KROFTA SUPRACELL DAF

OPERATION & MAINTENANCE MANUAL

11/28/2016

Krofta Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

1.1. **SUPRACELL** GENERAL DESCRIPTION

THE SUPRACELL PROCESS

The **KROFTA** SUPRACELL is a state of the art water clarifier used in thousands of applications worldwide. Through extensive research and development, the SUPRACELL has been proven to provide optimum water clarification in the least amount of space, maximizing the efficiency of its unique design.

A mix of influent and aerated water flows into the clarifier through the inlet pipes located on the rotating carriage. Microscopic air bubbles in the aerated water attach to the suspended solids in the influent in order to float the solids to the surface. The carriage rotation is based upon the zero velocity principle; any velocity that the influent flow has upon entering the flotation zone is negated by rotation of the carriage in the opposite direction, allowing flotation to occur immediately with a minimal horizontal velocity. Zero velocity allows for more effective flotation in a shallower tank through the use of the rotating inlet.

The floating solids accumulated on the water surface are scooped off by the sludge scoop located on the rotating carriage and discharged into the center sludge outlet pipe. Clarified effluent flows through extraction pipes located on the moving clarified tank wall and into the clearwell. The clarified effluent flows up the clearwell, into the effluent collection tank and out of the clarifier. The water depth and scoop speed can be varied by the operator to obtain the thickest possible float.

A portion of the clarified effluent is continuously recycled through the air dissolving system. The air dissolving system consists of the air dissolving tube, the recycle pump, and various gauges and valves. Clarified effluent is pumped into the air dissolving tube under pressure. Air is dissolved into the clarified effluent through air dissolving panels located in the air dissolving tube. The aerated recycle water flows out of the air dissolving tube and through a pressure release valve, causing the formation of microscopic air bubbles. The aerated recycle is mixed with the influent prior to the inlet pipes. The microscopic air bubbles attach to the suspended solids in the influent and float to the surface, removing the solids and leaving clarified water below.

Chemical addition is often necessary to floc (or draw together) particles prior to flotation. Chemical addition usually takes place in the raw water holding tank or in the influent piping.

SUPRACELL UNIT DESCRIPTION

STATIONARY TANK COMPONENTS

SUPRACELL wetted tank parts are standard in stainless steel. Non-wetted parts are standard in epoxy coated mild steel. Customer pipe connections are at flanges located under the unit. A sump well in the tank floor is provided to collect sediment pushed in by a rotating bottom scraper. Sediment is released through a purge valve located at the bottom of the sump well. A window located on the tank wall is provided for visual verification of floated sludge thickness and proper carriage speed. The outer tank rim supports the rotating carriage support wheels. An inner tank receives the floated sludge drained from the Spiral Scoop. Optional configurations include concrete floor and outer tank wall, or all mild steel units, epoxy painted.

ROTARY JOINT AND INLET DISTRIBUTION TUBE

IInfluent flows through the Rotary Joint and into the Inlet Distribution Tube. The Inlet Distribution Tube serves as a header box for a number of smaller outlet tubes which feed into the channels formed by the flocculation baffle walls. The outlet tubes and the baffle walls are spaced to provide the proper distribution of water into the tank. Handwheels on top of the Inlet Distribution Tube vary the distance of valve disc plates from the end of the outlet tubes, balancing the flow from the outlet tube. Balancing the flow rate across the Inlet Distribution Tube is important to minimize turbulence at the flocculator outlet.

SUPRACELL CARRIAGE

The SUPRACELL Carriage rotates the Inlet Distribution Tube, the Spiral Scoop, and other parts around the tank. The Carriage is supported by the Drive Wheel and the Support Wheels. The carriage is driven by a variable speed drive through a speed reducer.

Clarified water is drawn off above the floor of the main tank into the Clarified Water Extraction Tubes and the clearwell area within the Clarified Tank Wall. The rotating Clarified Tank Wall is provided with a rubber bottom seal to separate the clarified water from the flotation area.

Other components of the Carriage include the Flocculator Channels, the back-splash for the Spiral Scoop, and the structure supporting the Inlet Distribution Tube. A bottom wiper under the carriage moves sediment into the sediment sump. A side scraper adjacent to the scoop removes sludge from the tank wall.

SPIRAL SCOOP

The **KROFTA** Spiral Scoop removes floated material from the top surface of the water for discharge into the Fixed Central Part Tank and removal from the unit. It is supported on the outer end by a bearing that is mounted to the Carriage Frame. The inner end of the Scoop outlet pipe is supported by a saddle type support. The scoop is driven by a variable speed drive through a speed reducer.

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AIR DISSOLVING SYSTEM

The **KROFTA** Air Dissolving System aerates and pressurizes the flow required to provide flotation. The Air Dissolving System consists of the Air Dissolving Tube (ADT), an air meter, pressure gauges, a sample valve, a pressure release valve, and an ADT flow pump.

The ADT is standard in stainless steel and is designed to dissolve air into a pressurized water flow. The ADT requires minimum flows and pressures in order to function properly. Excess air and water is removed through the bleed off located at the center line of the tube. A pressure gauge is provided with connections to the inlet piping of the ADT and to the ADT itself. Isolation valves allow for a pressure differential between the inlet and the tube to be determined. The pressure gauge at the outlet monitors the system pressure when the pressure release valve is adjusted.

LEVEL CONTROL

SUPRACELL units have a height adjustable circular overflow weir internal to the clarifier in order to control water level. A constant water level in the unit is necessary in determining the scooping depth and therefore the sludge removal rate of the Spiral Scoop.

AUTOMATIC LEVEL CONTROL (optional)

The water level in the SUPRACELL unit is kept constant through the use of the automatic level control system. The automatic level control system consists of a flange mounted transmitter located on the outer tank wall, a control unit to process the transmitter signal, and an actuated butterfly valve located on the effluent line. The actuated butterfly valve opens or closes in order to maintain a constant water level, required to optimize operation of the clarifier.

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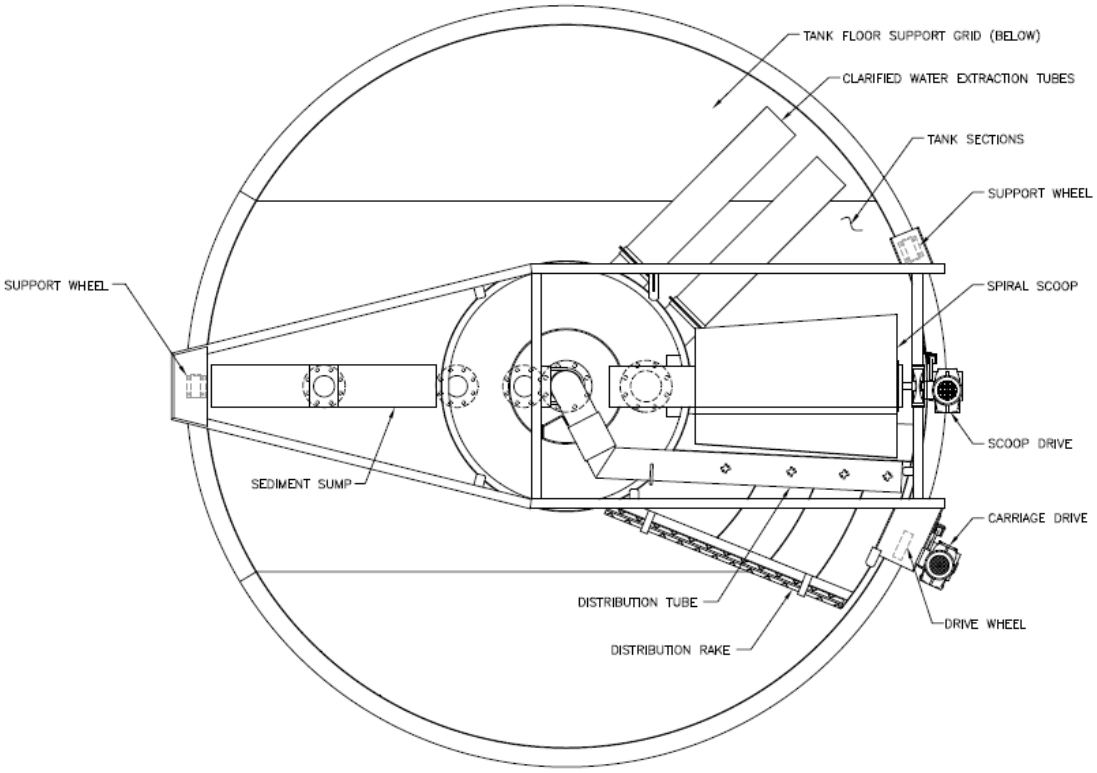
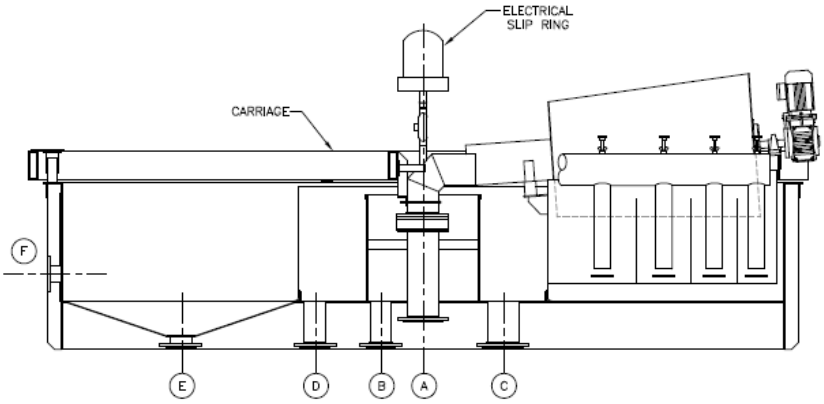
1.2. KROFTA SUPRACELL (SPC) ASSEMBLY*:*

KROFTA SUPRACELL (SPC) ASSEMBLY - CONFIGURATION OF SPC SIZES 6 TO 15:





ITEM	DESCRIPTION
A	UNCLARIFIED WATER INLET
B	FLOATED SLUDGE OUTLET
C	CLARIFIED WATER OUTLET
D	CLARIFIED RECYCLE OUTLET
E	SEDIMENT PURGE OUTLET
F	LEVEL SENSOR CONNECTION

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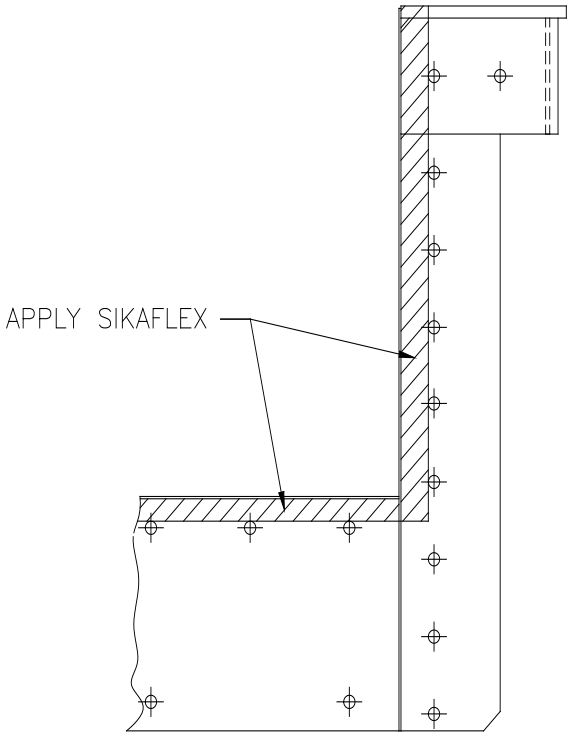
Tank Assembly

Before starting, make sure that the surface on which the unit will be placed is level and free of debris.

See tank assembly drawing for orientation and assembly order of tank sections. Check for and confirm match-markings on tank sections before beginning. Place the center section of the tank with piping connection oriented as shown on the Outline & Pipe Location drawings which are located in the Certified for Construction section of this manual.

Working on one tank section at a time, loosely install all bolts, washers and nuts. Place temporary spacers to hold open a gap of 1/4" wide between the tank sections. Caulk the joint gap thoroughly with silicone from the inside of the tank floor and wall to at least one inch deep from the inside tank surface. Apply a heavier bead in the corner areas where the vertical tank wall seam meets the floor seam since the corner areas may not fit together as tightly due to variance in alignment during assembly of the tank. Remove spacers and tighten all bolts before the silicone has cured. Smooth any excess silicone that comes out of the joint flush to the tank surface.

After assembly of the tank and connection to external piping, it is recommended that attachment angles be bolted or welded between the tank and the support structure to prevent movement of the clarifier.



Level Control Weir Assembly Instructions (Not Applicable with Units Set-up for Auto Level Control):

Note: Some of the following components may already be assembled on the tank. See the drawing that follows for item locations.

Position the Weir inner ring with its attachment brackets aligned with the three openings in the tank floor.

Assemble and clamp the three rubber bellows to the short pipes projecting from the tank floor and to the pipe sections on the weir attachment brackets. From under the unit, insert the three rods through the tank floor openings and bolt to the weir brackets.

Assemble the threaded brass rod with key to the right angle reducer and attach to the bracket in the bottom center of the Supracell. Connect the shaft from the handwheel to the reducer.

Attach the weir tripod bracket to the three rods, while an assistant turns the handwheel to thread the brass rod into the tripod.

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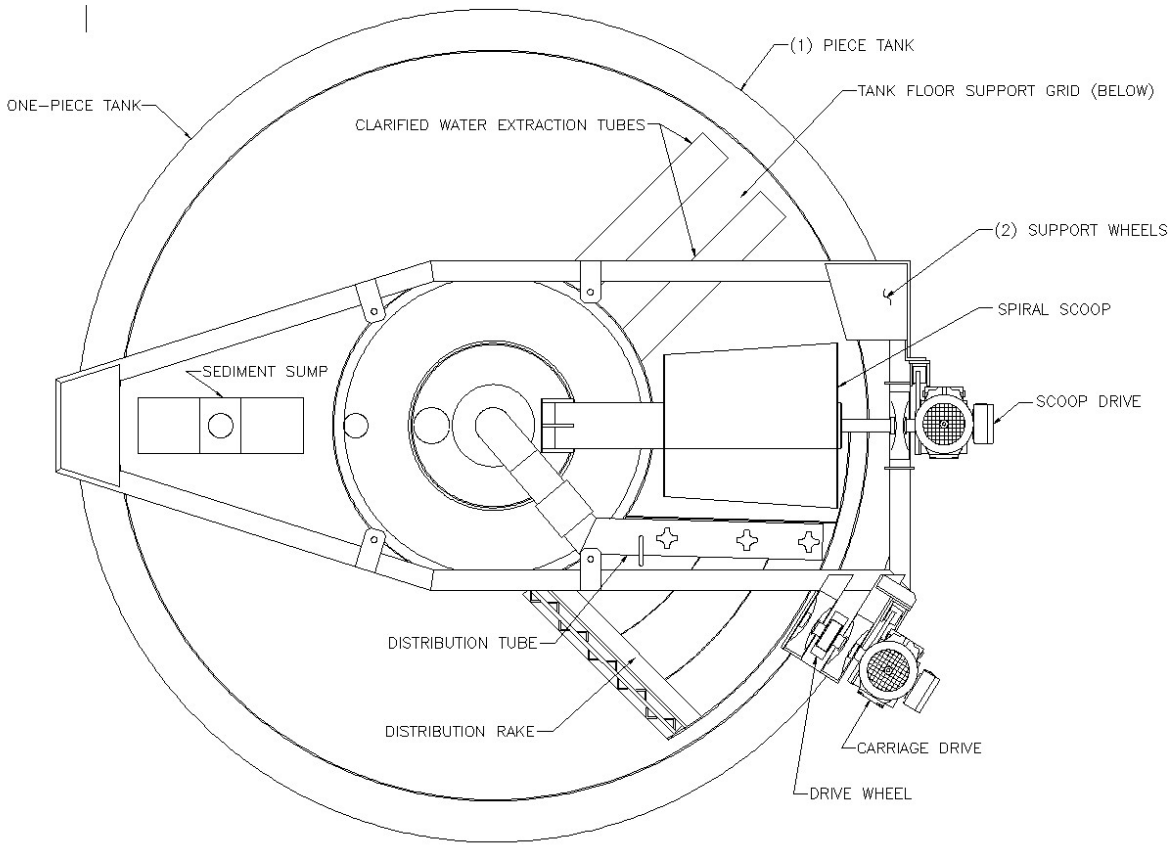
Movable Central Part Assembly Instructions

Movable Central Part Components



Note: Above tri-angular carriage design is for SPC models 6-15.

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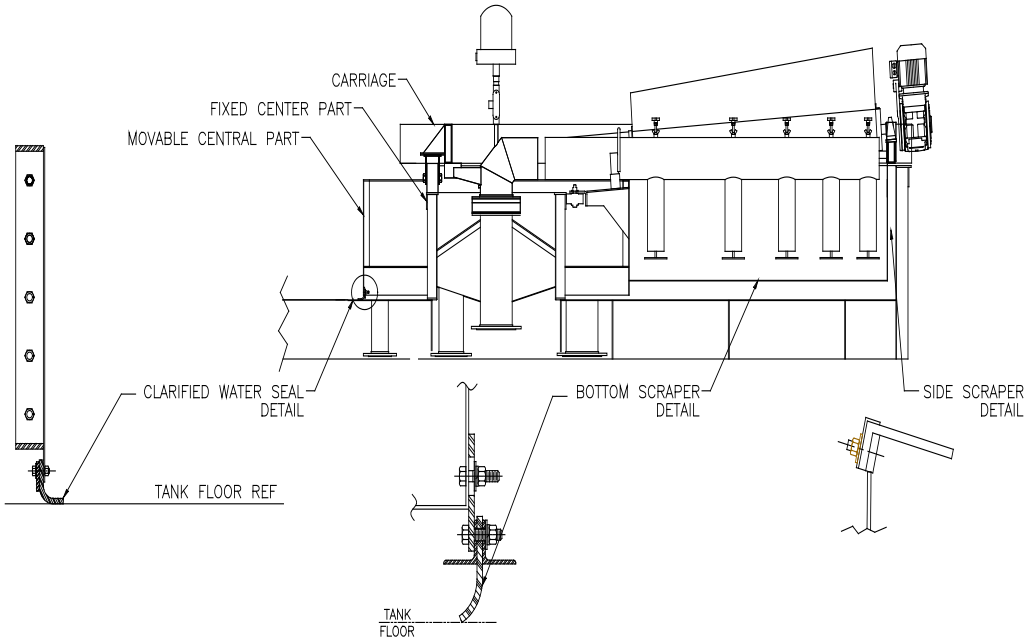

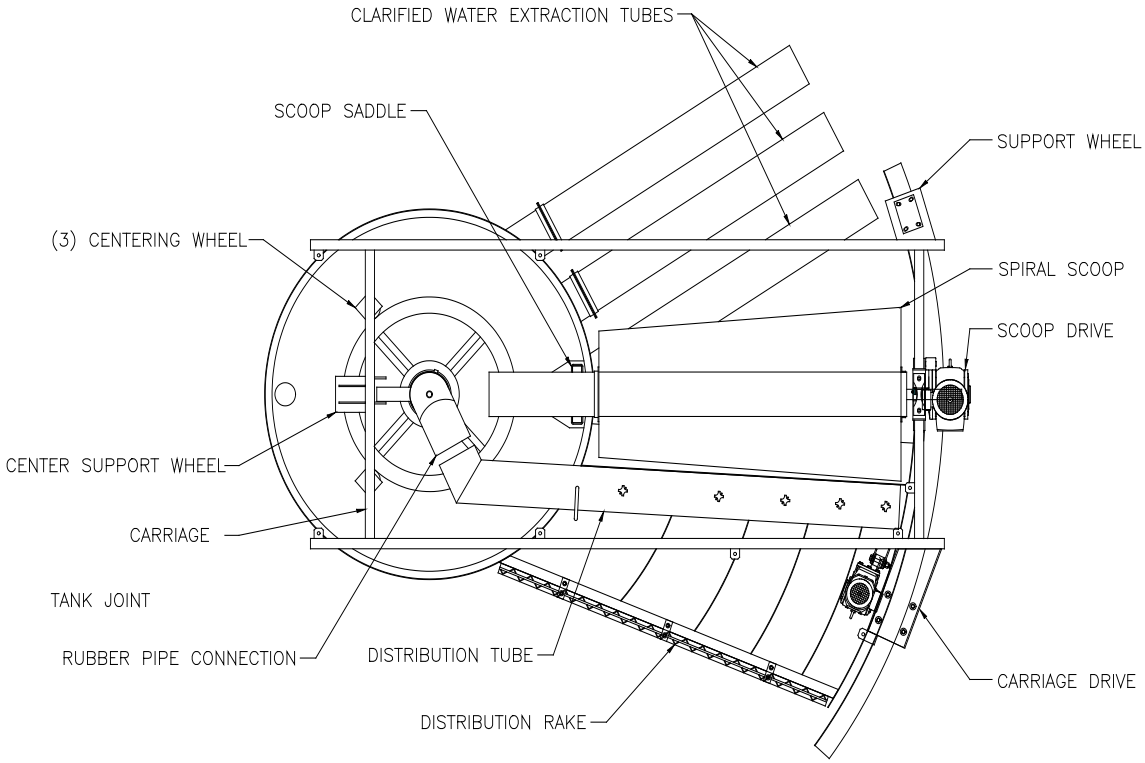

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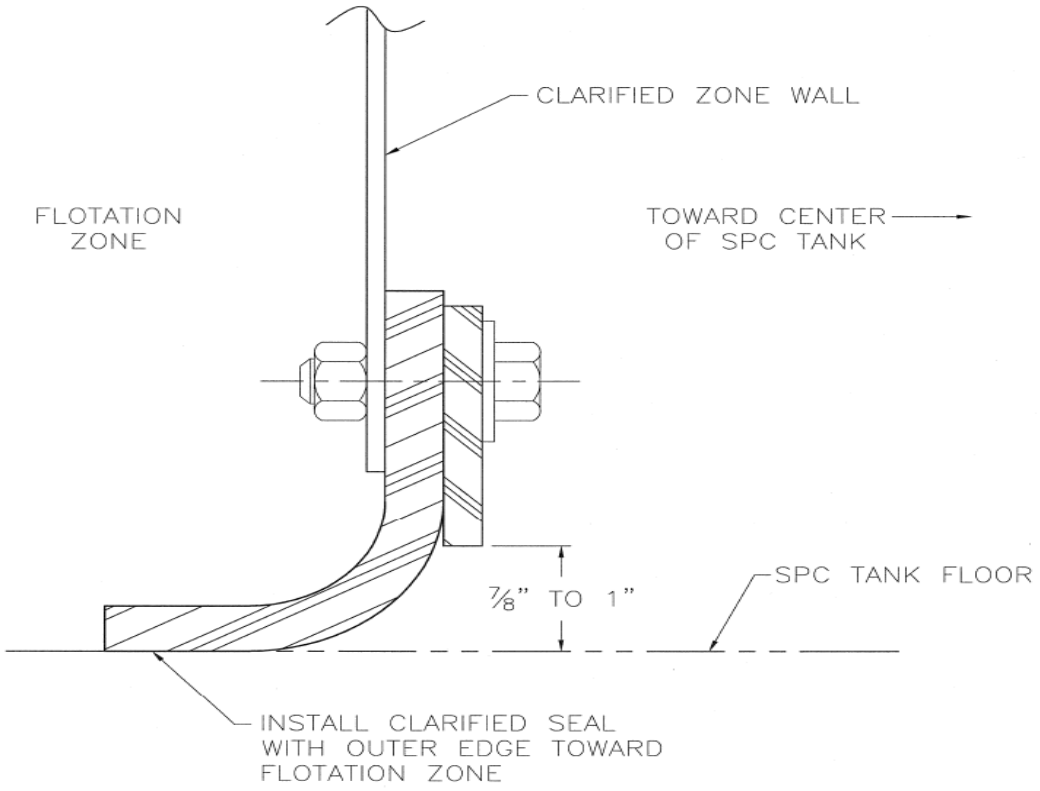
The Movable Central Part Wall and the Movable Central Part Bottom may be supplied in sections requiring pre-assembly. Set the parts in place on the Supracell floor, blocking them up

to the heights indicated. Only the Movable Central Part Wall sections require sealant. For these connections, loosely install the supplied connection bolts using temporary 1/4" thick spacers

between joints on both sides of the bolts, removing the spacers and tightening the bolts before the sealant cures.

The Distribution Tube is welded in place on the Movable Part Bottom. Handwheels adjust the water flow through each of the small outlet pipes. Make sure that they are in an open position of one to two inches for initial operation. See the Operation / Troubleshooting section for further adjustment instructions.

Install the Clarified Water Seal Wiper and backing strip to the dimensions shown, taking care to leave enough of the seal in contact with the floor to ensure that the water pressure will not push it inward during operation. Match any seal joints carefully to minimize leakage. Check that the minimum clearance in at least 1 inch from the rotating steel wall to the tank floor.



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The Bottom Sediment Wiper attaches to the leading edge of the Movable Part Bottom. Check that enough clearance is provided to avoid contact of the metal wiper support with the tank floor. The rubber wiper should be adjusted for minimal contact with the floor.

The Clarified Water Extraction Tubes can now be attached to the Movable Part Bottom.

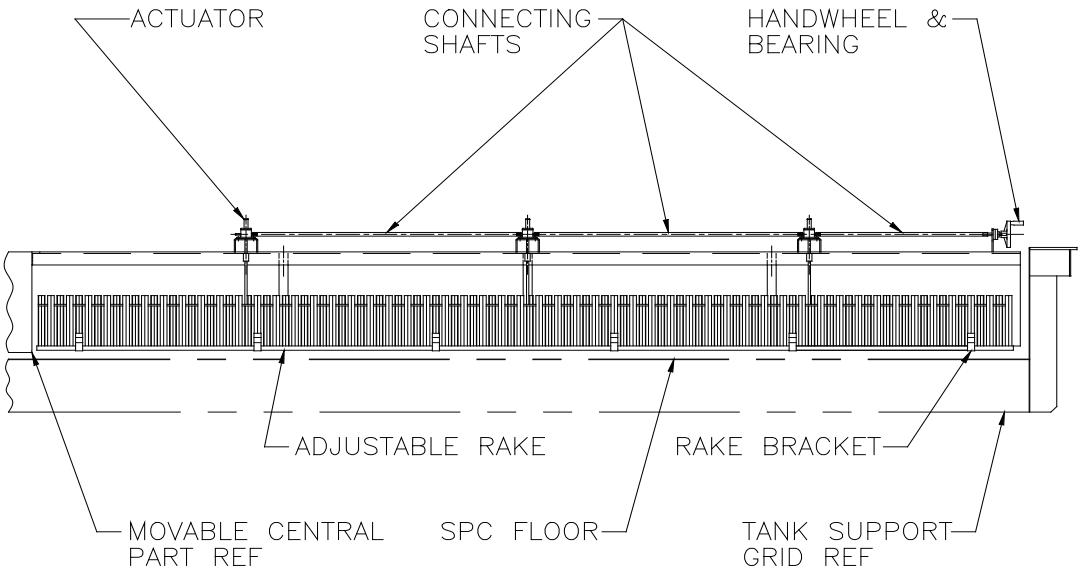
The Clarified Water Extraction Tubes are to be connected with bolts provided to their proper flange positions on the Movable Part Ring.

Note: The slots in the tubes must be turned towards the bottom of the tank.

Distribution Rake Assembly Instructions;

Install the Distribution Rake and support components into position as shown.

The Distribution Rake height is controlled by a screw clamp adjustment system. Check and adjust the assembly if required to make it level. For initial operation set at lowest height.



TYPICAL RAKE ASSEMBLY SHOWN. ACTUAL ASSEMBLY MAY VARY.
ALL UNITS DO NOT REQUIRE ADJUSTABLE ACTUATORS / HANDWHEELS.

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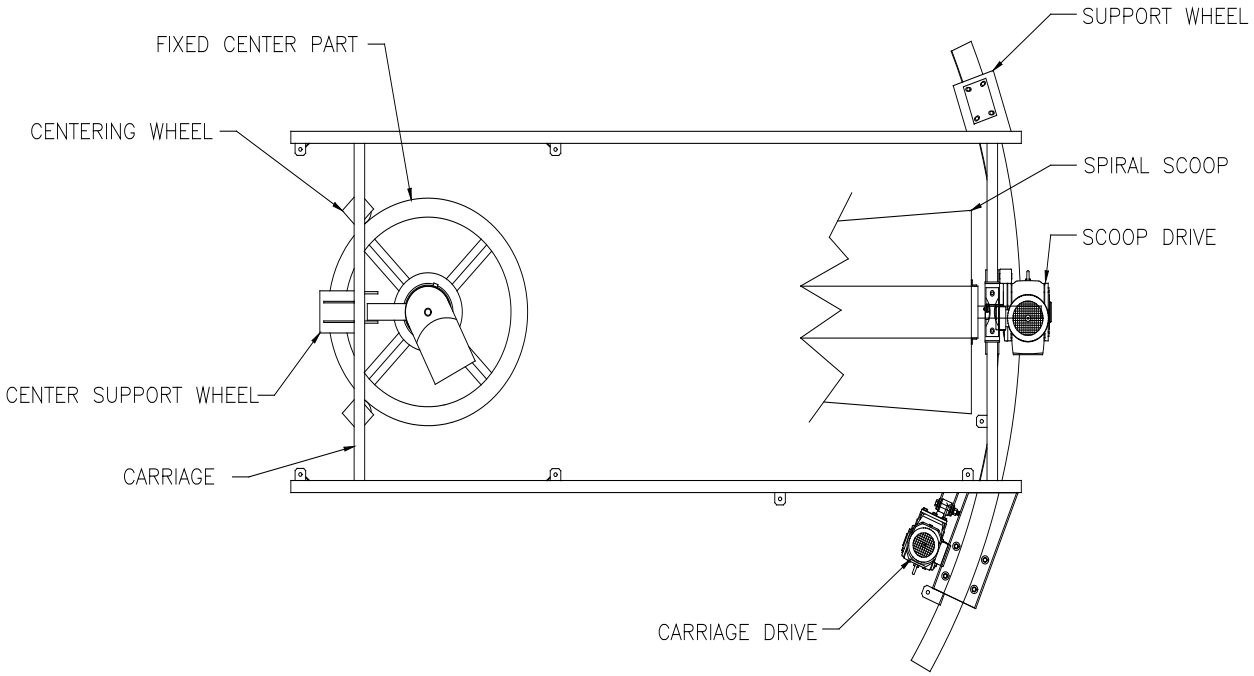
Carriage Frame Assembly Instructions



Note: Above rectangular carriage design is for SPC models 18 and greater. A tri-angular design is supplied for the SPC-6 thru 15.

The Carriage Frame supports the rotating components of the SUPRACELL. It may be in one piece for the smaller Supracells or in sections for larger ones. The sections attach with bolted connections.

Place the Carriage Frame above the already installed Carriage Components, lining up with the connection brackets. Block up so that the top of the main frame is level and as high as or higher than the design height off the SUPRACELL interior floor surface. When assembled, the wheels can be attached and the blocking removed. Check that the main frame is level and that any wheel shims provided are in place. Attach the Carriage Components with threaded rods and related hardware at this time, readjusting all Carriage Component elevations off the floor.

The wheel shimming and alignment details for this unit are shown at the end of this section.

The Carriage Frame assembly must be complete, with all wheels leveled, centered, and lubricated as necessary, prior to rotation.

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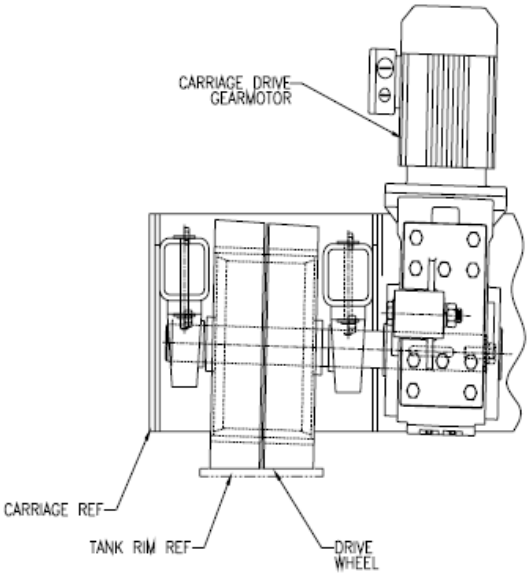
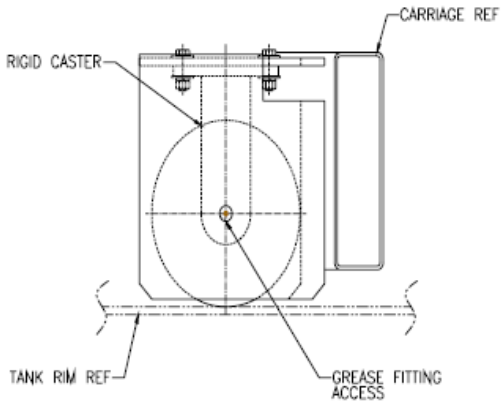
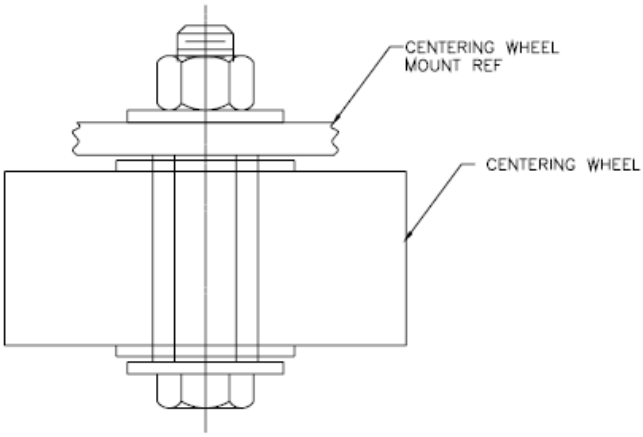


CARRIAGE DRIVE ASSEMBLY



OUTER / INNER SUPPORT WHEEL ASSEMBLY

(INNER SUPPORT WHEEL FOUND ONLY ON SPC MODELS ABOVE SPC 15)



CENTERING WHEEL ASSEMBLY

(FOUND ONLY ON SPC MODELS ABOVE SPC 15)

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Spiral Scoop Assembly Instructions

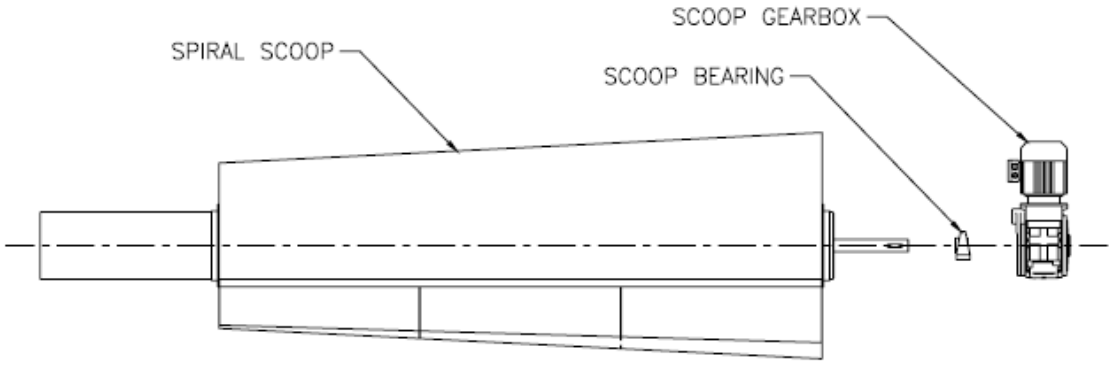
Assemble the Scoop Support Saddle on the bracket provided on the Movable Part. Assemble the Scoop Outer Support Bearing to the Spiral Scoop.

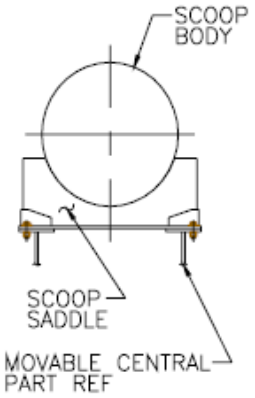
Place the scoop in the proper position with the Pillow Block Bearing on its attachment bracket on the Carriage Frame and the scoop outlet tube on the Scoop Support Saddle.

Mount the Pillow Block Bearing to the outside frame with hardware provided, but do not tighten.

When the lower edge of the Spiral Scoop is placed in the perpendicular position the edge should be level and parallel to the tank bottom. If not, shims can be placed (or removed from) under the support bearing or wheels. The wheels can also be adjusted toward or away from each other to raise or lower the scoop. The outer bearing can also be moved from side to side if necessary to align the spiral scoop on the correct axis.

When in place, tighten all bolts. Check for free rotation of the scoop.
Install the Gear reducer to the Scoop shaft end.





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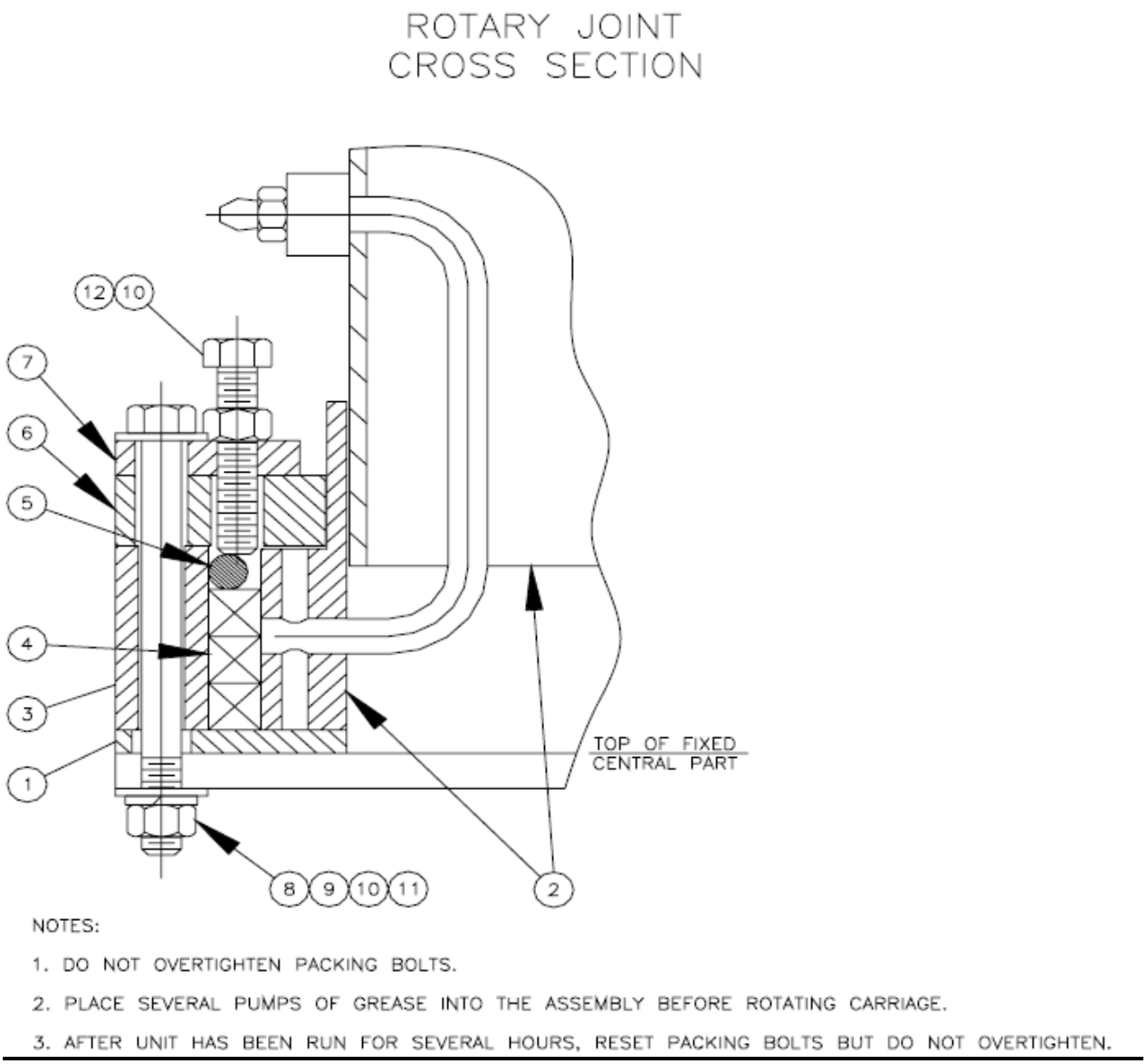
Single Rotary Joint Assembly



The Rotary Joint (Item 1) must be assembled on the Central Inlet Pipe as follows:

Lay the Plastic Bearing Ring (Item 2) on the flange of the Main Inlet Pipe, applying grease to the top surface of the gasket. Place the Outer Ring (Item 3) on top, making sure all the drill holes line up. Drop in several Bolts (Item 7) through the bolt holes to temporarily hold the parts in place.

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Pre-install the Packing Compression Ring (Item 5) over the bottom end of the Rotary Joint (Item 1), holding it up out of the way with wire or tape. Then lower the Rotary Joint onto the Plastic

Bearing Gasket (Item 2), centering it so that there is a 1/2" channel formed inside of Outer Ring (Item 3).

Install three to four layers of packing (Item 4) in the channel, carefully cutting each layer so that the ends meet together without a gap. Apply grease to all surfaces as packing is installed. Position each of the layers so that the cut joints are at least 90 degrees apart. The top packing layer should nearly fill but not project above the packing channel.

Lower the Packing Compression Ring (Item 5) over the Packing layers (Item 4). Remove Bolts (Item 7) used for temporary alignment, then position the Bearing Ring (Item 6, in two pieces) over the packing assembly, after greasing the bottom surface and making sure that the packing compression bolts (Item 8) do not project from the lower face of the bearing ring. Loosely attach the Bearing Ring with bolts (Item 7) installed with nuts on bottom. Tighten the bolts gradually, frequently checking for rotary movement of the unit using a pry bar against the Rotary Joint rotation arm and the carriage bracket. Do not over tighten bolts.

Fill the lubrication connections with grease at this time. Adjust the packing compression bolts in three or four stages using only gentle hand pressure on a short wrench to seat the packing. Over tightening will shorten the effective life of the packing. When finished, check again for rotary movement of the unit.

Note: The Rotary Joint is provided with a 1/4" pipe connection for greasing (Item 9). Perform all lubrication prior to initial rotation.

Single Rotary Joint Assembly
Pipe Connection & Clamp Assembly

The Rubber Pipe Connection, also called the Elastic Joint, connects the Rotary Joint to the Inlet Distribution Tube. Before attaching, adjust the alignment of the Rotary Joint to the Inlet Distribution Tube. The alignment is determined by the position of the Rotary Joint rotation arm against an adjustable bracket on the rotating carriage. Install the Elastic Joint clamps loosely over the pipe ends before installing the Elastic Joint. Position and tighten the clamps taking care not to pinch or distort the rubber.

Note: Refer back to Movable Central Part Assembly for placement of Rubber Pipe Connection.

1.3 SUPRACELL OPERATIONAL PARAMETERS

SUPRACELL OPERATIONAL PARAMETERS

Carriage Speed – "Zero-Velocity" – After carriage has passed window and is approximately 25% around the tank flocs should be rising in a vertical or near vertical direction. If moving to the left then the carriage speed is too slow. If the flocs are moving to the right then the carriage speed is to fast.

Scoop Speed – RPM of scoop should be set so that a minimum of a 4" sludge blanket is maintained. Never run the scoop VFD less than 12 Hz, as on some models the fan will not operate properly to cool the motor.

Water Level – The water level should be set so that the scoop grabs only the top 2" of the sludge blanket. Water level set too high will cause excess water to be removed by the scoop lowering the floated sludge consistency. Water level set too low will cause the scoop to be run at or near maximum rpm and may allow some of the floated sludge to be drawn into the extraction tubes. Manual weir models should be set at average flow level. Automatic level control units are accurate from ¼" to ½" at all flow rates.

Inlet Distribution Header- The inlet distribution valves should be set to be open the same amount of turns for each downspout. Opening the valves more or less than other will cause an uneven distribution of flow across the header. This can result in excessive turbulence or floc shear. The vent on the header should have an intermittent flow. If pressurized water is constantly emitted from the vent the distribution valves should be opened further. 15 turns open is the recommended starting point for operation.

Aerated Water Header (Double rotary Joint Models Only) – The Globe valves should be adjusted so that each distribution box receives an equal amount of aerated water.

Chemical Injection Points – A coagulant (aluminum or ferric salt) can be injected in the raw waste stream as far away from the unit as possible. The polymer should be injected as close to the bottom of the unit as possible and should always be after the Globe Valve or pressure release on single rotary joint units. Injection on double rotary joint units should be with 10'-15' of the inlet. Polymer inject prior to the Globe Valve can cause floc shear or emulsifying of fats, oils, and greases on some systems.

Distribution Rake – The rake is used to slow the velocity of the water as it enters the flotation zone. The rake should be set so that it is just below the water surface. On systems with fast rising flocs it may be necessary to set the rake at its lowest position. The rake may be used to assist in obtaining "Zero-Velocity" within the tank.

Bottom Purge – The purge of bottom sediments should be frequent enough so that a significant build-up of materials does not occur that fills the sediment sump. If the sump is completely filled, the turbulence caused by the extraction pipes (especially at high flows) may cause some of the bottom sediment material to be drawn into the extraction pipes. This will cause the clarified water

to contain suspended solids that would ordinarily been removed. Bottom sediments are often mixed with the floated sludge material and disposed off. Recycling of these materials will cause build-up over time.

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1.4. ADT DESCRIPTION AND OPERATIONAL PARAMETERS

Air Dissolving Tube Description

The *KROFTA TECHNOLOGIES CORPORATION* Air Dissolving Tube (ADT) has been in use on Dissolved Air Flotation (DAF) clarifiers since the 1970s. Since that time, over 2000 ADTs have been put into operation producing dissolved air in a recycle stream on a wide variety of applications and types of equipment. These pressure vessels often have 1 to 1 ½ minutes of retention time and operate at anywhere from 70 to 150 psi or more. This retention time is 6 to 9 times longer than that required by the ADT.

The typical pressure vessel design has an upper zone containing air in which pressurized water is introduced and sprayed across or mixed in. The air is dissolved into the water in this zone. The water then falls to the bottom of the vessel. The lower zone of the vessel is filled with water and has the purpose of eliminating entrainment of any undissolved air in the discharged water. Entrainment of air in a recycle stream will cause air hammer effects, coarse air bubbles, and turbulence in the flotation clarifier, which will result in decreased efficiency. This type of pressure vessel will require an ASME code and should be tested annually for safety purposes.

The ADT eliminates the need for large volumes of air and water by using air dispersion technology and centrifugal force in place of sheer volume and gravity. Compressed air is pumped into the ADT across the surface of an air panel. The material that this panel is made from disperses the air across the entire surface of the panel. This allows for faster dissolution of air into the water and hence a retention time of only 7-12 seconds. The flow pattern is a cyclone or vortex, which produces a centrifugal force that helps to eliminate the undesirable entrained air. A specially designed inlet nozzle is sized specifically for each application and can be easily changed out if the recycle requirements of future waste streams change dramatically. In addition, a “bleed-off” outlet also assists in eliminating too much air in the tube itself. This ensures that the tube will never air bind or create a plug flow around the air panel.

Some of the many advantages of the ADT are as follows:

- Small Size: The ADT is 6-9 times smaller than traditional style pressure vessels. This reduces footprint requirements and increase mounting possibilities. The ADT can be installed horizontally or vertically and can be easily retrofitted to any style DAF clarifier.
- Elimination of any entrained air from the outlet by centrifugal separation and “bleed-off” capability.
- Simple construction using standard piping components. Units can be fabricated in either 304 or 316 SS.
- Stainless Steel offers superior corrosion resistance over mild steel. It also offers a superior appearance and reduces maintenance since it does not need to be painted.
- The inherently safe design with standard piping components and a moderate operating pressure (65-85 psi) eliminates the need for an ASME certification.

- A customized inlet nozzle designed to meet specific flow requirements that can be easily removed and changed should the requirements change significantly. Adding 1 or more additional ADTs accommodate applications requiring large flows.

- Simple Operation: The ADT requires minimal supervision and attention once it is brought on line. There are no moving parts within the ADT. The ADT also utilizes a standard pump.

- Low Air Consumption: The ADT consumes less than 1 SCFM/500 liters (132 gallons) of ADT capacity.

- Maximized Flotation: When the ADT is matched with a properly sized globe valve for pressure release, the ADT will produce a 30-70 micron air bubble, which is well suited for dissolved air flotation.

- Installation versatility: The ADT can be provided on a wide variety of platforms. In addition to the standard tube, options can be selected which have the ADT mounted on a skid or stand, pre-piped and or wired to a pump or control system.

- 7 Models to chose from with capacities from <80 gpm to 800 gpm

Air Dissolving Tube/System

Air Pressure- Air Pressure should always be higher than the inlet recycle pump pressure. Generally, the recycle pump runs in the 70-80 psi range. Air pressure must be a minimum of 80 psi or 5-10 psi higher than the pump pressure to ensure it can overcome the internal tube pressure and get injected into the recycle stream. Instrument air is not necessary however remember to purge the regulator water trap regularly if not equipped with an automatic purge. There is a Safety Valve on the pneumatic control panel which is preset at 100 psi to prevent over-pressurization of the tube.

Air Volume – There is a Rotometer for each air dissolving tube panel. The meter should be set for a *maximum* of 30 SCFH or <1 SCFM per air panel. Best results may be obtained at ~20 SCFH per rotometer. There should be no water visible within the rotometer. If water is present, it likely indicates the check valve has failed at the ADT injection point. Replace both the rotometer and check valve if necessary.

Air Solenoid & Pressure Switch – On some installations there may be an automatic solenoid that opens upon initiation of a Start sequence. The air solenoid may have a slight delay from the actual pump start to enable the pump to start freely, reducing the chances of air binding or pump cavitations. If the system has a Pressure Switch as well, the system may not start in “Auto” mode when the proper air pressure is not present.

Recycle Pump – The recycle pump should be a standard centrifugal design. Pump requirements are generally 20-25% (or more depending on type of application) of the process flow and are designed at a minimum of 180’/HD (~78 psi). The suction of the pump should always be flooded

for proper operation and quick re-starts. Pressure at the ADT inlet should be in the ~75-80 psi range. This pressure is controlled by the globe valve.

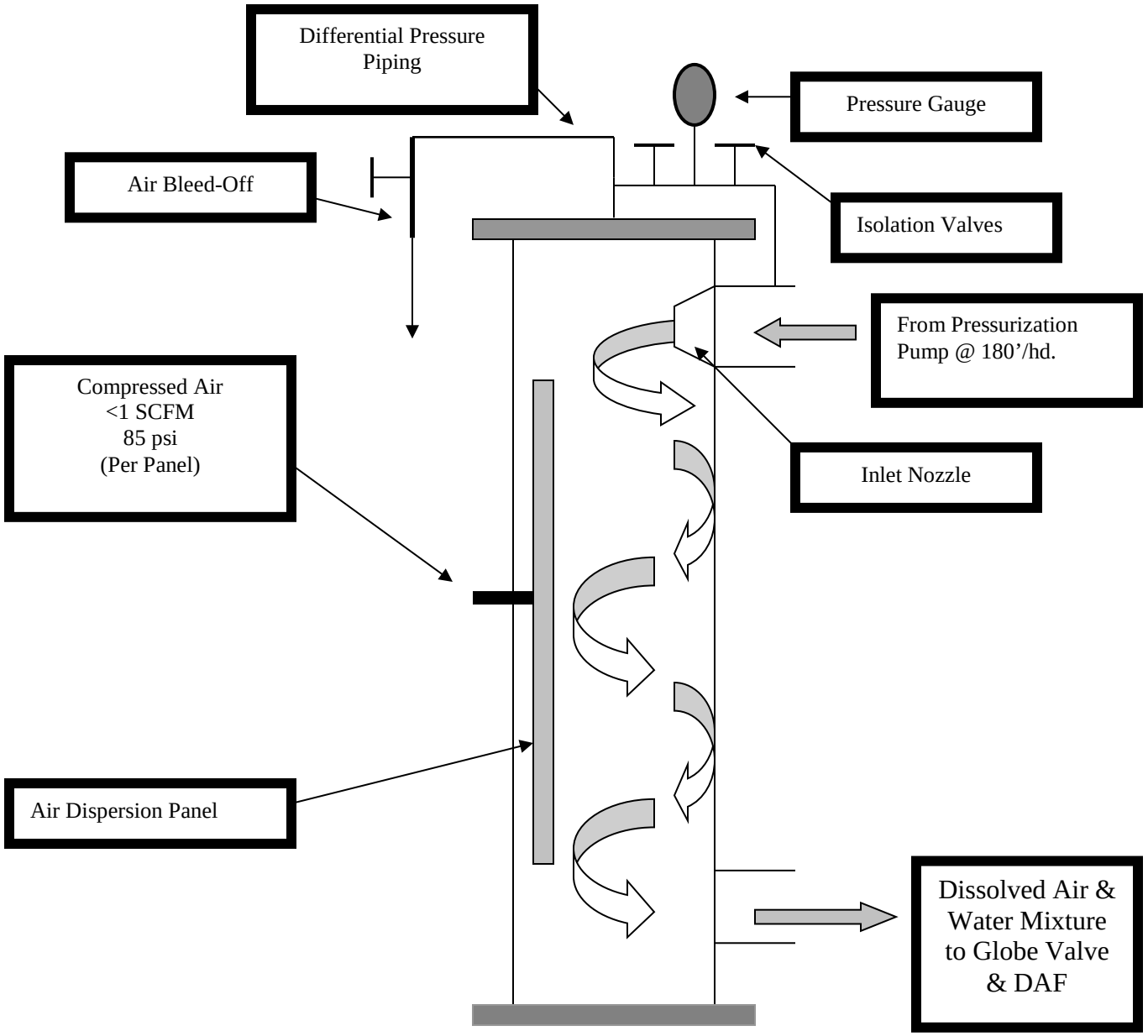
Air Dissolving Tube (ADT) – The ADT can be mounted vertically or horizontally. Inlet and outlet pressure can be determined by closing the Bleed-Off valve and alternately closing and opening the 2 remaining ball valves. One reading is the inlet (pump pressure); the 2nd reading is the pressure at the center of the tube (after the inlet nozzle). Almost all Krofta style units were designed for use at an 8-10-psi minimum pressure differential between these 2 readings. The differential will correspond to 20-25% of the design influent flow rate. A curve is generally supplied with each system that details flow rates at each differential reading. Larger pressure drops will provide more aerated water to the clarifier and vice versa. The Globe Valve(s) controls this volume (see Pressure Release below). Do NOT run the system at less than 60 psi (center of tube pressure) because dissolving efficiency will be diminished and system performance will drop. Too much recycle flow can add excessive turbulence within the DAF. This may be as detrimental to poor flotation in the DAF as not enough recycle flow to float the solids load in the DAF. Avoid large pressure drops (>12 psi) as excessive turbulence will likely result. You will also reduce the contact time for the air and water in the dissolving tube reducing efficiency. You will pump more water but there will be less air in each gallon entering the DAF.

Bleed-Off Valve – The ADT requires that a Bleed-Off Valve be open approximately 1/3 during normal operation. The Bleed-Off valve ensures that air pocket are not formed in the tube causing air binding, coarse air, or plug flow around the air dissolving tube panel. There should be an air/water mixture exiting the tube at all times. This is normally piped to a floor drain, clear well, sludge well, or back into the raw water stream.

Pressure Release – Pressure is released at the Globe Valve and mixed with the influent water in the pipe on Single Rotary Joint models. Pressure is released at the Globes Valve**s** and mixed in the tank on double rotary joint models. On Single Rotary Joint models, the Globe Valve should be 1'-3' from the bottom of the unit. It may be necessary on some systems to intermittently purge the Globe Valve(s) to maintain the optimum pressure differential on the ADT. On SAF-BP models, 2 or more Globe Valves are located in the flocculator and distribute the pressurized stream from the ADT into an aerated water ring. These valves are controlled by handles mounted on the outside of the tank. Some systems may be equipped with auto-purging models.

- **Note** – Never inject polymer or other coagulation/flocculation chemicals into the ADT. In general terms, it is recommended that the coagulant be injected as far away as possible (with as much contact or mixing as possible) and that the polymer (flocculent) be injected after the globe valve. This will help to eliminate floc shear due to the turbulence in the pipe at the area of pressure release and slow floc formation as well as poor flotation or rise rate characteristics in the DAF.

Air Dissolving Tube Description



The above representation visually depicts the ADT as well as its surrounding piping and controls.

Krofta Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

1.5. Supracell (SPC) DAF Quick Set-Up Guide and Procedures for Units with Krofta "Non-PLC" Control Panels.

ENCLOSURE & FUSES

The Krofta "Standard" (systems without a PLC) control panel is QA/QC tested at the factory for operation and inspected for the proper wiring. Please inspect the panel upon arrival at the job site prior to attempting to connect power and start-up. It is possible for items or wires to become loose during shipment. As most systems are 480V or more, use extreme care before touching any wire or device. It is recommended that the disconnect be in the OFF position whenever working extensively within the enclosure.

Also, please check the orientation of the fuses, especially the 3 main fuses on the disconnect, as they may be installed up side down for shipment to further ensure that prior to start-up the panel is connected properly. It is advisable to engage the fuses as needed to avoid damage to components during the start-up period. DO NOT engage them all at once prior to verifying that the wiring is correct.

The controls and items in the panel are very sensitive to moisture and rain as well as metal shavings. Please make sure that care is taken to fully close and secure the door panel when not in use. Also, when working within the panel please make sure that rain or wash down water does not get into the timers or process control unit or that any metal shavings are dropped into the components when cutting access holes in the enclosure. These items are very susceptible to moisture and debris due to their location on the panel door during installation and start-up. Standard panels and their components are rated NEMA 4 or in some instances 4X. They can be installed outside or exposed to rain or occasional splashing of water. It is not recommended even with these ratings that pressurized hose water be directed at them. For systems installed outside, a sun shade or UV Shield is recommended for optimum protection and device viewing.

It may not be possible for the panel to be 100% fully tested at the factory due to some accessory items not being wired at the factory or supplied by Krofta. Copies of the panel drawings are included in the panel as well as in the Operation and Maintenance Manual supplied by Krofta for any troubleshooting requirements.

RED LION PROCESS CONTROL UNIT (PCU) for Automatic Level Control System

Please refer to the attached manual for proper set-up and operation of this item (if equipped).

ALLEN-BRADLEY POWERFLEX 4 & 4M VARIABLE FREQUENCY DRIVE (VFD)

The PowerFlex 4 and 4M variable frequency drive (VFD) is generally configured at the factory to allow the external control pad Human Interface Module (HIM - mounted to the door of the enclosure) to be fully functional upon receipt of equipment and start-up.

If the external keypad is not functional, the VFD can only be controlled on the drive itself within the enclosure.

Before starting any motors and checking for rotation it is advisable that the following parameters are checked to determine if the VFD is programmed correctly. The procedure to access these parameters in the PoweFlex 4 and adjust the settings is outlined below in the following Critical Parameter Listing. The

first Column is for systems with a PowerFlex 4. The second column is for systems with a newer PowerFlex 4M.

Some systems may have different types or brands or drives if specified by the customer. Please refer to the OEM Documentation for these drives and cross reference them with the listing below to ensure they are programmed properly. Refer to the drawings or Faceplate to determine which VFD is supplied in your system. Refer to the Allen-Bradley OEM PowerFlex Guide for Fault Codes and other parameter listings.

For Allen-Bradley PowerFlex 4 VFDs – Critical Parameter Listing

P Group

PowerFlex 4	PowerFlex 4M	Comment
P031	P101	Set to Motor Nameplate rated voltage to be supplied to motor
P032	P102	Set to Motor Nameplate rated frequency to be supplied to motor
P033	P103	Set to Motor Nameplate rated Full Load Amps (FLA) of motor at supplied voltage
P034	P104	Set to minimum output frequency - (typically set this for 15 Hz)
P035	P105	Set to maximum output frequency - (typically set this for 60 Hz)
P036	P106	Set start source - Carriage drive to be set to 5 for control from HIM controller on outside of panel - Scoop drive to be set to 2 for 2-wire control (because we are using the scoop timer or selector switch for starting the scoop/scraper drive.
P037	P107	Default as 0 - Ramps to stop
P038	P108	Speed reference command - Set to 5 for both Scoop and Carriage drives
P039	P109	Acceleration time (customer preference)
P040	P110	Deceleration time (customer preference)

A or T Group

PowerFlex 4	PowerFlex 4M	Comment
A051	T201	Change/Set to 6
A052	T202	No change is required (has no effect on the way the system is set-up) Verify Default value is 4.

To enter the Programming Mode and verify the settings (on the VFD itself within the enclosure), press the ***ESC*** button twice or until the 1st letter on the display is flashing on the display. Press the arrows up or down to find the P group. Press enter (sideways arrow) or the ***SEL*** button to enter the group. Press the arrow(s) to change the group number. Hitting Enter or ***SEL*** will allow you to enter the parameter and view the setting.

To Activate the HIM or pad visible on the panel door, select the P group parameter P036/P106 (Start Source). The factory default is 0 which is the integral keypad on the VFD itself used above. For the carriage (SPC Models Only), Change this parameter setting to 5 for RS485 Port or the external keypad (HIM) on the door by pressing the arrow(s). For the scoop (SPC Models Only) or scraper (MFV or MFH Models Only) change this parameter setting to 2 for 2-Wire Control because there is a scoop/scraper timer or selector switch. Press ***ESC*** to cancel a change and press ***Enter*** to accept the change. Pressing ***ESC*** will allow you to exit the programming menu.

Repeat the procedure for the parameters listed on the Critical Parameter List. For P038/P108 (Speed Reference) either the Scoop/Scraper or Carriage will need to be set to 5. You will also need to repeat the above procedures for Parameter A051/T201. The factory default is 4. It will need to be changed to 6. A052/T202 does not need to be changed and should remain at the default setting of 4.

Upon completion the external keypad should be operational. Press ***ESC*** on the external keypad to bring up the output display.

CHECK EQUIPMENT ROTATION

On the VFD within the enclosure, press the UP arrow and set to ~30 Hz. Press the green start button and check to ensure rotation is correct. If rotation is incorrect it is advisable to bump the 2nd drive and/or recycle pump prior to changing wires and determine if all the rotations are the same way. If necessary it may be easier to change the source phasing rather than the individual component/panel wiring. Avoid running the drives below ~10 Hz. This will ensure the motor fan runs at a speed that will keep the fan cooled motor temperature at an acceptable operating level. In some instances where the VFD is used for controlling a pump, the pump may turn but not actually be pumping anything at output frequencies of less than 10 Hz as well.

Scoop and/or Scraper Operation

- When HOA switch is in **OFF** position, scraper should be off.
- When HOA switch is in **HAND or Manual** position, you must use the HIM controller to start and stop the scraper and to adjust the speed up and down. (Assumes it has been programmed as outlined earlier)
- When switch is in **AUTOMATIC** position, you must hit the start button on the HIM controller to engage the scraper drive and then depending on the timer values the scraper will start and stop automatically. Remember that the VFD should be running if the yellow LED light is lit on the scraper timer.
- Refer to timer operation instructions to configure the timer.

In Hand the timer should not affect the keypad. To test, press the Up arrow to adjust the frequency (Hz) output to ~30 Hz. Press the green button to start. Once the VFD has reached the set-point, press the red button to stop. Repeat the above procedures for any other drives if equipped.

Important Note: It may be necessary to configure the Scoop/Scraper Timer also for the external keypad to work properly. A setting of 0 seconds/minutes on the timer may override the keypad and not allow for start/stop. See the next topic for Allen-Bradley 700 HX Timer Configuration.

Trouble Shooting Tips: If you have problems with one of the external keypads working properly you can switch the RS485 line connecting the keypad to the working drive to the non-functioning drive to verify the wiring and programming changes made. Also – to clear a FAULT press STOP, cycle the power or set A100 or A450 on the 4M Model – FAULT CLEAR to 1 or 2.

ALLEN-BRADLEY MODEL 700-HX TIMER – Scoop/Scraper or Purge System

For either the Scoop/Scraper or Purge Timer functions it is necessary to configure the timer as a Dual or Twin Timer. As the display is digital the letters described below are as close as possible to what is exactly displayed. Please refer to the Allen-Bradley 700-HX instruction sheet for further details.

Before changing or setting any parameters make sure the slide/toggle on the top of the timer (located inside the door) is in the ***OFF*** position. ***On*** or ***Enable*** will restrict what parameters can be changed.

Start by pushing the ***Mode*** Button and the far right lower toggle button on the ***Up*** position for 1 second. FunC appears on the top display and tln on the lower display. Pressing the up key again (the far right toggle – up) will change the operation to tuln. Press and hold the ***Mode*** button and the up (far right) button for 1 second to accept the change and exit.

Press the ***Mode*** button for 3 seconds. This will allow you to set the time settings to hrs/minutes seconds as required. Normal operation for either timer will be seconds for the off time and minutes/seconds for the on time.

To set the parameters press the far right toggle until aFtr is shown (Off-Time) so that ---.-s is shown. Press ***Mode*** to move to the next parameter. The On time will be next and shown as antr. Press the far right toggle until --:--ms appears (m is shown over s). Press ***Mode*** again. The remaining parameters should remain at the factory defaults. By pressing the ***Mode*** button 4 more times and then pressing or holding the ***Mode*** button for 3 seconds you will exit the parameter setting mode.

Hit the toggle button to set the time for both Time 1 and Time 2. Time 1 will be the length (frequency) of time the timer counts before opening the purge valve or starting the scoop/scraper. Time 2 will be the length (duration) of time the purge valve is open or the scoop/scraper is running.

Operating Tip: A normal starting point for the purge timer is 5 seconds every 15-30 minutes. The frequency of purge can be adjusted once the flotation process is observed and the bottom sediments are examined. It is likely that for most applications the frequency can be extended to 1 hour or more. It is not necessary in most instances to have the purge valve open for more than 5-10 seconds. Open durations longer than this may result in low operating levels and difficulty in maintaining optimum floated sludge removal. The scoop/scraper function will vary from application to application and will depend on a wide variety of factors including desired sludge consistency, incoming solids loads as well as chemical dosage.

Trouble Shooting Tips: For the purge valve application, verify the air fitting is installed in the center of the 3 ports of the Bray Series 63 solenoid and that there is air (minimum of ~50 psi) at the actuator on the valve. Also make sure the solenoid installed is as required – a 120V solenoid. A 24V solenoid is not compatible in most instances unless specified. For applications of the scoop/scraper timer, make sure the HOA switch is in ***AUTO*** (when utilizing the timer function) and that there is an output programmed (in Hz) on the drive. The drives may need to be configured as described previously. Also, make sure the Speed Controls on the 2 other ports on the solenoid are set to exhaust slowly. If they are set to vent too slowly or not at all – the valve may not close quickly or at all. Adjust the set-screw as needed to modify the exhaust rate and allow the actuator to close. If the valve slams or makes loud noises, slow the rate of exhaust and verify that the air pressure is between ~50-120 psi max.

Krofta Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

SUPRACELL OPERATION PROCEDURES

NOTE: READ THIS SECTION THOROUGHLY BEFORE ATTEMPTING TO START THIS UNIT!

INITIAL START-UP PROCEDURES

Prior to starting up the DAF System for the first time a thorough inspection must be conducted by the customer to ensure that no construction debris, pipe shavings, or other foreign material or contaminants which could interfere with the proper operation of DAF System components and ancillary equipment including but not limited to valves, check valves, and pumps is present in the system.

1. Close all drain, sampling, purge and air inlet valves to the SUPRACELL and Air Dissolving System.

2. Open all Inlet Distribution Tube outlet handwheels an equal number of turns to give uniform valve openings of at least 1 1/2". It is important to leave the valves closed enough to create about six inches of water head in the Distribution Tube, which is necessary for even flow from the outlet tubes, while avoiding too small a valve opening, which can pressurize and damage the Distribution Tube during operation.

3. Check the level control mechanism. Turn on the raw water feed pump or open the inlet valve if the clarifier is gravity fed. Allow the water level to stabilize.

4. Start the drive motors for the carriage and scoop. Set the Scoop speed to mid range. Set the Carriage speed to achieve zero velocity of the influent. This will yield the least amount of turbulence in the flotation zone. To calculate the carriage speed, add the raw flow to the recycle flow to establish total GPM flow into the unit. Divide the volume of the flotation zone by the total influent flow to determine detention time in the unit. The time the carriage takes to make one tank revolution should equal the retention time of water in the unit.

<u>VOLUME OF FLOTATION ZONE (gal)</u> = CARRIAGE SPEED
RAW FLOW + RECYCLE FLOW (x+y) (0.00 min)

Note the following example: 300 GPM flow into a SUPRACELL with a volume of 900 gallons has a retention time of three minutes. Therefore, the carriage should be adjusted to revolve once every three minutes. A change in flow rate will require adjustment of rotation speed.

Use 259 gallons for a SPC 6 flotation zone. If the ADT model is ADT 300 the max capacity is ~40 gpm (y) and the max capacity for the unit is 259 gpm (X). Use actual flow rate for X – should not exceed 259 this will give you the adjustment of rotation of the carriage.

5.

a. Start the recycle pressure pump.

b. Open the ADT globe valve to provide a pressure drop across the ADT inlet corresponding to the recycle flow required by your process (See ADT Flow Curve). The pressure drop can be found by subtracting the pressure in the ADT from the inlet pressure to the ADT. Opening the valve from the inlet to the pressure indicator while the valve from the ADT is closed establishes the inlet pressure.

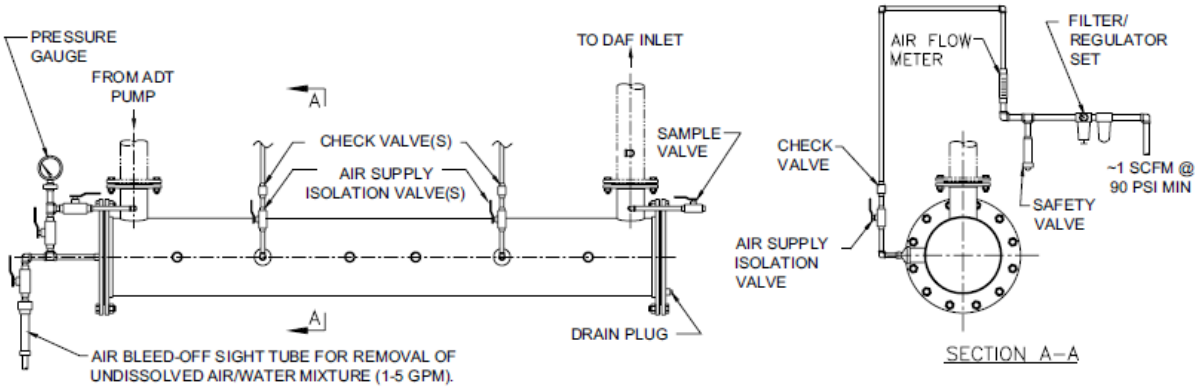
c. Closing that valve and opening the one from the ADT to the pressure indicator will provide the pressure in the ADT. Typically, the required pressure drop is 8 PSI.

d. Adjust the air pressure regulator to 85 - 90 PSIG. **Note:** that the air pressure must always be higher than water pressure to prevent backing of water into the air lines.

e. Open the Air Supply Isolation valve(s) to the ADT air panel(s). **Note**: that the air supply should be off whenever the pressure pump is not operating.

f. Set the air flow meter to 20-30 SCFH.

g. Open the bleed off valve slightly to allow any excess coarse air to escape. Generally 1-3 GPM of water also exists in the site tube, insuring a buildup of excess air cannot occur in the site tube. A clear piece of plastic is used to allow this visual observation and check of flow.



6. Start the chemical flocculent pumps. Check the Inlet Distribution Tube for even flow, adjusting the handwheels as necessary to equalize flow. Units operating at less than design capacity will require smaller openings than initially set.

7. The water level in the SUPRACELL should be adjusted for optimum floated sludge collection by the Spiral Scoop. Typically, a 4” to 6” sludge blanket with the scoop operating at 50% of the variable frequency output is the optimum condition. Lowering the water level reduces sludge collection, allowing a thicker, dryer layer of sludge to form on the surface. Raising the level increases collection and thins out the sludge layer. It will take up to an

hour after a level change before the sludge thickness reaches equilibrium. The sludge layer becomes too thick when it begins to break up in pieces and/or settle out. Adjustment of the Spiral Scoop rotation speed is important for fine tuning the sludge removal rate after the water level is established.

8. The settled sludge purge should be operated depending on the rate of sedimentation in the system. Typical purging of the sump should be 5 to 10 seconds. The interval between valve openings should initially be 15 minutes and then adjusted based on operating experience.

SHUT-DOWN PROCEDURES

1. Turn off the chemical pumps and stop influent flow into the unit.

2. Turn off the ADT pressure pump after closing the isolation valve from the compressor.

3. Continue to operate the Spiral Scoop and Carriage drive until the remaining sludge has been removed. Clean-up is easier if the SUPRACELL is allowed to run after the process flow has stopped. Clarified water will recirculate and most of the solids will be flushed from the system.

4. Valve and control settings previously established should not be changed.

5. The water does not have to be drained out unless the shut-down is for a long period or a complete wash-up is necessary.

6. If the SUPRACELL is drained, hose down all parts thoroughly; dried-on sludge can be very difficult to remove.

NORMAL START-UP AND OPERATION PROCEDURES

1. Follow the same sequence as for initial start-up, except that previously established valve and control settings should be maintained and unchanged.

2. Check that the ADT pressures and pressure drop valves are as previously set and that the clarified water is clear.

3. If the SUPRACELL was not drained, the Air Dissolving System can be started before the influent feed is turned on. This will help prevent solids build-up in the clarified water during start-up.

1.6. MAINTENANCE and TROUBLESHOOTING

GENERAL

SUPRACELL units should receive a visual inspection at least once weekly, a thorough item-by-item inspection monthly, and lubrication and adjustment on a three-month schedule minimum with continuous operation, or on a six-month schedule maximum with intermittent operation.

MECHANICAL MAINTENANCE

TANK
The rim should be brushed or hosed off periodically and should always be kept clean of dirt, grease, and oil. Periodic touch-up painting of mild steel parts is recommended if signs of wear, chipping, or rusting become apparent on the unit. Only routine cleaning is required for stainless steel.

ROTATING TANK PARTS
Only routine cleaning is required for stainless steel. Inspect rubber seals periodically for wear and replace them if their function becomes impaired.

SPIRAL SCOOP
Only routine cleaning is required for stainless steel. Check scoop support saddle for excessive wear, monthly.

CARRIAGE FRAME
Visually inspect the carriage and equipment on the carriage on a daily to weekly basis. Look for and correct signs of wear or misalignment of wheels or other components to prevent major damage from occurring. Clean the carriage structure periodically to remove accumulated dust, dirt, and grease. Inspect the carriage wheels monthly. Wheel bearings are made of self-lubricating material, and therefore require no lubrication.

The gearboxes require periodic oil changes. Note that an initial oil change may be required soon after start of operation. See the gearbox manufacturer's brochure for more detailed instructions.

SUPRACELL CARRIAGE SLIPPAGE ISSUES

If your Supracell has a carriage slippage or stopping issue, please refer to the list below for possible causes and remedies. Often there can be multiple reasons why rotation stops or is intermittent. The first question that should be answered is where the slippage is occurring? Is it random or it occurring in a specific spot or spots? Answering this may point you in several directions based upon the list below. When the system is set up properly, you should not be able to stop the forward movement of the carriage at all unless the drive is stopped – by decreasing output to the drive or hitting the E-Stop button on the control panel.

1) Carriage Speed is incorrectly set – A typical Supracell rotation will likely average somewhere between ~2:30-4:00 min/revolution if the system is at or near design capacity. In most instances,

the system is set up so that the carriage VFD is adjusted automatically based upon a signal from the influent flow meter. As water being processed by the SPC increases the faster the carriage needs to rotate and the less water being processed the slower the carriage needs to rotate. Verify that your drive is set up to accept this signal from the flow meter and that your system or PLC functionality is properly selected. If you see water rushing by the viewing window to the left when the carriage is approximately 180 degrees from the window, it is likely the force of the water running around the SPC is slamming into the front of the carriage, adding force the drive needs to overcome to move the carriage forward. It may be necessary to raise the output to the carriage motor to overcome this force. This can be done either manually by increasing the frequency (Hz) outputted to the drive if not equipped with the auto-pace functionality or by selecting the appropriate function in the PLC to auto-pace the drive. Additionally, verify that the Minimum Frequency Output Setting for the drive is set no lower than 15 Hz. For most applications, a minimum set point of 20-25 Hz would be acceptable and is recommended. See the O&M Section discussing Zero-Velocity Principles for additional information on this issue.

2) Rotary joint – The joint may be too tight or not lubricated properly. The packing or UHMW rings may also be worn causing added friction. Some minor leakage at the joint is acceptable. Avoid over torqueing the packing nuts or the packing may be crushed and become useless. Over tightening the joint may not allow proper rotation. Change the packing regularly and inspect the wear items such as the UHMW ring – replace as needed. Lubricate regularly. Check that the pusher bracket on the carriage is not binding up on the joint as it rotates and adjust accordingly if it is. See Attachment.

3) Bottom scraper – The neoprene blade may be hanging too low and dragging on a high spot(s) causing added friction. The blade sometimes will also catch the leading edge of the sediment sump if it is set too low and stop the carriage dead or slow it down considerably. Drain the unit and make sure this isn't happening. Verify the sump itself is not full and no debris are stuck in it which may be catching the scraper or movable part as it rotates. Also – inspect the tank floor for high spots and adjust the height of the blade accordingly. See attachment. The blade should be perpendicular with the floor – not dragging on it.

4) Side Wiper – The wiper may dragging on side of tank – generally caused when the carriages is rotating more like an egg than a circle. Verify alignment and that the rotation is circular. Adjust centering wheels (if equipped) as well as check for uneven wear on support or drive wheels.

5) Uneven or Unlevel Carriage – The threaded rods which support the carriage need to be checked so that the carriage is perfectly level. If the carriage is not level, when any high spot whatsoever, or any slick area is encountered by the drive wheel the wheel may loose traction. Install double nuts on the threaded rods to prevent loosening once re-leveled. Some minor compression in the actual drive wheel should be seen while the carriage is stopped. If not, the carriage may be lifting the drive wheel off the rim surface – reducing traction. Also verify the entire system, frame or skid is also level at this time. Shim as required.

6) Clarified Water Seal – See attachment for proper clearances regarding this seal. The seal may be torn or have gaps where it is dragging on high spots on the floor or where the carriage/movable part is pushed too low causing added friction. There should be a 7/8" to 1" gap between the steel movable part and the tank floor.

7) Improperly shimmed support wheel – This is a common cause and possibly the least obvious. Often as the carriage rotates and a support wheel rotates over a high spot or tank seam that is not perfectly flush it causes a little torque on the carriage frame and results in just enough lift on the opposite side of the carriage frame that the drive wheel looses traction and starts to spin. Often a simple shim down of the support wheels can prevent slippage. It is more common on rectangular carriage frames and smaller sized SPC's – less common or infrequent on more modern triangular frames. Check wear of wheels versus original outside diameter of the wheel.

8) Drive Wheel/Type/Support Wheels – Some SPC's come equipped with a smooth tread wheel with a durometer of ~90A. It is common for SPC's installed outside or in wet environments to be equipped with a softer durometer drive wheel that also has an X-Tread design. The X-Tread design helps to displace water from the wheel, adding traction, similar to a snow or rain tire on a car. In addition, the softer material spreads out a bit more on the rim offering more surface area to grip. The softer wheel will wear more readily than the harder material. Verify all other wheels are rotating and that the bearings have all been lubricated and are not locked.

9) Grease or water on the rim – Obvious, but sometimes really the only cause and no matter what wheel you put on it won't push the carriage around – make sure the rim is cleaned properly from time to time with a degreaser. A small neoprene wiper mounted to the leading edge of the carriage can help keep the rim clean and free of moisture or contaminants.

10) Low spot on tank seam – Check tank flange seems and make sure there are no high spots or low spots.

11) Sludge Depth is too deep – The DAF is not a sludge holding tank. Make sure that sludge is being efficiently removed from the DAF and that the depth does not exceed the top of the extraction tubes. Excessive sludge depth adds force the drive must overcome.

12) Worn Drive Wheel or Support Wheel(s) – The wheels wear down over time, changing the level of the carriage frame – make sure the wheels show no uneven or excessive wear. Replace as needed.

13) SikaFlex on tank Seam – Verify there is no excess SikaFlex tank seam sealant protruding up that any of the seals or wipers may be catching and hanging the carriage up on. It is common for this issue to occur during start-up if care is not taken during the assembly process to smooth out the seams before the sealant dries.

SUPPORT WHEELS

Proper alignment of the support wheels is important for wheel life and for reducing resistance to carriage rotation. Check the support wheels weekly for wear or damage. Excessive wear or damage can be an indication that other problems may be present.

The general cleanliness of the unit and the function of the wheels should be checked periodically. The unit should be emptied, cleaned thoroughly, and operated empty with all mechanical clearances checked to insure a complete inspection.

AUTOMATIC LUBRICANT INJECTORS

Bearings on some **KROFTA** equipment are provided with PERMA Automatic Lubricant Injectors. A nylon activating screw is provided on the top of the canister. It must be fully screwed in to activate the injector. When the canister is nearly empty, an internal metal ring becomes visible through the clear plastic cap, indicating that the canister should be replaced.

Note that temperature can change the performance of the PERMA canister. High temperature can increase the amount of lubricant released, therefore reducing the effective life of the injector. Conversely, low temperature decreases the release rate but increases the effective life. See the PERMA brochure for more detailed instructions.

Other **KROFTA** clarifiers may be equipped with standard zerk type grease fittings or zerk fittings on a central grease manifold.

ROTARY JOINT MAINTENANCE

Units provided with manual lubrication fittings should be lubricated as often as necessary for smooth rotation of the Rotary Joint, but at least once every 3 months. Schedule a thorough inspection of the Rotary Joint monthly.

If water begins to leak at an increasing rate (some leakage is normal) the packing seals may require compression adjustment as well as increased lubrication. The two piece top seal ring has a number of small compression adjustment bolts that are to be carefully adjusted in sequence around the joint. Tighten with a small wrench approximately one turn after the point where light to moderate resistance is felt. If tightening does not decrease leakage, replacement of the packing seals may be required. Contact your local **KROFTA** Representative for further details.

THE AIR DISSOLVING TUBE

Check the air dissolving tube every three months. If more than, 15 PSI is required to push air into the ADT with the pressure pump off, the dispersion panels have clogged and must be replaced.

Indications:

From time to time, the ADT panel inserts (vyon) may become clogged or blinded. This will inhibit the compressed air from entering the panel or prevent it from dispersing evenly across the surface of the panel. Should this occur the efficiency of the ADT will decrease dramatically and performance of the DAF will diminish.

Panels can become clogged from excessive polymer use, oil in the air supply lines, bacteriological growth, extended down times, infrequent routine cleaning, or other chemical excursions.

The first sign of plugging of the panel will often be an increase in the % open of the rotometer. Each panel consumes a maximum of 1 SCFM (60 SCFH). If the % open on the rotometer requires that the operator open the rotometer farther open each day to achieve the same air flow rate the panel may be gradually clogging.

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Others signs of clogging or binding may be coarse air bubbles in the DAF unit or poor flotation characteristics. A sample of dissolved air can be obtained from the sample port on the discharged end of the tube. The dissolved air that should be visible should stay in solution for a minimum of 30-60 seconds.

Always check the ADT bleed-off valve to ensure that it is approximately 1/3 open during normal operation. Should this valve be closed, air pockets could develop within the tube causing a "plug-flow" around the panel assembly also giving poor air quality in the DAF. If it is closed, it may also give a false indication that the panels are plugging.

Maintenance:

The ADT panels should be inspected and cleaned whenever there is a shutdown of the system. At a minimum, the panels should be cleaned every 6 months and replaced on a yearly basis.

To clean the panels, remove one or both of the end caps as required. A rough long handled brush should be used to scrub the front cover plate and panel.

Soaking for 12 hours or more in a mild acetic acid solution if they are not grossly plugged can rejuvenate the panels.

Replacement Options:

There are three (3) options available for replacement. A complete pre-assembled package is available from the factory. This will allow for quicker replacement and a short equipment downtime. Also available are panel "inserts" only. This option is significantly cheaper but will require more time to install and an extended downtime. The third option is a factory rebuild of the existing assembly. Ship the assemblies' back to Krofta and our shop personnel will mount new inserts to the original assembly using factory original materials.

Replacement Procedure:

Should the panels require replacement, extreme care should be taken as not to damage the stainless steel assembly. The assembly can be re-used with replacement inserts if so desired. Make sure to shut the system down and lock out the recycle pressurization pump. Isolate the compressed air source. Reference #1-#6, and #17-22 if replacing the entire assembly with a complete new assembly and not an insert only.

1. Remove the end cap(s) on the ADT. Inspect the gasket(s). The gaskets may need to be replaced once they are removed if they are damaged or stick to the cap or flange face.
2. Remove the galvanized caps on the outside of the ADT itself exposing the threaded support rods.
3. Disconnect the air line(s) exposing the air injection tube.
4. Un-thread the top nut, washer, and Neoprene O-ring on the center stem (air injection).

5. Un-thread the top nut, washer, and Neoprene O-ring on the threaded support rods (2 for each panel).
6. Remove the assembly from the ADT.

7. Un-bolt the 36 (some assemblies may have 36-44) panel retaining bolts. Replace worn or stripped bolts with 10-24 x 5/8" nylock bolts.
8. Break the silicone seal between the panel and the front plate as well as the rear assembly.
9. Remove the old panel insert *** ***SAVE***** the panel will be used as a template for the new panel.
10. Using the just removed panel as a template, mark the position of the bolt locations on the new panel insert.
11. Drill holes at the marked positions using a ¼" drill bit.
12. Lay a ~ ¼" bead of SikaFlex 1-A or comparable silicone adhesive between the rear assembly and the panel. Install the panel with the ***smooth*** side exposed to the front plate or water interface.
13. - Use SikaFlex 1-A or other approved material for food grade applications or drinking water contact.
14. Thread the bolts through the rear assembly and through the new panel.
15. Install the nuts on all of the bolts through the front palate and rear assembly.
16. Let dry 8-12 hours.
17. Re-Install the assembly into the ADT – The front plate should touch the inner edge of the tube with no gaps.
18. Use care in re-installing the nuts, washers, and Neoprene O-rings on the support rods as well as the air injection stem. If not installed properly water may leak from the ADT while it is in use. In addition, the compressed air may not disperse evenly into the panel insert if the Neoprene O-ring is installed improperly. It is also possible that air could leak out of the stem before it reaches the panel if the Neoprene O-ring is not installed correctly. Do not over tighten any of these nuts as they may strip rendering the panel useless.
19. Test the air system. Liquid soap can be used to check for air leaks and proper installation. Cover the injection point and edges of the panel and look for possible leakage. Repair as needed.
20. Replace the end cap(s) and gasket(s).
21. Remove the lockout tags on the pump system.
22. Re-start the system.

Photo illustrates the inside of an ADT
(As mounted in an ADT300 or ADT500)

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SUPRACELL (SPC) MAINTENANCE SCHEDULE*							
No.	ITEM	SHIFTLY	WEEKLY	MONTHLY	3-MONTHS	6-MONTHS	YEARLY
1	Clean Tank Rim		X				
2	Inspect Clarified Water Seal			X			
3	Inspect Side Wiper			X			
4	Inspect Bottom Scraper			X			
5	Inspect Expansion Joint			X			
6	Inspect Drive Wheel		X				
7	Inspect Outer Support Wheel(s)		X				
8	Inspect Center Support Wheels		X				
9	Inspect Centering Wheels		X				
10	Inspect Electrical Rotary Contact		X				
11	Inspect Rotary Joint		X				
12	Inspect Inlet Distribution Valves (Max. 15 Turns)			X			
13	Inspect Auto-Lube Lines (If Equipped)			X			
14	Inspect Distribution Rake and Actuator			X			
15	Inspect Scoop Saddle Support or Wheels		X				
16	Lubricate Scoop Bearing			X			
17	Lubricate Drive Wheel Bearing(s)			X			
18	Lubricate Outer Support Wheel Bearing(s)			X			
19	Lubricate Rotary Joint				X		
20	Lubricate Rake Actuator Assembly (3)				X		
21	Lubricate Center Support Wheels (2-3)			X			
22	Check Carriage Speed for Zero-Velocity	X					
23	Check Auto-Level Control System & Water Height	X					
24	Check Scoop Speed and Timer Setting (If Equipped)	X					
25	Test Purge Valve			X			
26	Check/Clean Sludge Conductivity Probes	X					
27	Check Compressed Air Pressure to ADT (Min. of 90psi)	X					
28	Check Differential Pressure Across ADT (5-10 # Differential)	X					
29	Check ADT Discharge Pressure (Min. 65 psi)	X					
30	Check Rotometer Flow (Max. 30 SCFH)	X					
31	Check ADT Bleed-Off Valve (~1/3 Open)	X					
32	Inspect/Clean ADT Panel(s)					X	
33	Replace ADT Panel(s)						X
34	Check/Flush (purge) Globe Valve	X					
SUPRACELL (SPC) MAINTENANCE SCHEDULE*							
No.	ITEM	SHIFTLY	WEEKLY	MONTHLY	3-MONTHS	6-MONTHS	YEARLY

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35	Drain and Clean Unit			X			
36	Check All Bolts and Flanges for Tightness			X			
37	Check air pressure & needle valve setting to AOD pumps	X					
38	Inspect DAF Feed & Effluent Pumps for Leaks or Debris	X					
39	Inspect Influent & Effluent FCV's for Function and Moisture in Positioner	X					
40	Drain Compressor and Regulator Traps	X					
41	Verify Compressor Cut-out & Cut-in Pressures (if equipped)	X					
42	Check Compressor oil level fill as necessary (if equipped)		X				
43	Check Compressor filter (if equipped)		X				
44	Check Chemical Metering to Pumps to Ensure Chemicals are Being Dosed – Acid, Caustic, Coagulant & Flocculants	X					
45	Inspect Chemical Feed/Injection Points (valves and fittings)			X			
46	Inspect Polymer Make-up Units	X					
47	Clean Polymer Make-up Units			X			
48	Check pH probe for fouling clean as necessary	X					
49	Calibrate pH probe via Buffer solutions			X			
50	Check Turbidity probe for fouling, clean as necessary (If equipped)	X					
51	Calibrate Turbidity probe with Cal solution (If equipped)			X			
52	Lubricate/grease all motors/bearings/gearboxes				X		
*	This is a typical inspection list. Note: individual site conditions vary and may require more frequent inspection, verification and maintenance.	X	X	X	X	X	X

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1.7. OPERATIONAL TROUBLESHOOTING

ADT ADJUSTMENTS

Under normal circumstances, no adjustment should be needed after the initial set up. If adjustment is required, make the following checks:

TAKE A SAMPLE FROM THE SAMPLING POINT: This is the best indication of the ADT operation. The sample should be drawn off into a graduated cylinder or other glass container. By looking closely, the air can be observed in the water. The air bubbles should be very small, giving the water a "milky" appearance. Larger bubbles should not be present. If enough air is present, the floc should rise to the surface at a rate of one foot per minute, leaving clear water underneath. The ADT is functioning properly and requires no adjustment if this is what is observed.

CHEMICAL ADDITION: Check to be sure that the chemical pump is functioning properly. A clear piece of pipe in the chemical feed line is useful to allow a visual check of chemical addition into the clarifier.

Changes in the nature of the influent before chemical addition can interfere with the flotation process. Detergents and defoaming agents can cause pH and chemical changes in the influent resulting in poor clarification. Determine that the nature of the influent has remained constant prior to making any chemical changes.

The pH of the waste water stream through the DAF must be monitored and controlled in order to prevent damage to DAF materials and components, to facilitate effective coagulation and flocculation, and to maintain permitted pH levels of the DAF effluent. Failure to properly control and verify pH levels in the DAF system reduces removal efficiency, increases chemical consumption and overall operating costs, may violate discharge permits, and may cause serious and irreversible piping or equipment and material damage that may necessitate repair or replacement of DAF materials, components and ancillary equipment. Krofta Technologies is not liable for such consequences.

Regular verification, by comparison to a known standard, of the accuracy of pH monitoring and control instrumentation is required. The DAF System operator should also document actual chemical usage Vs projected usage to determine the accuracy of automated chemical dosing systems and to aid in detecting chemical leaks in the system. Failure to properly document the verification methodology and data voids any damage claim.

Elevated temperatures alone or in conjunction with low or elevated pH levels may also increase the likelihood of irreversible damage to DAF materials, components, and ancillary equipment.

Elevated Chloride levels can damage DAF materials and components if not properly monitored and controlled.

KROFTA recommends that an isolation valve should be installed on the discharge side of any pail, drum, tote, tank, or other chemical storage or bulk storage container, and that the isolation valve should be closed and its position verified to prevent accidental discharge or siphoning of

any chemical during any maintenance procedures or for any prolonged periods of equipment down time.

Certain agents, gases, coagulants, flocculants, acids, bases/caustics, or any other chemical may adversely affect pH if not controlled and monitored properly, and subsequently may cause severe irreversible damage to Krofta-supplied equipment and materials. Properly maintaining or controlling these levels is the responsibility of the end user. Refer to the chemical vendor-supplied Safety Data Sheets and Specifications for additional safety and exposure precautions, handling recommendations, and materials compatibility.

PRESSURE AND FLOW ADJUSTMENTS: Check the pressure gauges to be sure that the pressures have not changed. If the pressure gauges indicate increasing pressure, this usually means the pressure release valve is plugging. Purge the valve and reset to the correct pressure.

Regulate the air to 85 - 90 PSI, a minimum of 10 PSI higher than the internal tube pressure.

THE BLEED-OFF SIGHT TUBE: The Bleed-Off Sight Tube is an integral component of the Air Dissolving System. The Bleed-Off should be partially open whenever the Air Dissolving System is in operation and checked to insure that an air/water mixture is being discharged.

If water only is discharged from the bleed-off, check the system to make sure that it is operating at proper pressure and flow. Increase air into the system in small quantities until an air/water solution is discharged.

If air only is discharged form the bleed-off, reduce the air meter settings. Excess air may cause turbulence in the clarifier or excessive foaming.

SOLIDS OVERLOADING PROBLEMS

Overloading is the result of an unusually high solids level in the SUPRACELL, as can occur at wash-ups or at times of heavy solids loading from the process. Overloading can cause unclear water and in extreme cases physically clog parts of the system. The most effective solution is to simply decrease the solids loading if at all possible. If the overload clogs the system with sludge, the system will unclog itself when the overload stops, unless the thick sludge is allowed to block the clarified water pipes.

NOTE: Do not run the SUPRACELL when it is completely filled with heavy sludge. This can cause strain and possibly damage rotating parts.

1.8. SAFETY REQUIREMENTS

KROFTA SUPRACELL

KROFTA SUPRACELL units are equipped with equipment safety guards for operator protection from outside the unit. SUPRACELL units size SPC-27 and larger are equipped with walkways allowing limited operator access onto the clarifier. For operator access to the SUPRACELL walkway, wait until the walkway is in the best access position before stopping both the Carriage and Spiral Scoop gearmotor. It is required that a lock be put on the main power switch in the "off" position at times when personnel are working on or in the SUPRACELL unit. The electrical control panel contains high voltages and can be hazardous if allowed to remain open during normal operation. It must be closed at all times with only qualified personnel allowed access. **At no time should any adjustment, inspection, or maintenance be undertaken on or in the SUPRACELL unit without the entire unit being completely shut down with the main power switch to the electrical equipment shut off. KROFTA Technologies CORPORATION** will not accept any responsibility for claims resulting from injuries caused by failure to follow the above guidelines.

ADDITIONAL SAFETY RECOMMENDATIONS

The following is an overview of the Safety Requirements for Krofta supplied equipment for the general knowledge of operators and vendors. It is assumed that the facility where Krofta equipment is installed has an established written Safety Program. The following document is recommended protocol for handling Krofta equipment during installation and operation and maintenance procedures but not to supersede the facilities established safety program.

1) Lockout Tagout:

It is required that whenever personnel are working on any Krofta unit or on the ancillary equipment for the Krofta units, that the main disconnect power switch for the unit be placed in the off position and a lock be placed on that switch, with a tag identifying the owner of the lock, to prevent unauthorized or accidental repowering of the systems. At no time should any adjustment, inspection, or maintenance be preformed or undertaken on or in the DAF unit without the entire unit being completely shut down with the main power switch to the electrical equipment properly shut off and locked and tagged out.

2) Electrical Control Panel:

The electrical control panel contains high voltage electrical components and can be hazardous to personnel through **electrical shock** should there be accidental contact with those components. During normal operation of the DAF unit, the electrical cabinet must remain in the closed position. Only qualified and authorized personnel should be allowed access to the interior of the cabinet. No wash-ups of the area in the vicinity of the electrical control cabinet should be allowed without the door being properly closed. Failure to keep the door closed during wash-ups can result in the destruction of the electrical components inside the cabinet and risk of electrical shock to nearby personnel.

3) DAF Units

Guards:
All Krofta DAF units are equipped with equipment safety guards for operator protection from outside the unit. Krofta units should not be run without all supplied guards properly installed in place.

Elevated DAF Units:
Krofta DAF units are often installed in an elevated position for operation convenience and space savings. It is suggested that elevated units be provided with a platform and railings to provide safe access to the DAF Unit. Normal maintenance procedures on the DAF units are easily and safely conducted from these platforms. Should maintenance procedures require access beyond what is afforded by the platform, additional safety procedures must be employed, specific to that procedure.

If the platform is utilized to gain access into the DAF tank, the main control switch must be placed in the off position and locked and tagged out. **See above**.
Because the DAF unit is elevated, when working beyond the access platform, Krofta recommends utilizing standard OSHA approved fall protection equipment to prevent injury to personnel working in unprotected locations.

Air Dissolving System:
Krofta DAF units utilize dissolved air in the recycle stream to remove solids. The air is entrained into the recycled water stream in the Krofta Air Dissolving Tube (ADT). That air is supplied to the ADT under pressure by an air compressor at a value greater than the pressure to the system provided by the recycle pump. Compressed air or pressurized water has the potential to inflict injury by accidental release of that energy. Prior to working on the ADT and associated equipment, the main equipment disconnect must be placed in the off position and properly locked and tagged out. **See above.** After the switch is placed in the off position and locked out, the pressure must be released from the system by opening the bleed valve on the ADT prior to performing any maintenance task.

DAF Feed Pumps:
For a specific project check to see if feed pumps are isolated and installed with dedicated electrical disconnects. Prior to any maintenance tasks being performed on the DAF feed pumps, the electrical disconnects for those pumps must be placed in the off position and properly locked and tagged out. Any residual pressure stored in the piping associated with the pump should be released prior to any maintenance procedure. If the feed pumps are not isolated and equipped with dedicated disconnects then follow the proper shutdown procedures and lockout or tagout that equipment.

Sludge Pump:
Any maintenance on the sludge pump should only be attempted after shutting down all systems and placing the main power switch in the off position and properly locking out and tagging that switch. Any residual pressure in the discharge pipe should be released prior to working on the pump.

4) Chemical Feed Systems:

Before any maintenance operation is conducted on any chemical feed system, the main power switch to the entire system must be placed in the off position and properly locked and tagged out. **See above**.

Proper operation of a DAF system often requires the use of chemistry to obtain the desired performance of the system. Krofta typically provides the necessary chemical feed pumps and associated tanks to dose the proper chemistry into the system.

Maintenance and operation of the chemical feed pumps should only be attempted by qualified and properly trained personnel using appropriate Personal Protection Equipment (PPE). When performing maintenance on any chemical system, great care should be taken to prevent accidental contact to the chemical by those persons performing the maintenance task and any other personnel in the area. Contact with chemicals associated with DAF operations has the potential for severe injury to unprotected personnel. Some chemicals commonly used in water and waste water treatment may damage valves, piping, seal materials, and equipment, including but not limited to stainless steel vessels such as tanks, mixing tubes, and DAFs if the recommended dosing levels, and control, storage, and delivery application techniques are not observed. Appropriate PPE is necessary when working on or around pressurized piping, pumps, valves, tanks, or equipment that may contain any chemical.

Krofta recommends that during any maintenance task performed on the chemical feed systems, the maintenance personnel doing that maintenance must be properly trained for handling that specific chemical and that the operator wears, at a minimum, all necessary personal protective equipment (PPE) recommended for protection from that chemical which includes eyewear and chemical specific PPE. A copy of the MSDS for each chemical handled should be reviewed and thoroughly understood prior to working on any chemical feed system utilized for that specific chemical.

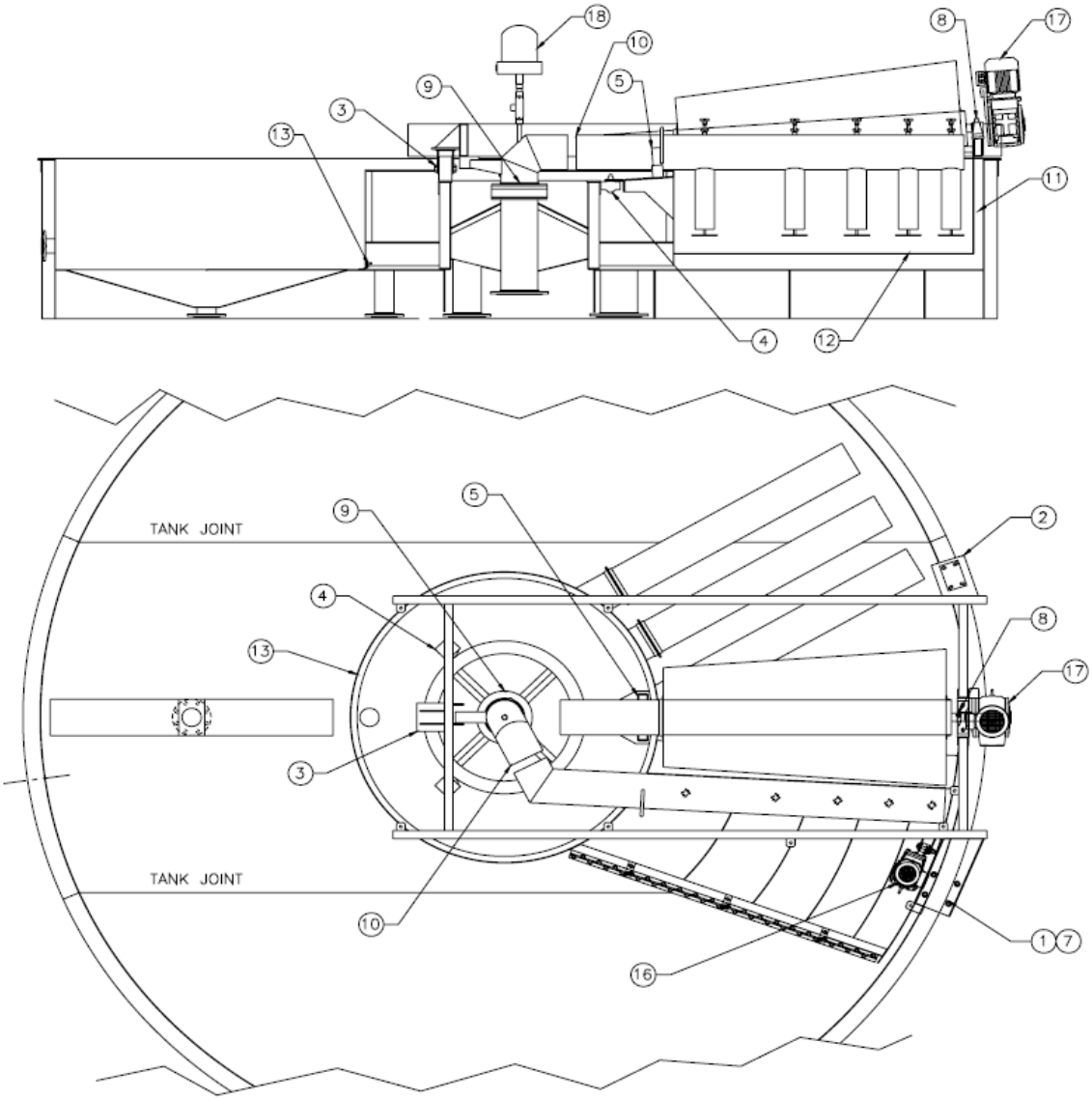
Chemical feed pumps have the potential for developing high pressure in the lines associated with the pump. Every care should be taken to relieve that pressure prior to working on that pump. Failure to relieve pump pressure could result in unnecessary exposure to the pumped chemical and could result in serious personnel injury.

5) Air Compressor

The Air Compressor cycles on and off according to compressed air consumption in the plant. While in the off mode, the compressor system remains pressurized.
Should maintenance be required on the air compressor, that equipment must also be locked out as per the above instruction and any pressure released prior to any maintenance task being performed.

1.9. SPARE PARTS FOR KROFTA SUPRACELL UNIT

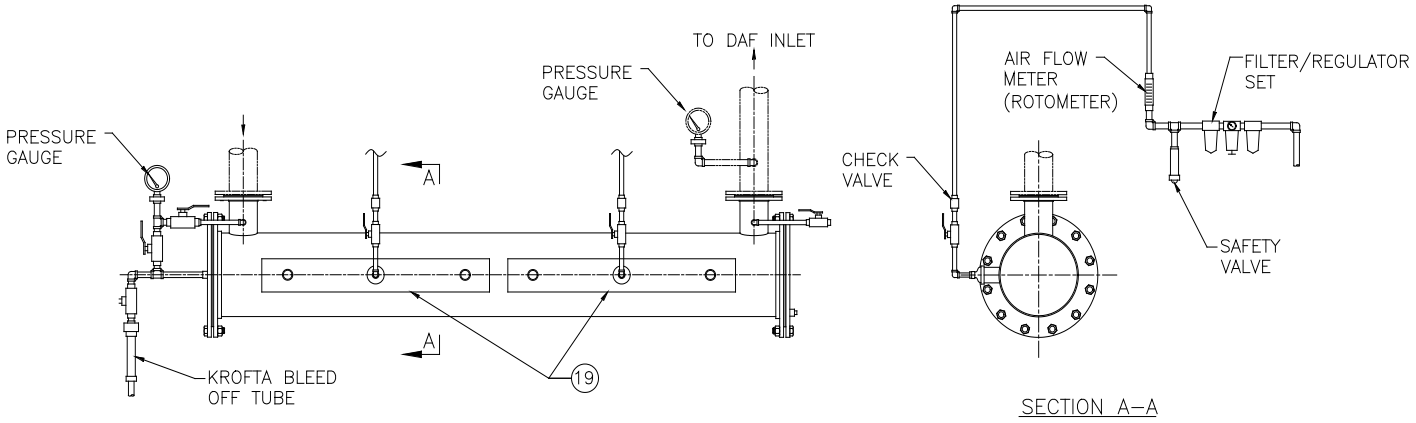
KROFTA SUPRACELL (SPC)



To get Spare Parts Quotes or to Place Spare Parts Orders – please contact:

ATTN: SPARE PARTS MANAGER
KROFTA TECHNOLOGIES CORP.
401 SOUTH STREET, P.O. BOX 7
DALTON, MA 01227
TEL: 413-236-5634 FAX: 413-236-6917 Email: info@krofta.com

KROFTA AIR DISSOLVING TUBE (ADT)



KROFTA SUPRACELL – SPARE PARTS LIST

ITEM	DESCRIPTION	QTY	PART NO		
1	CARRIAGE DRIVE WHEEL	**1**	**PN xx-xxx- SPC xx**	**-**	**SP01**
2	CARRIAGE OUTER SUPPORT WHEEL	**2**	**PN xx-xxx- SPC xx**	**-**	**SP02**
3	CARRIAGE INNER SUPPORT WHEEL (NOT APPLICABLE)	**NA**	**PN xx-xxx- SPC xx**	**-**	**SP03**
4	CARRIAGE CENTERING WHEEL (NOT APPLICABLE)	**NA**	**PN xx-xxx- SPC xx**	**-**	**SP04**
5	SCOOP SUPPORT SADDLE	**1**	**PN xx-xxx- SPC xx**	**-**	**SP05**
6	CLARIFIED EXTRACTION TUBE SUPPORT WHEEL (NOT APPLICABLE)	**NA**	**PN xx-xxx- SPC xx**	**-**	**SP06**
7	DRIVE WHEEL BEARING	**2**	**PN xx-xxx- SPC xx**	**-**	**SP07**
8	SCOOP BEARING	**1**	**PN xx-xxx- SPC xx**	**-**	**SP08**
9	ROTARY JOINT PACKING	**1**	**PN xx-xxx- SPC xx**	**-**	**SP09**
10	RUBBER PIPE CONNECTION	**1**	**PN xx-xxx- SPC xx**	**-**	**SP10**
11	SIDE SCRAPER	**1**	**PN xx-xxx- SPC xx**	**-**	**SP11**
12	BOTTOM SCRAPER	**1**	**PN xx-xxx- SPC xx**	**-**	**SP12**
13	CLARIFIED WATER SEAL	**1**	**PN xx-xxx- SPC xx**	**-**	**SP13**
14	LEVEL CONTROL SEAL (NOT APPLICABLE)	**NA**	**PN xx-xxx- SPC xx**	**-**	**SP14**
15	LEVEL CONTROL BELLOWS (NOT APPLICABLE)	**NA**	**PN xx-xxx- SPC xx**	**-**	**SP15**
16A	CARRIAGE DRIVE GEARBOX	**1**	**PN xx-xxx- SPC xx**	**-**	**SP016A**
16B	CARRIAGE DRIVE MOTOR	**1**	**PN xx-xxx- SPC xx**	**-**	**SP016B**
17A	SCOOP DRIVE GEARBOX	**1**	**PN xx-xxx- SPC xx**	**-**	**SP017A**
17B	SCOOP DRIVE MOTOR	**1**	**PN xx-xxx- SPC xx**	**-**	**SP017B**
18	ELECTRICAL SLIP RING	**1**	**PN xx-xxx- SPC xx**	**-**	**SP018**
19A	ADT VYON PANEL	**1**	**PN xx-xxx- ADT xxx**	**-**	**SP19A**
19B	ADT VYON PANEL INSERT	**1**	**PN xx-xxx- ADT xxx**	**-**	**SP19B**

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