CannaBeast®

A registered Trademark of InCon Process Systems

IPS MANUAL

Applicable Products

Single Stage 0.2m^2

Single Stage 0.6m^2

2-Stage 0.2m^2

2-Stage 0.6m^2

3-Stage 0.6m^2

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1. Important Notes

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CannaBeast® systems are designed by InCon Process Systems (IPS) and provided to you by Lab Society. Continuous distillation is a reliable and consistent process however, it requires proper operation and use of the equipment to assure reliability and quality of products distilled.

Proper preparation of feed- stock is necessary to operate the plant successfully. The feed should be free of solid material, material that will come out of solution during distillation and free of low boilers that will not properly condense at conditions the plant is running.

Care should be taken to assure that no chemicals harmful to 316SS, glass, Teflon, viton, Kalrez or graffoil are present in the feed or formed when heated. Operators should also be carefully trained and monitored to allow for proper operation of the plant. Improper use of the plant, from the items above or others, may cause damage. Damage caused by improper use is not covered by any warranty.

2. Customer Service

Wes

3 . Safety

The plant contains moving parts and high voltage components. Users are solely responsible for following local codes and OSHA guidelines for safe operation and maintenance of the plant. This is especially important with rotating equipment, high temperature utilities and high voltage devices. No untrained individuals should work with any of these components. This plant is designed for use in General Purpose Areas. **The system is NOT wired or set-up for explosion proof operation and should not be operated in presence of flammable materials.**

Accident Prevention and Safety

This section relates to the safe operation of the equipment. It is meant as a product specific guide for installers, operators, maintenance, and other workers who will be working with the Cannabeast system but does not take precedence over or override any applicable national or local safety codes and practices that may apply to your specific installation.

The Cannabeast is a heavy duty industrial grade process equipment package and therefore must be treated as such in terms of operation and safety. Parts can be heavy when removed for maintenance, be sure to use proper lifting techniques and supports. The equipment produces heat and noise which should be accounted for in the overall industrial safety design of the facility.

Burn Hazards

There are many locations on the Cannabeast where burn hazards exist. The Cannabeast SPD (short path distillation) body uses heat transfer fluids that may reach up to 250C in temperature. This heat jacketing of the body is important to reach the desired process effect. However, at operating temps the body, oil piping, and flexible stainless steel hoses all become extremely hot to the touch and can cause burns.

The process piping also uses a jacketed design heated from the skid-mounted tempered water units which can get up to 100C. This piping also becomes very hot to the touch and can cause burns to an unaware operator.

It is recommended to insulate all hot oil jacketing and piping with a non-flammable insulation where possible to prevent accidental burns and also reduce electrical consumption. Trying to insulate the process piping may not be practical.

Electrical Hazards

The equipment on skid is powered by high voltage motors and pumps. Therefore the risk of shock and electrocution always exists. Ensure the equipment has been installed and grounded properly by a certified electrician or electrical contractor.

When working on any electrical components be sure to disconnect any incoming power to the unit.

Rotating and Pinch Hazards

There are rotating and pinch hazards on the Cannabeast® skid. In particular, the gear pumps (3, 5 or 7 depending on system ~~configuation~~configuration), and the SPD basket motor gear assembly. The pumps come equipped with motor guards and covers, however, if they are removed for service they must be re-installed prior to use.

The SPD basket motor hub assembly also comes with two screen guards, however, these are not installed prior to shipping and must be installed during the startup prior to full commissioning or operation. ~~Likewise~~Likewise, if these guards are removed in order to service the equipment they must be re-installed prior to subsequent use.

Crush Hazards

There are crush hazards when working on the equipment, particularly during maintenance when removing and reinstalling parts such as pumps or the SPD wiper basket. When working on the piping or the pumps it is easy to stand up and hit your head on some of the other piping or frame.

Cut Hazards

While great care is taken to ensure there are no sharp edges for all the equipment on the skid, there may be areas that may require extra attention to when working with or on the machine. Use best safety practices as necessary.

4. General Functional Description

The Cannabeast is a short path thin film distillation system designed to bring the high production capabilities of a larger industrial distillation system to the Cannabis and related industries. The Cannabeast evaporators use the wiped film distillation process of separating liquids along the heated transfer surface while under vacuum.

There are a few different configurations of the Cannabeast~~., through the many years of plant manufacturing, distillation, and toll processing IPS has designed, built, and run all sorts of configurations.~~

The two stage plant is designed to run at 5kg/hr, though lower and higher rates are possible as well. Both stages are designed with individual vacuum systems including pumps and cold-traps. The plant is designed with tempered water systems to control the temperature of the process lines and condensers. Thermal oil heaters are provided to control the temperature of the Evaporator Jackets. There are a total of 5 external gear pumps. This includes a Feed Pump, R1 Transfer Pump, D1 Discharge Pump, R2 Discharge Pump and D2 Discharge pump. The plant also has a chiller for cooling the cold-traps. The plant is not insulated, this may be done at the client's discretion. The plant has a control panel. This contains 7 VFDs and the feed pump flow readout.

Single stage 0.2 m2 SPD system: 5-20 Liters per hour

Two stage 0.2 m2 SPD system: 5-20 Liters per hour

Single stage 0.6 m2 SPD system: ~~20~~15-50 Liters per hour

5. Transportation, Rigging, and Installation

The Cannabeast usually ships in a large wood crate on a flatbed trailer to protect its contents during shipping. The exact size and weight will depend on the system purchased.

Please be sure to confirm the exact dimensions and weight of your system before receiving the equipment.

The crates can be unloaded with a forklift, overhead crane, or any similar lift that can handle the appropriate weight. The forks need to be at minimum 6' in

length, extensions may be used. Please consult professional riggers and equipment installers if you do not have the correct equipment or know-how.

The crate can be easily disassembled by removing the screws that hold the roof and walls together. There are typically lag bolts that hold the frame to the wood decking of the crate that will also need to be removed. Then the equipment can be lifted straight off of the wood deck and then moved to its installed location.

The physical installation simply requires that the equipment be set in place. Once the equipment skid/frame is set in place ideally it should be leveled from the top of the evaporator body. However, this requires removing the basket so the second best option would be from the top of the basket mounting plate. For reference see photos below.

There are anchoring bolt holes in each of the corners of the frame that may be used to permanently anchor it in place. IPS also recommends the use of vibration pads underneath the mounting plates.

Electrical Installation

Refer to the included panel schematics for your system to see what the correct customer connections are as each system may vary slightly depending on the final component selection.

Each system is typically pre-wired and shop tested although some instruments are expected to be field installed by the service technician at startup. Generally speaking only the incoming power is required to be run by the customer.

Utilities Installation

The main utilities for the Cannabeast line include:

Hot oil heater(s)

The hot oil heater(s) for the Cannabeast are self contained units that are typically mounted to the skid prior to crating and shipping. They are typically filled with heat transfer oil and tested during IPS' factory acceptance testing procedure, therefore there generally is no additional installation effort required by the customer unless specifically informed otherwise.

Tempered water heater(s)

The tempered water heaters are also tested at the factory but will need the supply and drain lines connected by the end user/customer.

Chiller

Info on chiller. (LS)

6. Machine Overview

The Cannabeast is a fully comprehensive short path thin film distillation system. The purpose of this section is not to describe the process or

benefits of thin film distillation, but to explain the general function of the equipment you have purchased.

For better organization, the system can be broken down into several different categories:

1. Feed system and piping

   The feed system is where the input material is loaded and transferred to the evaporator.

2. Short path evaporator(s)

   The evaporators are where the distillation separation ~~reactions~~ takes place. The quantity of evaporators are described in the amount of "stages" the system may have.

3. Process piping jacketing

   The process pipe on the Cannabeast come with an outer heated jacket. This jacketing is temperature controlled by their own process loops.

4. Hot oil lines and jacketing

   In order for the ~~correction reaction~~distillation and separation to take place the evaporators need to have a heated surface. In order to achieve this the fluid of choice is a heat transfer oil.

5. Vacuum

   The vacuum system is an important part of achieving your end process goals. This system includes everything including the vacuum pump(s), vacuum piping, and gauges.

6. Chiller and Cold Traps

   The chiller and cold traps protect the vacuum pumps and allow the system to run at lower pressure (higher vacuum).

7. Control System

Depending on the system, the Cannabeast is either a manually operated machine, has some semi-autonomous functionality, or is a full automated production machine.

For more specific breakouts of each system see the next section.

7. Machine Components

The main components are listed in this section:

~~Chemical Distribution~~Gear Pumps

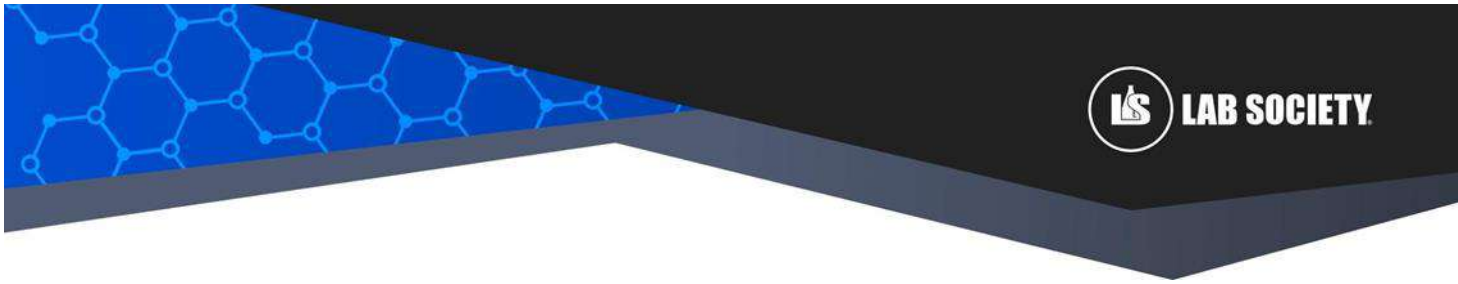
Witte Gear Pump

These pumps move the material through the piping. Typical configurations include one pump to control the feed at the outlet of the tank, and pumps at each distillate and residue outputs respectively. Therefore on a typical 1-stage system there will be 3 chemical gear pumps, on a 2 stage system there are usually 5 pumps, and 7 pumps on a standard 3 stage system.

Feed Tank

Feed tanks vary in size but on a 1-stage and 2-stage 0.2 m2 unit a 8 gallon stainless steel jacketed tank is typically provided. These tanks have a simple non latching lid.

Pressure Transmitter(s)



The feed pump outlet typically has a pressure transmitter installed in order for an operator to help monitor the performance of the system as well as trouble shoot any issues that they may be having.
Sometime there are pressure transmitters on the distillate and residue pumps as well depending on the configuration of your system.

SPD Wiper Motor and Drive

This is a motor driven wiper basket system with a gear reducer. It is controlled by a variable speed drive.

SPD Wiper Basket

The internal wiper basket is of SS construction and has glass impregnated Teflon rollers. This creates an evenly distributed thin film in the evaporator.

Back Pressure Valve

The feed system has a back pressure valve that prevents fluid from being forced into the plant when it is under vacuum. It is not a check valve.

Sight Glasses

Fused sight glasses are used for high durability and allowing for verification of flow and level.

Manual Ball Valves

Manual ball valves are used throughout the plant for operation and maintenance purposes.

Cold Trap

Each evaporator has a cold-trap attached to it. These aid in condensation of low boilers and improve the ability to achieved lower pressure in operation.

Vacuum Gauge

Different vacuum gauges are provided to monitor, and control, system pressure.

Vacuum Pumps

A variety of vacuum pumps can be used in operation. Vane and diaphragm are the more common in this size. Detail training is done by LS on the proper use, and selection, of vacuum pumps.

Tempered Water Heaters

Jacketed lines and condensers have their temperature controlled by Tempered Water Systems. These systems allow for precise control and efficient condensation while also simplifying maintenance.

Hot Oil Heaters

The evaporators are heated via recirculated thermal oil. This allows for precise control of temperature. InCon uses only sealed heaters in their systems, safer and cleaner than open bath designs.

8. Machine Controls and Operation

Insert LS SOP

Items to Verify Prior to Start-Up

Prior to operation of the plant operators should verify that all equipment is in proper working order. This includes utilities that are functioning according to design, all process lines are in good condition, all ANSI flanges and other connections are properly tightened, and gaskets/seals are in good working condition. The plant should have minimal to no vacuum leaks present, this is done by a Drop Test. The Control Panel should be properly closed during all operation.

Utility Valves

It is critical to proper operation that all utility and process valves are in the proper position for start-up. All sections of the plant to be heated by the tempered water systems should be valved open. At NO TIME should sections have the supply AND return valves closed. This could cause overpressure and damage/rupture of jacketing or piping.

Utilities

The hot oil system should be inspected and tested to be leak free and control at the proper temperature. Refer to the manual for detailed operation instructions. The heaters for the evaporators should be at operating temperature for a minimum of 15 minutes prior to start-up.

The tempered water units should be inspected and tested to be leak free and control at the proper temperature. Refer to the manual for detailed operation instructions. All jacketed sections should be at temperature for 30 minutes prior to starting any feed to the plant. This is to assure that each section has had time to properly warm up.

The chiller should be inspected and tested to be leak free and control at the proper temperature. Refer to the manual for detailed operation instructions.

Vacuum System

The vacuum pumps should be properly vented to an outside space and be functioning properly. A drop test should be performed to assure the plant is reasonably leak free. If a control system is being used on the pressure than the operation of this for the desired operating conditions should be tested prior to start-up.

Setting Proper Plant Operation Conditions

The plant must be set up at the proper conditions of pressure and temperature to allow for evaporation, condensation, gravity flow of liquids and proper pumping. This is often a balance act between pressure and temperature and requires proper preparation of feed stock prior to distillation. The condensers should be at least 30 degrees Celsius below the evaporator temperature, they should also be high enough that the material being condensed flows well. To increase the difference raise the evaporator pressure. This will require higher temperature on the evaporator but allow for more flexibility on the condenser temperature setting.

Overview for CBD Distillation

If the primary goal is to distill out Terpenes in the first stage and CBD in the second stage than it is required that the feed-stock be properly stripped of solvent/low boilers prior to beginning distillation in the plant. If this is not done than the low boilers may overwhelm or bypass the cold-trap and collect in the vacuum pump and damage it. This is not covered by warranty. If pressure climbs dramatically when starting, if

there is a lot of reflux or cold-trap collection present than the feed material has not been properly stripped or the operating conditions chosen are too aggressive. If this occurs then one of two options remains. 1. Further strip the feed material prior to operation or 2. Increase the pressure in the first evaporator until the volatiles are collected by the condenser. Temperature may need to be raised as well, this depends on process goals and feedstock composition. Alternatively, the system can be used to remove solvent by running through the plant at atmospheric conditions, not under vacuum, and distilling out solvent and collecting the residue to be re-fed through the plant.

If terpenes have been properly removed in the first stage than the second stage will be able to maintain proper vacuum levels to distill CBD. This stage will be at higher vacuum (lower pressure) than the first stage. Operation is expected to be in the 100micron to 2mmHg range, though you may choose to run above or below these conditions. The higher the vacuum (lower the pressure) you run the lower the evaporator temperature will be. However, this will increase the likelihood of byproducts getting into the cold-trap and/or the vacuum pumps. It is recommended that you operate the plant at the highest pressure that achieves proper distillation and quality. The plant will be easier to operate and more reliable when this is done. Tracing temperature/condenser temperature is expected to be in the 80C range for the second stage. The evaporator temperature will be set to maintain proper distillation results.

In practice the vacuum system without controllers or bleeds will have a set pressure that it will run at. If these conditions work under the limitations noted previously it is often best to do so. However, a pressure control for the first stage has been provided, as have different vacuum pumps for testing purposes.

As the materials are fairly high viscosity it is important to keep them flowable enough that the pumps can properly operate without building up too much pressure. Running the pumps too quickly or with too cold (thick) material in them **WILL** damage the mechanical seals. Pumps should be started at a low RPM and sped up only once the process lines have been cleared of any colder material. The VFDs will be programmed with upper limits on frequency to reduce the likelihood of running too quickly.

Pump Operation and Things to Watch out For.

Proper pump operation is critical for reliable operation of the plant. It is important to understand how they work in order to not run them in a fashion that can damage the pumps. The Discharge pumps do not have valves after them in order to prevent operators from dead-heading the pumps and damaging the mechanical seals. During training pumps will be discussed in detail. Below are some tips for operation.

- Do not start at high RPM
- Make sure that process lines are at the proper temperature
- Do not try to pump material out too quickly, this can cause the system

to build very high pressure and damage the pumps.

- Make sure there are no leaks near the pump
- Make sure the discharge lines are properly purged before starting flow and before turning the pump on
- NEVER DEADHEAD A PUMP. This means pumping against a frozen line or with a discharge valve covered. This can immediately damage the pump and mechanical seal. Start pumps slowly and monitor the discharge pressure. Make sure all lines are at proper temperature before starting the pumps.
- Have the back pressure valve at the lowest setting that prevents free flow into the evaporator
- Thin materials will require higher pump speeds and will wear the pumps out more quickly
- The Feed Pump has an auto mode. This is not to be used until proper VFD limits on RPM are in place.
- NEVER do maintenance on a line where the pump is running. They can produce high pressure and expose the operator to spills or liquid sprays at elevated temperature and pressure.
- If a pump does not appear to be functioning properly, immediately shut the plant down so that you can methodically evaluate the issue.
- Discharge pumps have check valves. They don't always work. Make sure no gas is flowing back through line or pump will not prime or pump.

Start-Up Procedure

1. Ensure plant is clean and dry.
2. Close discharge and feed isolation valve.
3. Leave R1 valve open, for 2 stage plants.
4. Start Chiller for cold traps.
5. Once cold turn on vacuum system. (What pump being used depends upon goals)
6. Make sure that vacuum levels are where desired.
7. Turn on tempered water units at desired temp once confirming valves are in the proper position.
8. Confirm as water heats that each section is heating correctly.
9. Wait till feed is at the proper temperature and viscosity before turning on evaporator heaters.

10. Once confirmed turn on evaporator heaters.
11. Put lightly greased stoppers on discharge lines and open discharge valves to purge lines. If check valves are sealing properly the stoppers may not stay in position. This is ok.
12. Once all systems are functioning properly run all pumps, except feed, one at a time slowly to confirm that all lines are empty. For the R1 pump have the basket turning when confirming the lines are clear.
13. Verify lines are clear by looking through sight glasses.
14. Turn on wiper baskets.
15. Start feed in manual mode targeting 5kg/hr.
16. Once flow is seen in R1 turn on R1 pump at predetermined speed. This is generally just fast enough to pump the pipe dry. It will take time to determine what speed this is for each pump and each stage. It may vary slightly, and the operators should monitor this.
17. Depending upon conditions you may see flow in any of the other streams next. Start pumps once flow is seen. You can confirm there is no backstreaming of gas by looking at the sight glass, monitoring pressure and covering the outlet with either a stopper or a gloved finger.
18. Once all streams are flowing at a steady rate measure your discharge splits.
19. Adjust temperature to achieve proper splits. Try and keep pressure constant once you have determined what the proper operating pressure is.
20. Monitor the cold-trap closely. If there is a lot of material or you see icing on the outside then you are refluxing. This will contaminate and damage the vacuum pumps. We will discuss separately how to handle this subject using a combination of different vacuum pumps, pressure control, proper running pressure/temperature as well as proper pre-stripping.
21. Monitor temperature, pressure, flow, splits, Cold-Trap level, oil level in mechanical pump speeds and product quality regularly. We recommend recording key data once to twice an hour.

Shutdown

1. Turn off feed pump
2. Close feed isolation valve
3. Run R1 dry

4. Close R1 Isolation valve
5. Turn off R1 Pump
6. Turn off E1 Wiper
7. Run D1, D2 and R2 dry
8. Close their isolation valves before turning them off
9. Turn off heaters. It is recommended to turn off the heating elements first and a minute later turn the heater off. This cools the elements prior to flow stopping.
10. Leave chiller, tempered water and vacuum system running.
11. Once the evaporators have cooled you may brake vacuum and pump the system dry of any material that has drained out.
12. At this point you may turn off the chiller and tempered water units.

Quick Shut-Down.

1. Turn off all pumps, starting with the feed and close isolation valves.
2. Turn off evaporator heaters, just shut them down without the cooling cycle.
3. If there are issues with the chiller, tempered water unit or vacuum system you may shut them down.

Emergency Shut-Down

1. Throw main breaker on panel.
2. If there is time and it is safe to do so close feed isolation valve, and discharge pump isolation valves.
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9. Fault Causes and Repair

~~Common issues that we have seen include:~~

~~2.~~ ~~222~~

~~3~~.1. ~~333~~LS to add common issues. Put in the explanations you use and we will review and edit.

Trouble Shooting

- Plant Pressure too low
  - This is generally caused by using an incorrect vacuum pump, is the result of a broken vacuum gauge or an incorrectly operating vacuum controller. Check and correct accordingly.
- Plant Pressure too high
  - Primary causes are vacuum leaks, incorrect vacuum pumps, poorly operating vacuum pumps, poorly operating chiller, poorly operating condenser or the presence of excessive non condensing volatiles.
- Pump not pumping

    - Primary causes are pump not on, pump turning incorrect direction, pump running too slowly, pump not properly primed, failed mechanical seal, isolation valves is closed, check valve is stuck or the pump internals are worn.
- Feed flow not registering
    - First confirm that there is actual flow based on what you see in the R1 sight glass. If flow is present this could be the result of a failure of the gear indicator or wiring. See the corresponding manual.
- Not getting distillate
    - Primary causes are pressure too high, temperature too low, condenser not at the proper temp (too high or too low can cause this) wiper basket not properly operating, heater not operating correctly or feed composition is different than expected.
- Too much distillate
    - Primary causes are too low pressure, too high temperature, different feed composition than expected or the residue is backing up and overflowing into the distillate.
- Too much cold-trap
    - Primary causes are pressure too low, condenser too hot, or too much volatile material in feed stock.
- Vacuum leak
    - Primary causes are items recently worked on, leaks through pumps that have lost prime, failed pump mechanical seals, loose flanges or fittings or failed mechanical seal on the evaporators.
- No feed flow
    - Primary causes are feed pump not on, feed isolation valve close, feed pump running too slowly, feed pump running in reverse, no feed in tank, feed in tank too cool/thick to pump, back pressure valve or flow meter are stuck.
- Utility not operating properly
    - Check power, fluids, valves and see individual manuals.
- Chiller not holding lower temperature

Primary cause is too much condensate in the cold-trap. See individual manual for other issues.

10. Maintenance

Proper maintenance is important to keep your machine running properly. For each individual component such as the pumps and heaters, please refer to the maintenance section in each parts' individual manual.

Service for the short path evaporators generally resolves around cleaning may involve taking apart the unit and piping for ease of access.

Typical Maintenance Schedule:

CIP Procedure

There are different methods of cleaning the evaporators and piping. The recommended method of cleaning in place (CIP) will be detailed in this section. However, there may be slight differences depending on your machine's exact specifications. Please contact your Lab Society or IPS rep if you have any questions.

Procedure...

SPD Disassembly and Basket Service Procedure

The following section is a reference guide for the mechanical disassembly and re-assembly of the short path evaporator for maintenance.

Fig 1. Typical 2 stage 0.2 SPD Cannabeast

Tools you will need are:
7/8" wrench – for hose connections
3/4" wrench (2) – for ½"-13 hex head bolts and nuts
7/16" wrench and ratchet – for 1/4-20 hex head bolts
9/16" wrench and ratchet – for 3/8-16 hex head bolts
1/8" hex key/allen wrench – to remove or adjust the lovejoy coupler and machine guards
3/16" hex key/allen wrench – for socket head bolts

I. OVERVIEW

The evaporator is comprised of 5 main sections (see fig 2 below):

1. Motor and gear reducer assembly
2. Basket assembly
3. SPD body
4. Residue chamber

5. Condenser section

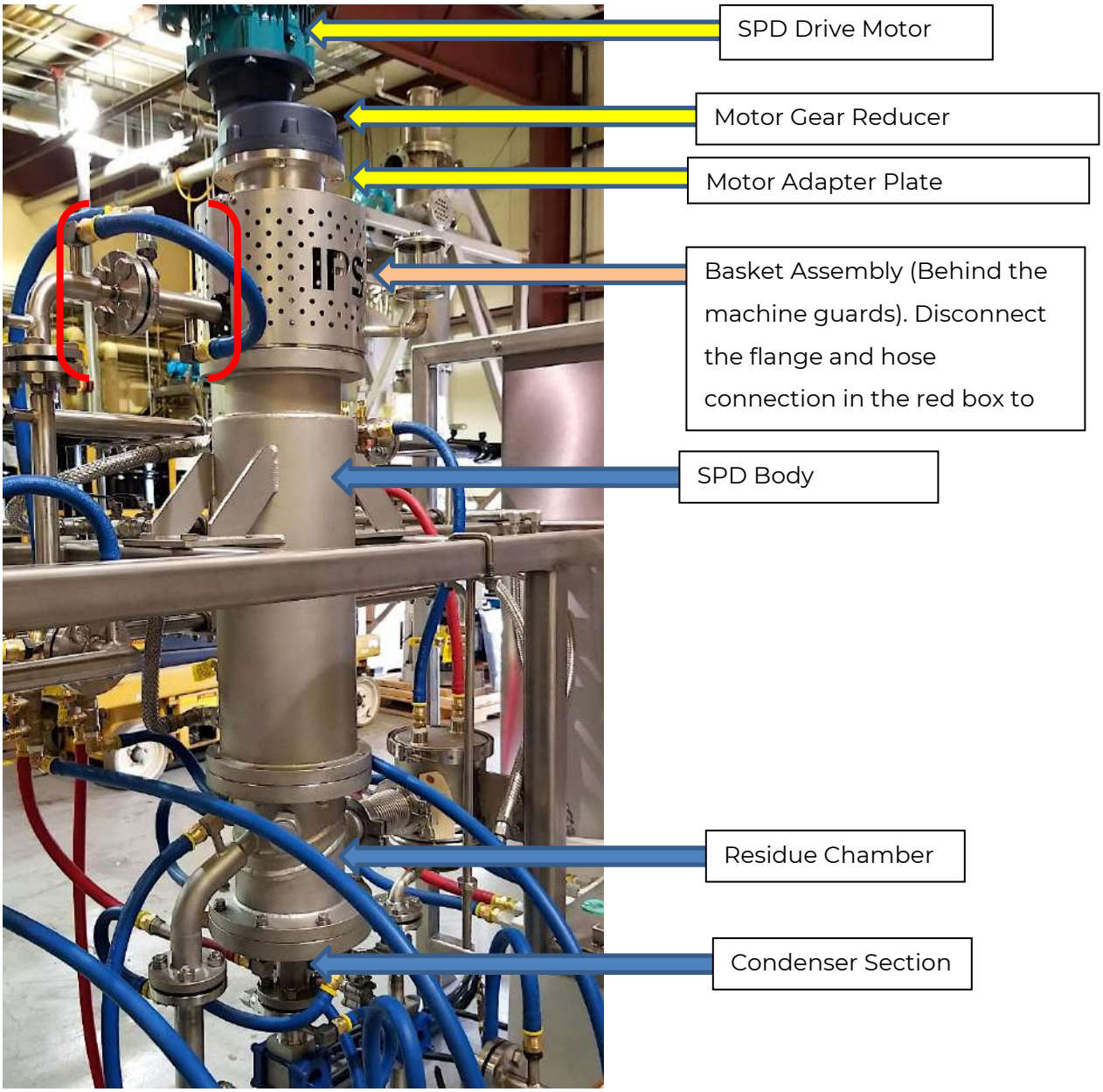

Fig 2. 0.2 m2 SPD Assembly

All sections are bolted together and can be removed if necessary for cleaning, replacement, or any other reason without affecting the other pieces.

When only the basket assembly needs to be removed, it's easier and safer to remove the motor assembly first, so we will cover these sections first and in more detail.

II. MOTOR ASSEMBLY

The motor assembly is comprised of 3 pieces: the motor, the gear reducer, and the adapter plate. Together they weight around 35 lbs. These three pieces are shown by the yellow arrows in the figure above.

The motor assembly is also connected to the drive shaft part of the basket assembly via a 3-piece hub connector shown below:

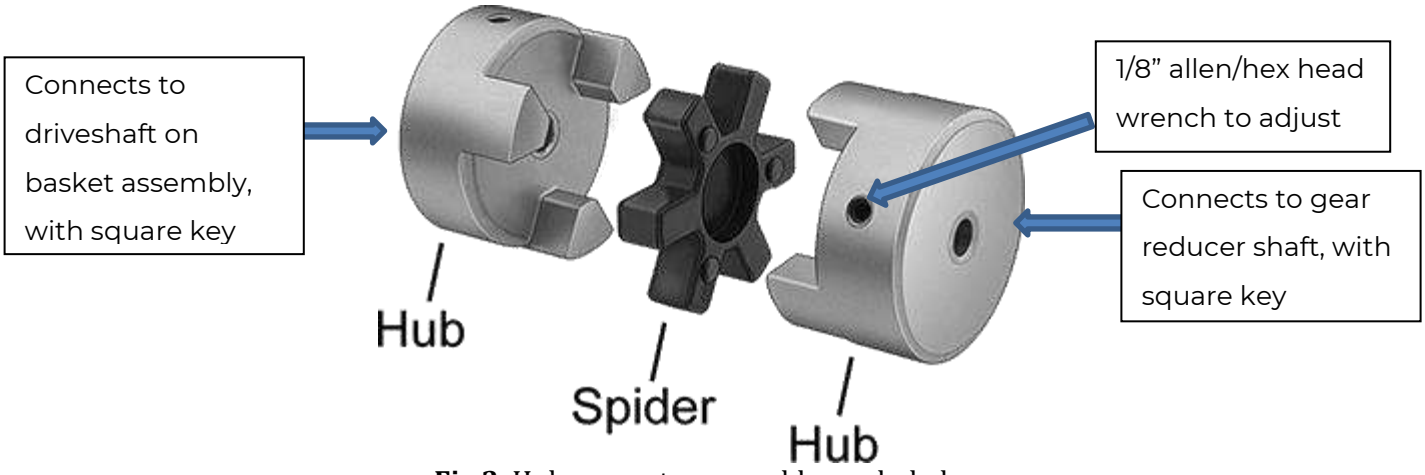

Fig 3. Hub connector assembly, exploded

Fig 4. Hub connection, as-installed

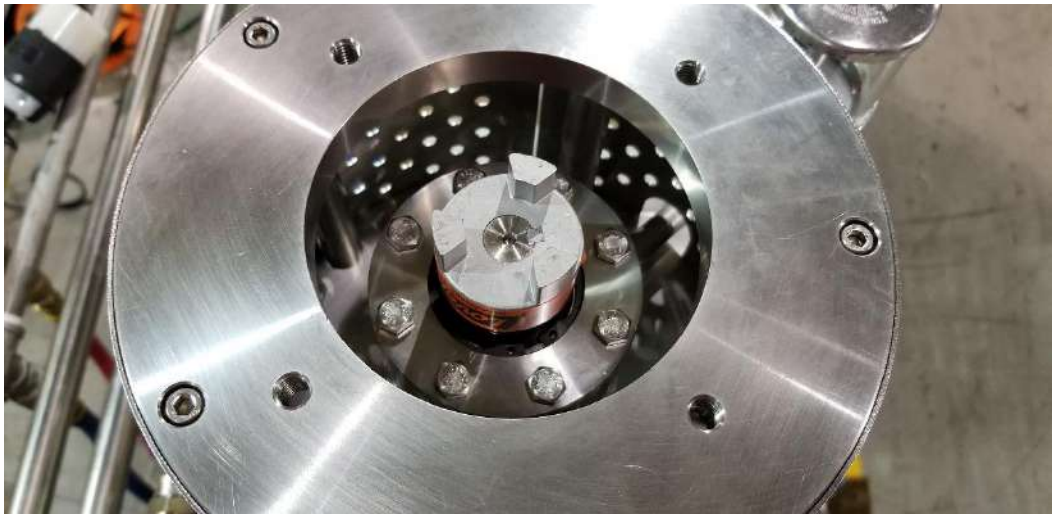

Fig 5. Hub installed on basket driveshaft, with key installed

Disconnecting the motor assembly from the basket assembly

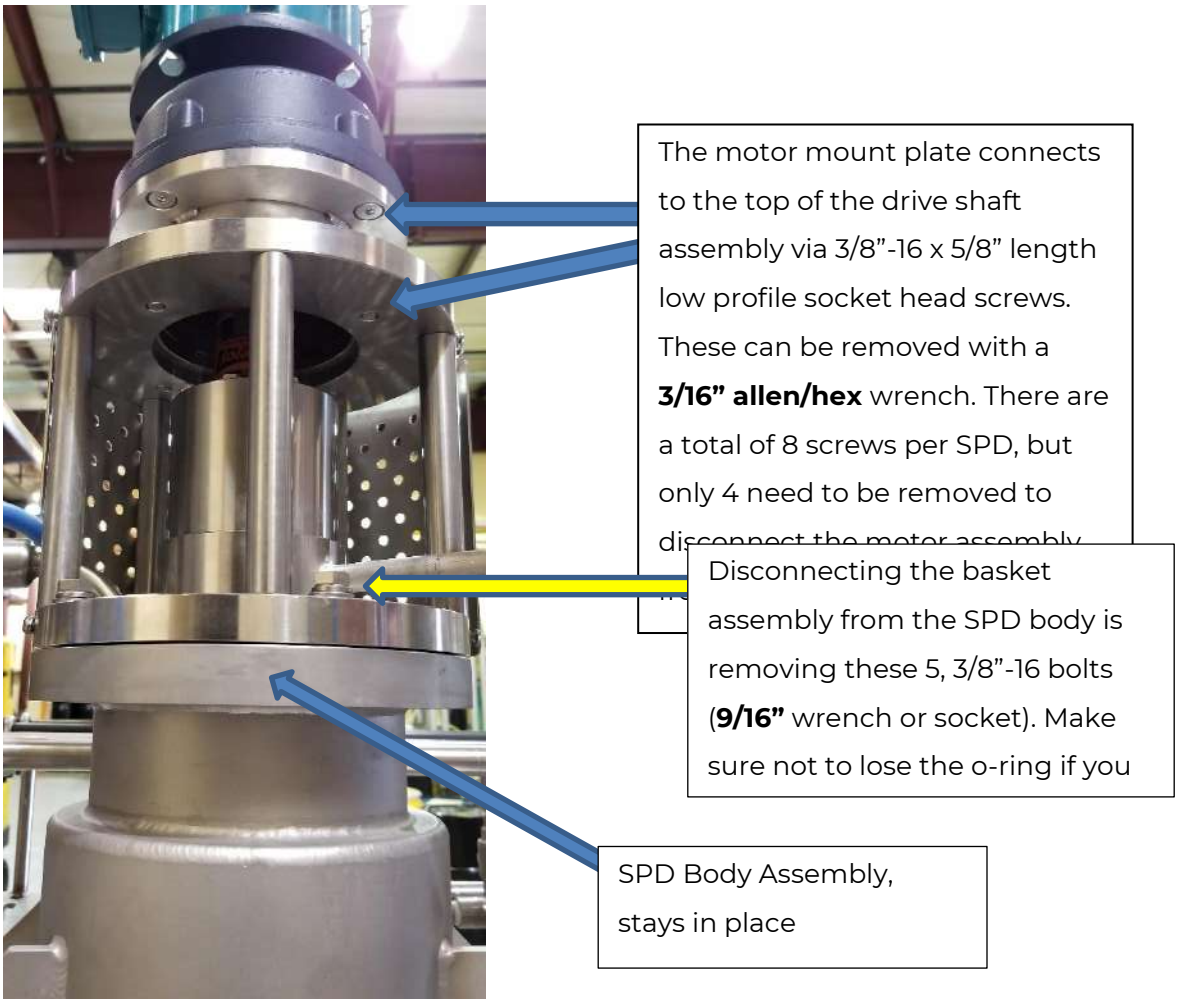

Fig 6. Basket Assembly and Mounting Points

Other notes:

1. Disconnect the electrical connection (twist lock) before pulling the motor assembly
2. The machine guards do not need to be removed in order to remove the motor assembly, they are shown here partially removed for clarity. However, the screens do need to be removed in order to remove the basket assembly. These are installed using 10-32 pan head machine screws and can be removed with a **1/8” allen/hex key** wrench (8 total per SPD).

3. The gear reducer is connected to the motor itself with 4x 3/8-16 hex head bolts, and can be seen at the very top of Fig 6 above. If necessary, these can be removed with a **9/16"** wrench or ratchet. Generally it is not needed to disconnected the gear reducer from the motor.

III. BASKET ASSEMBLY

The basket is connected to the SPD body top flange via five (5) 3/8-16" hex head bolts. To disconnect, simply take out these 5 bolts, disconnect the inlet flange (Four ½-13 bolts, use ¾" wrench) and the jumper hose (7/8" wrench) as shown in Figure 2.

After being disconnected, the entire basket assembly can be lifted straight out of the SPD body.

CAUTIONS: The basket assembly weighs 50 lbs without the motor assembly attached. Please use best safety practices when either lifting the basket out via lift or by hand.

Do not lift the basket from the drive shaft or drive shaft pieces.
Do not lose the flange o-ring if you plan on reusing it.
When removing or reinstalling, ensure the basket is straight and in-line with the SPD body as it is critical that the basket remain straight and square to the mounting plate.

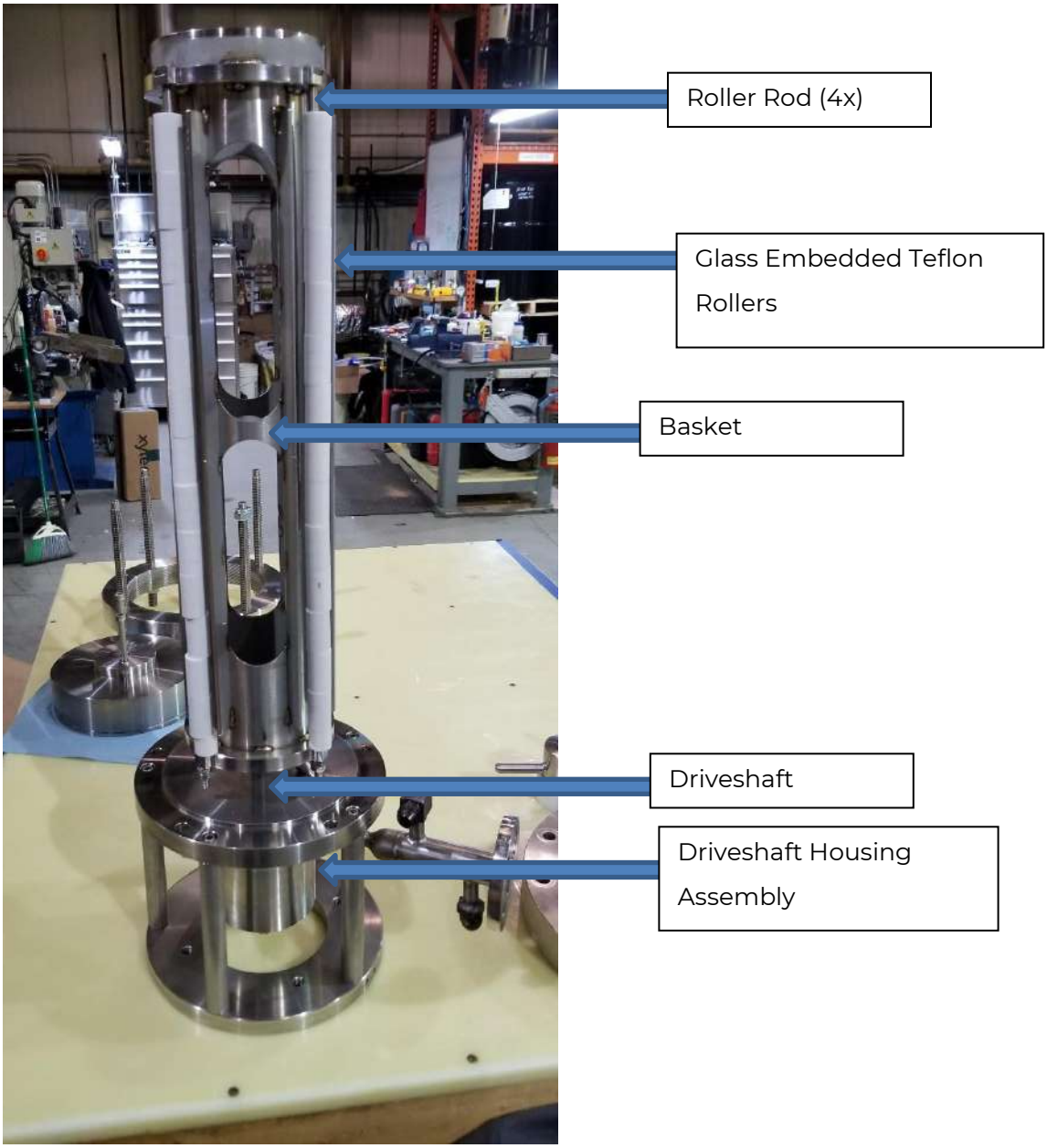

Fig 7. Basket assembly

Removing or installing the basket

The basket is connected to the driveshaft with a single ¼-20 hex head bolt.

Fig 8. Basket installation

The correct hardware configuration is flat washer – wedge style “Nord” lock washer – bolt

Fig 9. Drive shaft bolt setup. Note that the "Nord" lock washer is a two-piece locking washer and won't perform correctly if one half is lost.

To remove or re-install the bolt is a simple process but it may be difficult to access depending on available tools. A ratchet can be fit in-between the openings of the basket, or multiple extensions can be used to reach from the open end of the basket. Simply hold the basket with one hand to keep it from spinning, and use a ratchet and socket (**7/16"**) to loosen or tighten.

Fig 10. Reaching the drive shaft bolt

If removing and re-installing the basket or drive shaft housing, do a quick visual inspection that the driveshaft is installed in the center of the opening (there should be even gaps on all sides).

Changing basket rollers

Each basket comes with 4 sets of rollers. When the basket is upside down (ref Fig 7) it is easy to remove the roller rods without detaching the basket from the driveshaft.

Fig 11. Roller rods are pinned at the bottom end of the baskets by the machined grooves that prevent them from spinning.

Fig 12. The proper hardware assembly to re-install the roller rods as shown. Jam nut – Wedge "nord" lock washer – jam nut.

For the rollers themselves, there are 13 in one length (1.33") and 1 in a shorter length (0.67") per roller rod, for a total of 52 of the longer rollers and 4 of the shorter rollers per SPD. These are easily slid on or off the roller rods once the one end is free.

IV. SPD BODY, RESIDUE, AND CONDENSER SECTIONS

If these sections need to be removed from cleaning it is simply a matter of removing the bolts and disconnecting them. For reference the following hardware is used:

SPD Mounting Arms to Frame – ½"-13 (3/4" Wrench Size) – 4 per SPD
SPD Body to Residue Section – 3/8"-16 (9/16" Wrench Size) – 8 per SPD
Residue Section to Condenser Section - 3/8"-16 (9/16" Wrench Size) – 8 per SPD
The hardware utilizes the same – flat washer – lock washer (split type) – bolt configuration

Generally, the easiest method of removal is for the sections to be taken off from top to bottom. For example, to remove the Residue it would be raised above the condenser coil.

The Residue and Condenser sections will also need to have other process connections disconnected in order to be removed. These are typical hoses and pipe flange connections as seen elsewhere.

V. RE-INSTALLATION

Reinstallation is simply a reverse order of the disassembly process.

Additional items of note are to follow best standard practices for torqueing flanges, gaskets, and o-ring connections. The following information is a guide for the most common connections.

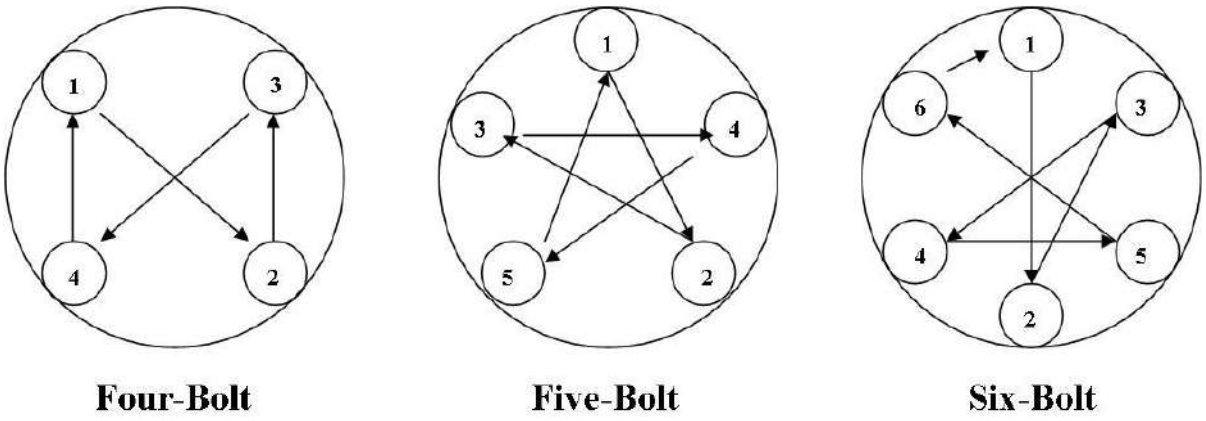

Fig 13. Typical bolt tightening sequences

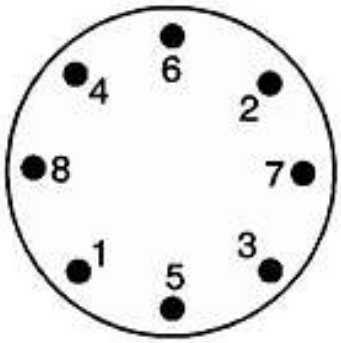

Fig 14. 8 bolt torque pattern

Torque Values for Stainless Steel and Non-Ferrous Fastener

Bolt Size	18-8 Stainless Steel		316 Stainless Steel	
	Dry	Lubricated	Dry	Lubricated
2-56	2.5 in-lbs	2.1 in-lbs	2.6 in-lbs	2.2 in-lbs
2-64	3	2.6	3.2	2.7
4-40	5.2	4.4	5.5	4.7
4-48	6.6	5.6	6.9	5.9
5-40	7.7	6.5	8.1	6.9
5-44	9.4	8.0	9.8	8.3
6-32	9.6	8.2	10.1	8.6
6-40	12.1	10.3	12.7	10.8
8-32	19.8	16.8	20.7	17.6
8-36	22	18.7	23	19.6
10-24	22.8	19.4	23.8	20.2
10-32	31.7	26.9	33.1	28.1
1/4-20	75.2	63.9	78.8	67
1/4-28	94	80	99	84
5/16-18	132	112	138	117
5/16-24	142	121	147	125
3/8-16	236	201	247	210
3/8-24	259	220	271	230
7/16-14	376	320	393	334
7/16-20	400	340	418	355
1/2-13	43 ft-lbs	37 ft-lbs	45 ft-lbs	38 ft-lbs

Fig 15. Typical recommended torque for various stainless steel fastener sizes. Source: Fastenal (For reference only, will vary depending on gasket type).

Other notes:

- It is highly recommended to use high temperature anti seize on all stainless to stainless fastener connections to prevent galling.
- Viton o-rings can be reused if not damaged from heat and retain their original shape when not under compression.
- Grafoil style compression gaskets should not be reused and replaced prior to re-assembly.

11. Decommissioning

Decommissioning includes shutting down the equipment for extended storage, removal, or for any other reason it may not be operated for a long period of time.

Decommissioning procedures include the following steps:

- Shutdown main disconnect and breakers inside the main panel before working on any electrical components or disconnecting the main incoming power.
- Shutdown all connected utilities prior to disconnecting them from the panel. The actual electrical types may vary but typically include;
    - Chord with plug type that connect to the outlets on the side of the panel
    - Directly wired to terminals inside the panel. These wires are easily removed via push pin terminals.
- Disconnect other electrical connections such as;
    - Chords to vacuum gauges
    - SPD wiper motor power plugs
    - Any vacuum pumps and chiller electrical connections
- Drain fluids from the system;
    - Tempered water lines can be simply disconnected and drained into buckets
    - There are drain ports on the bottom of most pumps that can be removed and also used as drains for the process piping
    - Heat transfer fluid/hot oil lines can be drained at any of the flex hose connections. Typically this is done by draining into buckets.

- Properly dispose of all and any fluids from the system per local and national environmental requirements. Refer to MSDS and related technical documentation.

- All valves should be closed, tank lid installed, and open connections should be capped or taped off. Now the machine may be wrapped and or stored.

12. Disposal;

a. Once the fluids have been removed and the machine has been electrically and mechanically disconnected it may be removed and disposed of as necessary.
b. Ensure that product waste is disposed of and processed correctly per all applicable environmental and safety regulations and codes.
c. Metals, electronics, and other specialty materials should be recycled whenever possible.

13. Technical Data

Single stage 0.2 Specifications

Two stage 0.2 Specifications

Single stage 0.6 Specifications

Two stage 0.6 Specifications

3 stage 0.6 Specifications

14. Glossary

Stage – Refers to the amount of evaporators and at which location. Evaporators are typically run in sequential order.

15. Appendix

The following list of documents shall be used in conjunction with this manual in order to completely operate and maintain this equipment to its best efficiency.