge Valve

WARNING: When removing the crude oil be very CAREFUL as it is EXTREMELY HOT.



1. Stop Feed Pump (Press "STOP" on VFD Remote Control)
2. Close the Feed Line Ball Valve (see diagram above to locate Feed Line Ball Valve)



3. Release Vacuum from System

Slowly open the Vacuum Release Ball Valve (similar to Solvent Discharge) and monitor the vacuum pressure goes down to 0 HG.

4. Close Vacuum Release Ball Valve.

5. Prepare residue collection vessel under Residue Drain Spout.

6. Open Residue Discharge Valve

7. Locate the Air Chuck Assembly on the Residue Recovery Tank. The Ball Valve should be closed.

8. Attach an air compressor or N₂ Generator to the Air Chuck Assembly [Located on the Residue Recovery Tank]

If there is a pressure regulator on the compressor, set it between 5-15 PSI. You will not be using more than 5 PSI for this operation.

CAUTION: The Residue Recovery Tank is HOT, use caution when working near/around it.

9. Introduce Pressure to the system

Slowly open the Air Chuck Assembly ball valve to introduce pressure. Start with 1-3 PSI while monitoring the pressure gauge.

WARNING: Do NOT pressurize the system above 15 PSI. If you do, the 15 PSI Pressure Relief Valve will trigger. Be sure to have a collection vessel under the PRV blow off assembly. A suggestion to ensure you do not over pressurize the system, is to toggle the Ball Valve on the Air Chuck Assembly so that the system can only reach a maximum of 5 PSI.

The residue should now be discharging from the Residue Drain Spout.

10. Verify the Residue Tank is empty (view through sight glass)

12. Close the Ball Valve on the Air Check Assembly

13. Close the Residue Discharge Valve.

You will repeat this step each time your residue fills, or you are done running a batch.

STEP 6: CLEANING CYCLE

The cleaning cycle is a very important step in your solvent recovery process. Following this cleaning procedure will ensure your AutoVap will continue to run at full efficiency and it will increase the longevity of your equipment, especially the feed pump.

Leaving the feed pump to sit with tincture material to dry will surely cause your pump to fail. The material you are processing through your AutoVap contains fats and sugars. These materials collect as a residue throughout the entire feed/residue side of your AutoVap.

The Clean Cycle Order is: Solvent - Distilled Water - Solvent

This means, once you have discharged all your material, you will run clean solvent through the AutoVap, then you will run distilled water (this is for the sugars), and then run some more clean solvent (to remove the water residue)

These are the steps to run your cleaning cycle:

1. Discharge all residue material from your AutoVap
You want to start your cleaning cycle with the AutoVap empty in both, the residue and solvent side.
See STEPS 4 and 5 for instructions how to discharge your material.
2. Prepare Clean Solvent (4-8 Gallons)
Prepare clean solvent just as you would your tincture, for normal processing.
3. Run the clean solvent through your system. About 1-2 gallons.
During this phase, you are running the system at normal operating parameters: Heater set at around 190F, Chiller set at ~40F, Vacuum set at 22HG, Pressure set around 42 PSI
When you have run about 2 gallons through the system at these parameters, proceed to the next step.
4. Release Vacuum on the system
Close the Vacuum Manifold Ball Valve and SLOWLY open the Vacuum Release Ball Valve
Verify the vacuum level drops to 0 HG

NOTE: This now ensures that the clean solvent will now completely clean the residue side of the AutoVap. The condenser side is already clean.

5. Run the remainder of the clean solvent through the system with these parameters (no vacuum).
Monitor the lower sight glass on the Residue Falling Film. The solvent should be clear by the end of running all your clean solvent.
6. Drain the Residue Vessel
Follow the process in STEP 5 to drain this "dirty" solvent.
NOTE: This solvent is really diluted tincture that you can store/save and run through the AutoVap another time, if your business model allows for that.
7. Prepare Distilled Water (3-6 Gallons)
This part of the cleaning cycle is VERY IMPORTANT and should NOT BE OVERLOOKED. The distilled water will help remove any sugar residue that has collected throughout your AutoVap.
8. Release vacuum from system. Set Vacuum Pressure to 0 HG
9. Run the distilled water through your system. This is the same procedure as running tincture or solvent through the AutoVap.
NOTE: With the vacuum set to 0 HG, you should not have water reaching the solvent recovery tank; it should all be "raining down" into your residue tank.
10. Drain all water from the system. Residue Tank and Solvent Recovery Tank.
NOTE: You will most likely NOT want to save this water
11. Prepare more clean solvent (1-2 gallons)
12. Run this solvent through the system. This will remove any traces of the distilled water in your system.
13. Drain this solvent. You most likely will NOT want to keep this solvent as it is contaminated with water, unless you have a process to remove water from your solvent.

The AutoVap is now clean and ready for the next shift.

OPERATING SUGGESTIONS AND TIPS

The AutoVap15 has been in operation for quite a few years now and there have been many various ways of running it depending on each customers specific process. Here we have compiled a list of some suggestions and tips to ensure you are getting the most out of your AutoVap15 Solvent Recovery.

- 1) DO NOT overlook your cleaning process.
Cleaning your system after every shift (8-10 hours of continuous operation) is extremely important.

Remember the Solvent-Distilled Water-Solvent cleaning process. The distilled water is important for dissolving and removing the sugar residue.

2) Parameters: Feed Pressure and Vacuum

There is no required parameter for either the feed pressure or vacuum pressure. However, there are some parameters to stay within.

Feed Pressure Min - Max: 30-65 PSI

It has been tested that running the system at **42 PSI** should recover at least 15 gallons per hour.

Running the system slower may decrease the recovery rate, but will leave you with a "thicker" residue material with less solvent in the final product.

Running the system faster will leave your material a bit "soupy" but will increase your solvent recovery rate.

Vacuum Pressure Min-Max: 20-25 HG

It has been tested that running the system at 22 HG is an efficient, safe operating parameter.

You can increase your vacuum pressure, but be aware that this can "pull" your residue material over into your solvent recovery side and taint your clean solvent.

Pulling deep vacuum can also cause vapors to carry into your vacuum pump, which can cause vacuum pump failure over time.

3) Heat and Cold Temperatures

The temperature you set your Water Heater at will depend on what solvent you are recovering. You can do some research to check the boiling point of the solvent used, along with the latent heat of evaporation. This will determine how much heat you should apply.

Keep in mind that with vacuum, the boiling point of solvents decreases. You can research the boiling point of solvents under vacuum.

For Ethanol, it has been tested that anywhere from 190F-194F is ideal for efficient evaporation.

The temperature of your chiller should be set anywhere from 34F-42F. Again, you will want to do some research about how the solvent you are using condenses.

4) Water Heater Flow Rate

The flow rate of the water heater is extremely important to ensure your AutoVap is performing at full efficiency.

For the AutoVap15, you should have a flow rate of at least 5 gallons per minute. The higher the flow rate the better. With some recirculating pumps, you may be able to see around 10-15 gallons per minute.

The flow rate may be determined by a few variables:

1. The capacity of your recirculating pump
2. The length and flow of your plumbing line supplying the AutoVap and returning to the Water Heater
3. Water pressure. This closed loop system can, in fact, lose water pressure over time and may need to be re-primed.

5) Never Run Your Pump Dry

Be sure to monitor your tincture material being fed into the system. You never want to have the feed pump running dry. This can cause your pump to fail and will cost you time and money to replace.

NOTE: The TruSteel warranty does NOT cover pumps that were run dry.

6) Never dead head your pump

Always remember to open the Feed Line Ball Valve when running your AutoVap. Failing to open the Feed Line Ball Valve could "dead head" the pump and cause failure.

Again, TruSteel does not warranty pumps that were improperly run, such as dead heading due to operator error.

7) Auto Discharge on Recovery Vessel

Having Auto-Recovery on the Solvent Vessel is a great convenience. You will not have to stop the AutoVap to discharge your material.

Great news, any AutoVap15 Basic can be upgraded to an Auto Discharge. Contact TruSteel for pricing and more information.

8) Purge Residue Material

If you have the time, you can actually use the AutoVap15 Residue tank as a purging tank. After filling your residue tank with "crude" (full is around the 3/4 mark), you can stop the feed and just pull very deep vacuum on the system. You can purge your material for 15-30 minutes. This will leave you with a thicker final product with less solvent left.

9) Feed Tank (feed from bottom)

We suggest using a feed tank that feeds from the bottom. A bottom fed tank uses gravity to help feed the material which will eliminate any air pockets in the feed line. This will ensure you are not causing a large air pocket with can cause cavitation at the pump and cause it to run dry.

A conical fermenter tank works well for this application.

10) Extra Pump

It is highly suggested you purchase either an extra pump or a rebuild kit. Pumps can fail from either operator error or from natural deterioration over time. You can decrease downtime by having an extra pump on hand instead of relying on TruSteel to have one in stock and have to rush delivery (expensive shipping costs).

SECTION V: TROUBLESHOOTING

1) Falling Film Heat Issues (Soupy Material)

ISSUE: The evaporator seems to not be evaporating efficiently and it is "raining down" solvent filled residue into the residue collection tank.

POSSIBLE CAUSE: This is most likely due to a low flow rate from your water heater. Please check the flow rate at your water heater. If it is at 5 gallons per minute or lower, you will want to add more water into the closed loop system.

Check your water heater temperature. What is the temperature in? What is the temperature out? In the electric water heater models you can check the diagnostics on the water heater (Temp in, Temp out, Flow Rate)

After verifying the water heater is working properly and the flow rate is up over 5 gpm, run the system again and see if your recovery has improved.

2) Feed Pressure Issue

ISSUE: I cannot get the feed pressure up to 42 PSI, it only reaches around 20 PSI and then drops.

POSSIBLE CAUSE: Your feed pump could be starting to fail. Pumps do deteriorate over time. This is NOT covered under the TruSteel Warranty. We suggest to either have an extra pump on hand, or purchase a pump rebuild kit.

3) Checking for Vacuum Leaks

ISSUE: The AutoVap is not holding vacuum. The vacuum is dropping quickly.

POSSIBLE CAUSE: There could be a small leak in one of the connections (clamps) in the system. With the system empty of processing material, you can perform a pressure test on all clamp connections.

POSSIBLE CAUSE 2: Verify all all clamps are completely closed

4) AutoDischarge Not Discharging

ISSUE: AutoDischarge was discharging normally and now it is not discharging.

POSSIBLE CAUSE: The check valve after the solvent recovery pump could be stuck. Try removing the check valve and performing a blow test to confirm that the check valve is working.

5) Inconsistent Spray Pattern

ISSUE: The spray pattern at the top of the falling film doesn't seem like an even spray.

POSSIBLE CAUSE: The spray nozzle could be slightly clogged. Remove the spray nozzle and clean it with solvent, then water, and then solvent.

6) Solvent in Vacuum Pump

ISSUE: There is a lot of solvent coming through the vacuum pump.

POSSIBLE CAUSES: You are either pulling too deep of vacuum on the system (more than 24 HG), or the chiller is not actually cooling the condenser arm (verify the chiller is working).

SECTION VI: OPERATION & SAFETY INFORMATION

Operators of the AutoVap™ are required to follow all safety protocols and instructions. The user and operator are responsible for any injuries to person or property while using this equipment and are advised to follow procedures as detailed in this operating manual.

Only trained professionals with the complete understanding of the equipment- and full understanding of the risks associated with the use of alcohol, should be operating this equipment. The evaporating and condensing of alcohol has inherent risks. Any misuse of this equipment can result in severe injury, including but not limited to death, disability and property damage.

Safety Warning Definitions

- The **DANGER** notice indicates an immediate hazard which, if not avoided, will result in serious injury or death.
- The **WARNING** notice indicates a hazardous situation which, if not avoided, can result in serious injury or death.
- The **CAUTION** notice indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, and or damage to the equipment. Do not proceed beyond a **CAUTION** notice until indicated conditions are rectified.

It is the operator's sole responsibility to use the equipment in a safe manner. Operators assume all risk associated with the use of this equipment and agree that the equipment is to only be used for lawful purposes.

DANGER This equipment uses high-proof alcohol. Alcohol is a flammable liquid. Improper use may cause alcohol to discharge, resulting in an unsafe environment. Use proper ventilation, personal protective equipment, and appropriate detectors.

DANGER Inhalation of highly concentrated alcohol vapors may affect the central nervous system. This is characterized by nausea, headache, dizziness, unconsciousness and/ or coma. It may cause respiratory tract irritation and a narcotic effect. Please read MSDS for further safety instructions.

WARNING Operators must follow all precautions and safety guidelines to ensure their own safety and the protection of property.

WARNING Always visually monitor fill levels, tanks, valves, seals and hoses for leakage. While the system is protected with pressure relief valves, proper monitoring should be taken to ensure



overfilling does not occur.

WARNING All hoses may contain alcohol under pressure. Wear proper personal protective equipment such as safety goggles and gloves when handling any part of the machine and working around alcohol.

WARNING Component wear varies depending on the amount of usage. Inspect all nuts, bolts, and gaskets before each use. If there is any question about the integrity of a component, replace it immediately.

CAUTION The facility must provide adequate ventilation/exhaust, as determined by the Engineer of Record, to maintain the local atmosphere below 25% of the Lower Flammability Limit (LFL).

CAUTION Alcohol vapor is heavier than air and can settle in low places.

CAUTION DO NOT use or store equipment or containers where they could be exposed to high temperatures. Relief valves can open allowing alcohol to escape. DO NOT artificially heat equipment or containers above 125°F.

CAUTION This system is NOT equipped with an overfill prevention device. Ensure proper fill levels prior to operation.

CAUTION All system containers must be checked for accidental pressurization. Depressurize prior to opening.

CAUTION DO NOT allow children or non-trained operators to tamper with or play near the equipment.

ETHYL ALCOHOL SAFETY INFORMATION – MSDS

EMERGENCY OVERVIEW WARNING! Flammable liquid and vapor. Causes respiratory tract irritation. May cause central nervous system depression. Causes severe eye irritation. This substance has caused adverse reproductive and fetal effects in humans. Causes moderate skin irritation. May cause liver, kidney and heart damage. Target Organs: Kidneys, heart, central nervous system, liver, eyes, optic nerve.

Potential Health Effects

Eye: Causes severe eye irritation. May cause painful sensitization to light. May cause chemical conjunctivitis and corneal damage. Inhalation, ingestion or skin absorption of alcohol can cause significant disturbances in vision, including blindness.

Skin: Causes moderate skin irritation. May cause cyanosis of the extremities. alcohol can be absorbed through the skin, producing systemic effects that include visual disturbances.

Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May cause systemic toxicity with acidosis. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure.

Inhalation: Inhalation of high concentrations may cause central nervous system effects



characterized by nausea, headache, dizziness, unconsciousness and coma. Causes respiratory tract irritation. May cause narcotic effects in high concentration. Vapors may cause dizziness or suffocation.

Chronic: May cause reproductive and fetal effects. Laboratory experiments have resulted in mutagenic effects. Animal studies have reported the development of tumors. Prolonged exposure may cause liver, kidney, and heart damage.

FIRST AID MEASURES

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

Skin: Get medical aid. Wash clothing before reuse. Flush skin with plenty of soap and water.

Ingestion: Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

General Information: Containers can build up pressure if exposed to heat and/or fire. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Vapors may form an explosive mixture with air. Vapors can travel to a source of ignition and flash back. Will burn if involved in a fire. Flammable Liquid. Can release vapors that form explosive mixtures at temperatures above the flash-point. Use water spray to keep fire-exposed containers cool. Containers may explode in the heat of a fire.

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. For large fires, use water spray, fog, or alcohol-resistant foam. Use water spray to cool fire-exposed containers. Water may be ineffective. Do NOT use straight streams of water.

Autoignition Temperature: 362.8 deg C
(alcohol Flash Point: 13.9 deg C (57.02 deg F)
Explosion Limits: Lower: 3.3 (alcohol)
Explosion Limits: Upper: 18.0 (alcohol)
NFPA Rating: health: 2; flammability: 3; instability: 0

APPENDIX

VACUUM/ELEVATION CHART

Capacities Are Reduced As You Go Higher- Use this guideline and also other web resources to figure what your gauge reading difference is for you elevation. Pressure Gauges are set for sea level.

The basic formula is:

Current Atmospheric Pressure x Max. Rated Level of a Vacuum Pump
29.92 Hg (absolute vacuum)



Refer to the following table to correct for vacuum pump performance at various altitudes.

Altitude Above Sea Level (feet)	Altitude Above Sea Level (meters)	Atmospheric Pressure (psi)	Maximum Vacuum Level Attainable (inches Hg)	Vacuum Level Loss at Altitude	Maximum Vacuum Level Possible at this Altitude
0	0	14.70	29.921	–	–
1000	305	14.16	28.9	3.4%	96.6%
2000	610	13.66	27.8	7.1%	92.9%
3000	914	13.16	26.8	10.4%	89.6%
4000	1219	12.68	25.8	13.8%	86.2%
5000	1524	12.22	24.9	16.8%	83.2%
6000	1829	11.77	24.0	19.8%	80.2%
7000	2134	11.33	23.1	22.8%	77.2%
8000	2438	10.91	22.2	25.9%	74.1%
9000	2743	10.50	21.4	28.6%	71.4%
10,000	3048	10.10	20.6	31.3%	68.7%
11,000	3353	9.71	19.8	33.9%	66.1%
12,000	3658	9.34	19.0	36.5%	63.5%
13,000	3962	8.97	18.3	39.0%	61.0%
14,000	4267	8.62	17.5	41.4%	58.6%