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## Desilter Operation, Maintenance, & Technical Manual

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## 1.0 Safety

### General safety rules and warnings

This manual contains important information concerning installation, operation, and proper maintenance of your PSI Desilter. To prevent injury to personnel or equipment damage, this manual should be read by those responsible for the installation and operation of the Equipment. In addition, the safety precautions below should be followed at all times.

1. Follow your companies LOCK-OUT/TAG-OUT Procedures before performing any maintenance.
2. Inspect equipment for damages, loose fittings, safety guards (if applicable), and proper installation.
3. Wear proper PPE based on your companies Personal Protective Equipment and Safety procedures.
4. When lifting equipment, ensure proper lift points are used. Use properly rated slings that are capable of handling the equipment.
5. Do not use the equipment for anything but its intended use.

## 2.0 Warranty

### ***Warranty Terms and Conditions***

The MAX2000®, MAKDADDY®, and Vak® name are registered trade names of Kelbro, Inc dba Process Solutions International (PSI). Their use is reserved by Kelbro, Inc. dba Process Solutions International (PSI) and applicable laws. It shall not be used without permission and written authorization from Kelbro, Inc. dba Process Solutions International (PSI).

### ***Terms of Sale***

Any terms and conditions contained in any purchase order or other form of communication from PSI's customers, which are additional to or different from these terms and conditions, shall be deemed rejected by PSI unless expressly accepted in writing by PSI. In general, no modification, amendment, waiver or other change of any of these terms and conditions or attachments hereto, or of any of PSI's right or remedies thereunder, shall be binding on PSI unless expressly accepted in writing by PSI's authorized officers. No course of dealing, usage of trade or course of performance shall be relevant to explain or supplement any of these terms and conditions. If any document issued by any party hereto is sent by facsimile or another form of electronic document transmission, the parties hereto agree that (a) the copy of any such document printed on the facsimile machine or printer of the recipient thereof is a counterpart original copy thereof and is an "writing", (b) an electronically stored and reproduced copy of any such document shall be deemed to be legally sufficient evidence of the terms of such document for all purposes.

### ***Delivery; Risk of Loss***

All sales are F.O.B. PSI's plant or other point of shipment designated by PSI. Shipping dates are estimates only which are not guaranteed and are based upon prompt receipt from Buyer of all necessary shipping and other information. PSI reserves the right to make delivery in installments, all installments to be separately invoice and paid for by Buyer when due per invoice, without regard to subsequent deliveries. Delivery of equipment to a commercial carrier at PSI's plant or other loading point shall constitute delivery to Buyer, and any risk of loss and further cost and responsibility thereafter for claims, delivery, loss or damage, including, if applicable, placement and storage, shall be borne by Buyer.

When equipment is delivered by PSI's truck, unloading at Buyer's dock shall constitute delivery to Buyer. Claims for shortages or other errors in delivery must be made in writing to PSI within ten (10)

days after receipt of shipment and failure to give such notice shall constitute unqualified acceptance and a waiver of all such claims by Buyer. Claims for loss or damage to equipment in transit by common carrier must be made to the carrier and not to PSI. Freight and handling charges by PSI may not reflect actual freight charges prepaid to the carrier by PSI due to incentive discounts earned by PSI based upon PSI's aggregate volume of freight tendered to a carrier or when a carrier must be used which charges a rate which is different than the rate upon which PSI's freight and handling charges were based. When shipments are delivered in PSI's private trucks, Buyer will be charged an amount approximating the prevailing common carrier rate.

***Excusable Delays; Force Majeure***

PSI shall not be liable for any ordinary, incidental, or consequential loss or damage as a result of PSI's delay in or failure of delivery or installation due to (i) any cause beyond PSI's reasonable control, (ii) an act of God, act of the Buyer, embargo or other government act, authority, regulation or request, fire, theft, accident, strike, slowdown, or other labor disturbance, war, riot, delay in transportation, or (iii) inability to obtain necessary labor, material, components, or facilities.

Should any of the aforementioned events of force majeure occur, PSI, at its option, may cancel Buyer's order with respect to any undelivered equipment or extend the delivery date for a period equal to the time lost because of delay. Notice of such election shall be given promptly to Buyer. In the event PSI elects to so cancel the order, PSI shall be released of and from all liability for failure to deliver the equipment, including, but not limited to, any and all claims on behalf of Buyer for lost profits, or any other claim of any nature which Buyer might have.

If shipping or progress of the work is delayed or interrupted by Buyer, directly or indirectly, Buyer shall pay PSI for all additional charges resulting therefrom.

***Storage***

If the equipment is not shipped within fourteen (14) days after notification has been made to Buyer that it is ready for shipping, for any reason beyond PSI's control, including Buyer's failure to give shipping instructions, PSI may store the equipment at Buyer's risk and expense in a warehouse or on PSI's premises, and Buyer shall pay all handling, transportation and storage costs at the prevailing commercial rates promptly following PSI's submission of invoices for such costs.

***Warranty Period***

PSI warrants the products manufactured under the Kelbro register trade name mentioned above to be free from defects in materials and workmanship and to conform to PSI written specifications for a period of 12 months from the date of manufacture.

***Warranty Remedies***

If, prior to expiration of the foregoing applicable warranty period, any of such products shall be proved to PSI's satisfaction to be defective or nonconforming, PSI will repair or replace such defective equipment or components thereof, F.O.B. PSI's plant or other destination designated by PSI, or will refund or provide Buyer with a credit in the amount of the purchase price paid therefore by Buyer, at PSI's sole option. Buyer's exclusive remedy and PSI's sole obligation under this warranty shall be limited to such repair or replacement, F.O.B. PSI's plant or other destination designated by PSI, or refund or credit by PSI, and shall be conditioned upon PSI's receiving written notice of any defect within a reasonable period of time (but in no event more than thirty (30) days) after it was discovered or by reasonable care should have been discovered. In no event shall PSI's liability for such defective or nonconforming products exceed the purchase price paid by Buyer therefore.

***Exclusions***

This warranty does not (i) cover shipping expenses to and from PSI factory or other destination designated by PSI for repair or replacement of defective equipment or any tax, duty, custom, inspection or testing fee, or any other charge of any nature related thereto, nor does it cover the cost of disassembling or removing defective equipment or reassembling, reinstalling, or testing repaired or replaced equipment or finishing the reinstallation thereof, (ii) apply and shall be void with respect to equipment operated in excess of rated capacity or otherwise not in accordance with installation,

maintenance, or operating instructions or requirements, to equipment repaired or altered by others than PSI or PSI's authorized service agencies, or to equipment which was subjected to abuse, negligence, misuse, misapplication accident, damages by circumstances beyond PSI's control, to improper installation (if by others than PSI), operation, maintenance or storage, or to other than normal use or service, and (iii) apply to equipment or components not manufactured by or for PSI. With respect to equipment or components not manufactured by PSI, PSI's warranty obligations shall in all respects conform and be limited to the warranty actually extended to PSI by its suppliers, but in no event shall PSI's obligation be greater than those provided under PSI's warranty set forth in this section.

The fore going warranties are in lieu of all other express and implied warranties (except title0, including, without limitation, the implied warranties of merchantability and fitness for a particular purpose. No employee, representative, or agent of PSI other than an officer of PSI is authorized to alter or modify any provision of this section or to make any guarantee, warranty, or representation, express or implied, orally or in writing, which is contrary to the foregoing.

Any description of the equipment, whether in writing or made orally by PSI or PSI's agents, specifications, samples, models, bulletins, drawings, diagrams, engineering sheets or similar material used in connection with Buyer's order are for the sole purpose of identifying the equipment and shall not be construed as an express warranty. Any suggestions by PSI or PSI's agents regarding use, application or suitability of the equipment shall not be construed as an express warranty unless confirmed to be such in writing by PSI's authorized officer.

#### ***Consequential Damage Disclaimer***

PSI's liability with respect to equipment proved to its satisfaction to be defective within the warranty period shall be limited to repair, replacement or refund as provided hereof, and in no event shall PSI's liability exceed the purchase price of the equipment involved. Kelbro shall not be subject to any other obligations or liabilities, whether arising out of breach of contract, warranty, tort (including negligence) or other theories of law, with respect to equipment sold or services rendered by PSI, or any undertakings, act or omissions relating thereto. Without limiting the generality of the foregoing, PSI specifically disclaims any liability for property or personal injury damages, penalties, special or punitive damages, damages for lost profits or revenues, loss of use of equipment or any associated equipment, cost of capital, cost of substitute products, facilities or services, downtime, shutdown, or slowdown costs, or for any other types of economic loss, and for claims of Buyer's customer for any such damages.

PSI shall not be liable for and disclaims all consequential, incidental and contingent damages whatsoever. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under section 2-719 of the uniform commercial code, PSI shall have no liability to Buyer for consequential damages, such as lost profits, lost revenue, damage to other equipment or liability or injury to a third party.

#### ***Indemnification by Buyer***

Buyer shall indemnify, hold harmless, and defend PSI and PSI's employees and agents from and against any and all damages, liability, claims, losses and expenses (including reasonable attorneys' fees, court costs, and out-of-pocket expenses) arising out of or resulting in any way from claims by customers of Buyer or third parties against PSI alleging a breach of contract or warranty by PSI to the extent that such damages, liability claims, losses and expenses which may be payable by PSI to Buyer pursuant to the and as limited by PSI's warranty and damage obligations as contained hereof so as to effectively limit Kelbro's obligations to customers of Buyer or third parties to those set forth.

#### ***Return of Equipment***

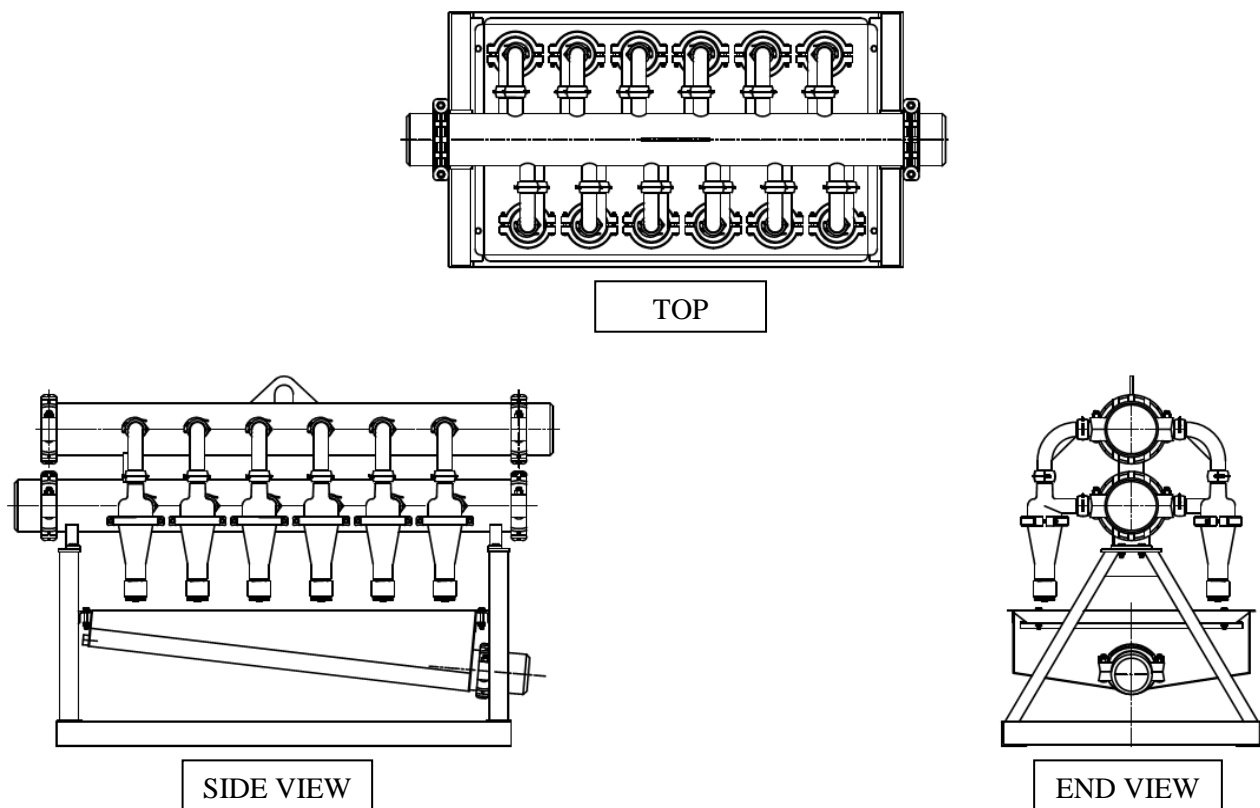
No equipment or part shall be returned to Kelbro without written authorization and shipping instructions first having been obtained from PSI under the company's Return Policy.

**Return Policy:**

- Client/Customer requests an RMA from Sales Department
- Sales shall issue an RMA with an assigned number along with the Product Warranty information and a quote for replacement cost.
- Client/Customer issues a Purchase Order to PSI (pending evaluation), with the RMA properly filled in.
- Product is returned back to PSI at Client/Customer's expense with all RMA documents for reference. If the product is warranted, then the freight cost will be credited back.
- An evaluation will be conducted to determine warranty status.
- If product is not returned within 30 days of issued RMA, then an invoice will be issued regardless of warranty status.
- A copy of the evaluation is available upon request.

**3.0 General Arrangement Drawing**

*(12-4 shown in drawing)*



## 4.0 Technical Manual Contents

### 4.1 General Description

The PROCESS SOLUTIONS INTERNATIONAL Desilter is used to remove "silt" size particles from drilling fluids. "Silt" refers to all particles smaller than sand sizes (74 microns) and larger than colloidal material (about 2 microns). The word "silt" applies here only to size. The "silt" solids may actually be shale, limestone, silica sand, barite or any other material of silt size which may be present.

Normally a Desander first removes the solid particles that are 74 microns or larger "sand". Then the Desilter removes the "silt". If a Desander is not operating ahead of the Desilter, the Desilter will perform first as a Desander until the sand particles are removed first and then it will start to remove the silt.

PROCESS SOLUTIONS INTERNATIONAL Desilters are hydro cyclone solids separators. As their name implies, they remove "silt" size particles from the drilling fluid.

To be effective the Desilter should be sized to process 150% of the circulation rate and the mud to be desilted should be fed from the desander mud compartment.

PROCESS SOLUTIONS INTERNATIONAL Desilters consist of an assembly of hydro cyclone solids separators. The assembly includes mounting of eight to sixteen cones on heavy duty steel supports together with a feed manifold, overflow manifold, and a steel collecting trough.

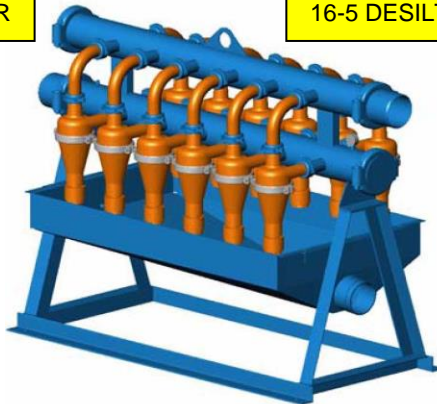
8-4 DESILTER  
8-5 DESILTER



10-4 DESILTER  
10-5 DESIL TFR



12-4 DESILTER  
12-5 DESILTER



16-4 DESILTER  
16-5 DESILTER

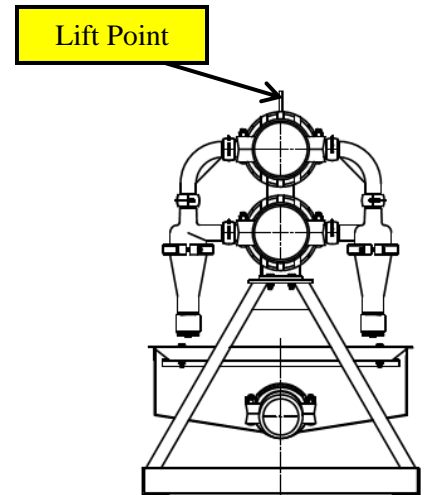
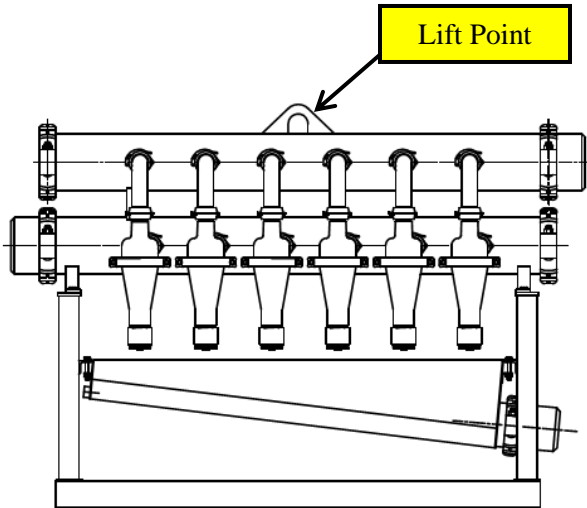


In reading the number-12 is the number of cones and 4 is the size of the cone meaning a 4" cone.

## 5.0 Lifting Procedure

Extreme care must be taken to prevent damage when moving the Desilter. Use properly rated slings that are capable of handling the equipment.

1. When lifting equipment, ensure proper lift points are used.



## 6.0 Installation Procedure

### Suction Piping

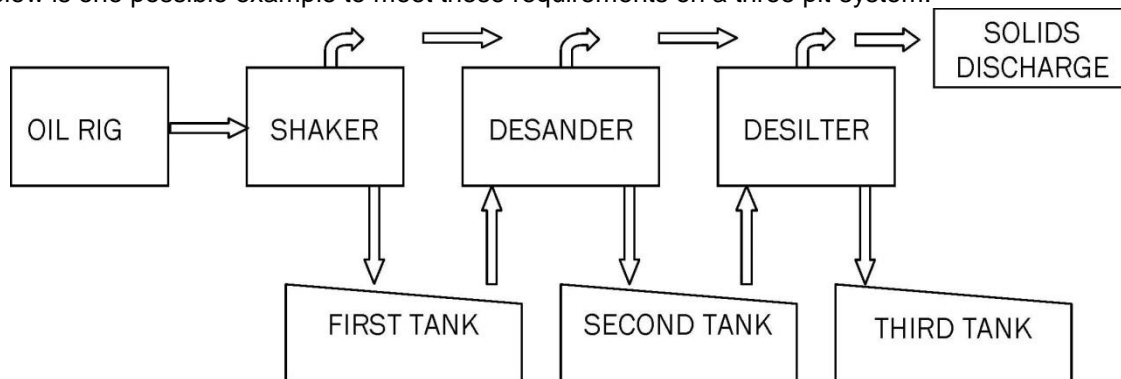
The Desilter should be located to meet the following conditions:

1. The Desilter feed suction should be where it picks up mud that has been through a Degasser and a Desander, if these are present.
2. Since the Desilter should handle more mud than is being circulated through the hole, an equalizer line or over flow zone must be provided to return the extra mud to the Desilters feed (suction) point.
3. An equalizer near the bottom of the pit is preferable to a top equalizer for returning the back flow.
4. The flow between tanks should be controlled so that the mud cannot reach the next tank except through the Desilter. A bypass such as an equalizer line should be provided for those times when the Desilter is not being operated.
5. The overflow desilted mud should enter the next tank section after the Desilter feed suction point.



The underflow discharge should be located so that a gravity flow can carry the separated solids to some collection point such as a waste pit. A small stream of water can be used to help the flow of the solids.

Below is one possible example to meet these requirements on a three pit system.



The suction piping to the pump should be at least as large as the inlet of the pump. If the suction line is longer than about 10 feet it should be about two inches larger than the pump inlet to prevent loss of pressure head. The piping should attach to the tank at a tank flange. A full opening valve which provides a full shut-off should be used in the line so the pump can be serviced without having to empty the tank.

The intake of the suction lines, inside the tank, should have an elbow facing down about 12 to 18 inches above the bottom of the tank to reduce the chance of picking up large rocks and trash which could tend to plug the suction line or damage the pump. If the suction line is higher than 18 inches it will cause a vortex and will take air into it even when the tank is reasonably full.

If a suction hose is used and is dropped into the tank it must have a heavy duty screen with 5/8 inch or 3/4 inch openings to screen out large particles that could plug the cone or damage the pump. The screen should be easily removable for inspection and cleaning.

If possible the pump should be below the operating mud level to provide self-priming and to reduce pressure loss. If the pump is higher than the mud level it is most important to use a foot valve in the suction line.

Use as few elbows as possible. The elbows should be large radius elbows to reduce the friction loss and to help maintain the effective pump pressure at the feed manifold.

### Feed Piping

The feed piping from the pump to the feed manifold must be at least 6 inches in diameter and must have as few elbows as possible. For the 16-4 Desilter the feed line should be at least 8 inches in diameter. The elbows should be large radius elbows to minimize losses.

### Overflow Piping

The overflow piping from the overflow manifold carries the desilted mud back to the pits. This line must discharge above the mud level to prevent a siphon effect. It should be horizontal or sloping slightly downward toward the discharge end. The elbows should be large radius elbows.

If it is necessary for the mud to drop a long distance to the mud level the discharge line must empty into a separate container which is open to the air and which has its own piping down to the mud level. This avoids a siphon effect on the cones. The siphon effect will stop the discharge of the silt at the apex.

An alternate method is to weld a 1 inch vacuum breaking line equipped with a valve into the overflow manifold. This lets air into it when needed instead of pulling air through the apex valve.

The discharge line should not slope upward from the overflow manifold. Raise the Desilter so that no lift is required in the discharge piping. The back-pressure from a rising discharge line forces additional mud out the apex valve and increases the loss of whole mud to the underflow.

### Solids Discharge Line

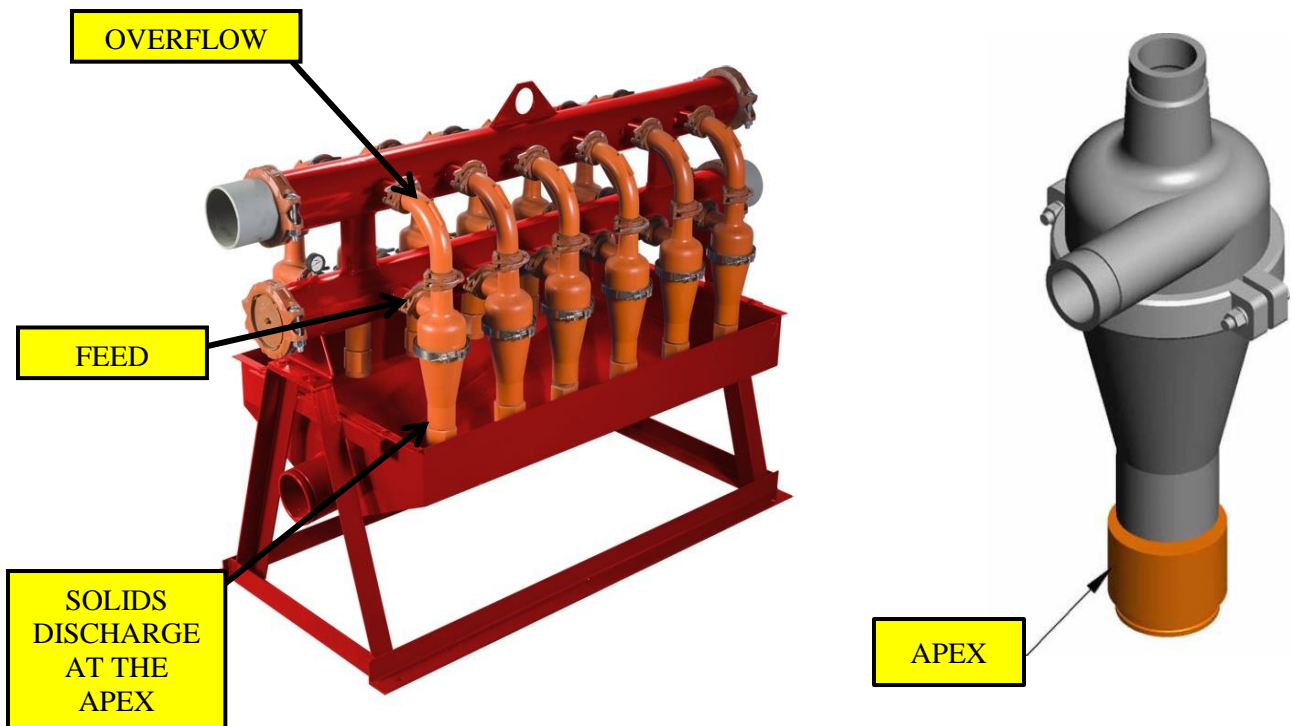
The two main factors in moving the separated solids to a waste area are:

1. Sufficient slope in the solids discharge piping or through.
2. A water flush to help the solids flow when there is a large amount of solids large enough to settle out of the underflow mud.

A minimum slope of about one foot for every three feet of discharge trough is recommended when a water flush is being used. If the recommended slope cannot be provided a water jet line into the sand discharge pipe will help carry the solids down it.

The discharged solids must not be allowed to back up and cover the apex of the cones.

If it should cover the apex it would force more silt to be carried back to the mud system in the overflow



## 7.0 Startup Procedure

### Starting and Stopping Procedures

- Open the suction valve if there is one.
- Start the pump and bring it up to full normal speed or until the feed pressure is enough to give about 90 feet of head at the existing mud weight. If the pressure cannot be brought within 10% of the required pressure, the performance of the Desilter will be poor and the underflow loss may be excessive. See below.
- When the Desilter is stopped close the suction line valve if the pump is below the mud level.

HEAD REQUIRED (FEET) AT THE FEED MANIFOLD  
FOR VARIOUS PRESSURES AND MUD WEIGHTS

	8.5 LB/GAL	9.0 LB/GAL	9.5 LB/GAL	10.0 LB/GAL	10.5 LB/GAL
30 PSI	68	64	61	58	55
35 PSI	79	75	71	67	64
40 PSI	91	86	81	77	73
45 PSI	102	96	91	86	82
50 PSI	113	107	101	96	92

### Flow from Cone

Spray discharge indicates that there is a small amount of solids in the feed stream. There should be suction in the center of the apex where air is being sucked up into the cone.

Rope discharge is a spiraling solid stream of mud and sand, which is discharged from the apex of the cone. When the feed stream is very high in solids this is the appearance of the underflow and is considered normal. If the underflow is a rope discharge but is not high in solids then this indicates a problem inside the cone. Partial plugging of the vortex finder, low feed rate/pressure or excessive wear to the inside of the cone may cause this effect.

Excessive, straight discharge will result when the vortex finder is plugged. Cleaning will be required.

No Discharge indicates that the apex is plugged with rocks or trash. A stiff wire or screwdriver may be used to dislodge objects stuck in the apex.

**Cleaning Cones:** may be required to repair the problems of incorrect discharge.

Shut off feed pump and allow mud to drain from the cone.

Remove groove lock clamp from inlet pipe on individual cone.

Remove groove lock clamp from outlet pipe, holding cone to prevent dropping.

Loosen Stainless Steel clamp from center of cone, separating cone into two pieces. Wash thoroughly with water, making sure that the mating surfaces are clean.

Reassemble and tighten stainless steel clamp with appropriate wrench.

Loosen and remove apex nut. Remove Apex Bushing.

**WARNING!!**

Repairs to the manifold which involve welding should only be done after the cones have been removed. Excessive heat will damage the Polyurethane inlet and outlet.

## 8.0 Routine Maintenance

**Use proper lock-out/tag-out precautions when performing maintenance.**

Once the unit is placed into full operation, a Preventative Maintenance Program should begin. This program should include regular inspection set up on a periodic basis.

The Preventive Maintenance Program should include a general inspection of:

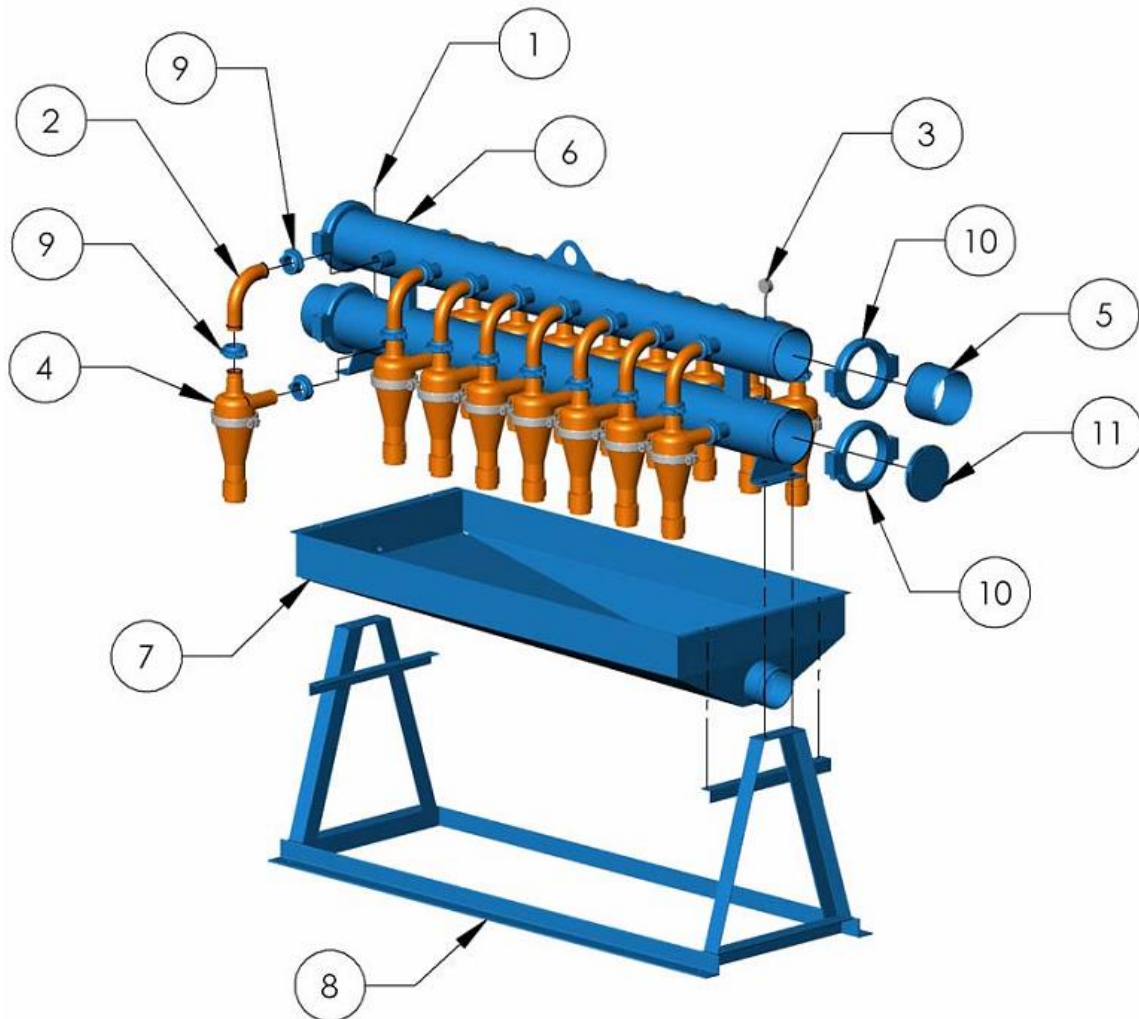
- Check for leaks.
- Check pressure gauge.

## 9.0 Shut down and Storage

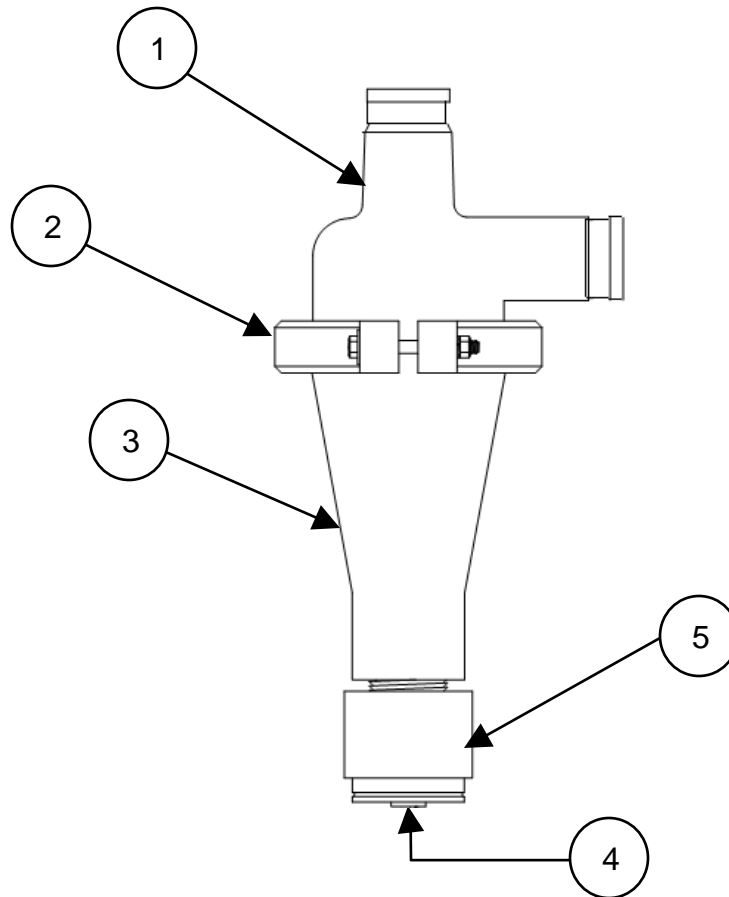
**On shut down, make sure that you are following proper lock-out/tag out procedures before taking off any feeds or discharges.**

- Apply a rust inhibitor to any exposed metal areas.
- Clean out as much debris as possible in the cones and APEX before storage.

## 10.0 Parts List



DWG. #	Description	Quantity				
		8-4	10-4	12-4	16-4	20-4
0001	Plug Pipe	1	1	1	1	1
0002	Polyurethane Elbow	8	10	12	16	20
0003	0-100 PSI Gauge	1	1	1	1	1
0004	Cone Assembly	8	10	12	16	20
0005	Schedule 40 Nipple	2	2	2	2	2
0006	Header	1	1	1	1	1
0007	Trough	1	1	1	1	1
0008	Frame	1	1	1	1	1
0009	Victaulic Clamp	24	30	36	48	60
0010	Victaulic Clamp	4	4	4	4	4
0011	Blind Flange	2	2	2	2	2



DWG. #	Description	Quantity				
		8-4	10-4	12-4	16-4	20-4
0001	Inlet	1	1	1	1	1
0002	Stainless Steel Clamp	8	10	12	16	20
0003	Cone	1	1	1	1	1
0004	APEX	8	10	12	16	20
0005	APEX Nut	1	1	1	1	1

## 11.0 Trouble Shooting

### Pressure at the feed manifold is too low

1. New Installation:
  - a. Check whether the pump has an impeller of the size to deliver 90 feet of head with the weight of the mud in use.
  - b. Check whether the pump has an impeller of the size to deliver 90 feet of head with the height of the feed manifold above the mud level.
  - c. Check whether the pump has an impeller of the size to deliver 90 feet of head with the speed being provided for the pump.
  - d. Check whether the pump has an impeller of the size to deliver 90 feet of head with the size and number of cones being supplied.
2. Check the speed of the pump:
  - a. This should be 1750 rpm if an 1800 rpm electric motor.
  - b. This should be 1600 rpm if a diesel engine.
3. Check the length and size of the delivery line from the pump to the manifold.
4. Check the length and size of the pump suction line.
5. If the pump is piped to supply anything besides the Desilter, see that the other things are not taking part of the mud from the pump. Above 500 gpm the pump pressure decreases noticeably with increased volume. The pump impeller should have been chosen for the desired pressure at the expected volume throughput and any extra volume requirement will lower the pressure.
6. See that the screen, if any, on the suction line is clean.
7. See that the suction line intake area is not sanded up and that the suction line is clean.
8. If the pump is belt driven check the belt tension.
9. See that the shaft packing gland is tight enough that air is not being pulled into the pump through it.
10. Check for possible air leaks in the suction hose.
11. Check the amount of lift required:
  - a. For a new installation choose the right impeller for the height from the mud-level to the feed manifold.
  - b. In an installation where normal pressure has been obtained see if the mud level is low. A five foot drop in mud level will cause a loss of feed manifold pressure of about 2-1/2 psi with a 10 lb/gal mud.
  - c. Check the diameter of the impeller. An old impeller may be badly worn and be smaller than its original size.

### No underflow or too little underflow

1. Check the feed pressure. It should be at least 4.2 x Mud Weight in ppg and preferably 4.7 x Mud Weight. This is 45 psi for 9.6 ppg mud.
2. Check the apex for size and see if it has been plugged or partially plugged by trash. If poking a wire up the apex briefly increases the underflow, the problem probably is trash too large to get out – remove the apex and clean it.
3. There may be very little silt in the feed mud.

4. The overflow piping may have enough drop in it to siphon mud from the cone at the expense of the underflow. Install a vacuum breaker in the overflow line or remove the drop in the line.

#### **Underflow discharges as a rope**

1. The apex is too small.
2. The mud viscosity or gel is too high.
3. The feed pressure is too low.

#### **Underflow is too light – less than 2.5 lb/gal (0.29 kg/liter) heavier than the feed mud**

1. See if there is enough silt in the mud to justify running the Desilter.
2. Apex may be several sizes too large. Change to the smallest apex that will allow a spray discharge.

#### **Underflow is heavy – more than 4 lb/gal (0.48 kg/liter) heavier than the feed mud**

1. The mud may have an appreciable sand content. If a Desander is being used ahead of the Desilter check to see that it is installed correctly and is operated correctly. If a Desander is not being used consider getting one.
2. If the mud is a saturated salt mud the difference between underflow weight and the feed weight should be slightly less than for fresh water mud or between 2.1 lb/gal (0.25 kg/liter) and 3.0 lb/gal (0.36 kg/liter).
3. If the discharge is roping change to a larger apex valve that will let it spray.

#### **Too large a volume is lost through the underflow**

1. See that the underflow has a spray pattern. A rope underflow does a poor job of desilting and may waste mud unnecessarily.
2. If the underflow weight is at least 2.5 lb/gal (0.29 kg/liter) heavier than the feed mud the underflow is not really excessive if reducing solids content is important. At this underflow weight each gallon of underflow is eliminating about 6 lbs of silt or about 4 times as much silts as a gallon of the feed mud carries.
3. If the underflow weight is less than 2.5 lb/gal (0.29 kg/liter) heavier than the feed the apex valve may be too large for the current silt content.
4. There may be too little silt in the mud to justify desilting.
5. The feed pressure may be too low. Bringing the pressure back to 4.7 x mud weight in ppg should increase the weight of the underflow and reduce the amount of liquid mud in it.



## **12.0 Inspection and Tests**

SEE ATTACHED (if applicable)

## **13.0 Certification(s)**

SEE ATTACHED (if applicable)

## **14.0 Additional drawings, diagrams, etc.**

SEE ATTACHED (if applicable)

## **15.0 Contact Information**

Replacement parts for PSI SUPPLIED equipment can be ordered from Process Solutions International or any of their agents, worldwide. Please include the model number if possible.

To order parts or to receive technical support via telephone, contact Process Solutions International using the information listed below.

**Process Solutions International  
A Division of Kelbro, Inc.  
7519 Prairie Oak Drive  
Houston, TX 77086  
(281) 893-4774; FAX (281) 893-1027**