



# Instruction Manual

## Votator® 4x120

### Scraped Surface Heat Exchanger



Read and understand this manual prior to operating or servicing this product.

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Revision Date: February 2010

Publication: 95-03075

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## Warranty

Seller warrants its products to be free from defect in materials and workmanship for a period of one (1) year from the date of shipment. This warranty shall not apply to products which require repair or replacement due to normal wear and tear or to products which are subjected to accident, misuse or improper maintenance. This warranty extends only to the original Buyer. Products manufactured by others but furnished by Seller are exempted from this warranty and are limited to the original manufacturer's warranty.

Seller's sole obligation under this warranty shall be to repair or replace any products that Seller determines, in its discretion, to be defective. Seller reserves the right either to inspect the products in the field or to request their prepaid return to Seller. Seller shall not be responsible for any transportation charges, duty, taxes, freight, labor or other costs. The cost of removing and/or installing products which have been repaired or replaced shall be at Buyer's expense.

Seller expressly disclaims all other warranties, express or implied, including without limitation any warranty of merchantability of fitness for a particular purpose. The foregoing sets forth Seller's entire and exclusive liability, and Buyer's exclusive and sole remedy, for any claim of damages in connection with the sale of products. In no event shall Seller be liable for any special consequential incidental or indirect damages (including without limitation attorney's fees and expenses), nor shall Seller be liable for any loss of profit or material arising out of or relating to the sale or operation of the products based on contract, tort (including negligence), strict liability or otherwise.

## Shipping Damage or Loss

If equipment is damaged or lost in transit, file a claim at once with the delivering carrier. The carrier has signed the Bill of Lading acknowledging that the shipment has been received from SPX Flow Technology in good condition. SPX Flow Technology is not responsible for the collection of claims or replacement of materials due to transit shortages or damages.

## Warranty Claim

Warranty claims must have a **Returned Goods Authorization (RGA)** from the Seller before returns will be accepted.

Claims for shortages or other errors, exclusive of transit shortages or damages, must be made in writing to Seller within ten (10) days after delivery. Failure to give such notice shall constitute acceptance and waiver of all such claims by Buyer.

## Safety

### READ AND UNDERSTAND THIS MANUAL PRIOR TO INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT

Waukesha Cherry-Burrell recommends users of our equipment and designs follow the latest Industrial Safety Standards. At a minimum, these should include the industrial safety requirements established by:

1. Occupational Safety and Health Administration (OSHA), Title 29 of the CFR  
Section 1910.212- General Requirements for all Machines
2. National Fire Protection Association, ANSI/NFPA 79  
ANSI/NFPA 79- Electrical Standards for Industrial Machinery
3. National Electrical Code, ANSI/NFPA 70  
ANSI/NFPA 70- National Electrical Code  
ANSI/NFPA 70E- Electrical Safety Requirement for Employee Workplaces
4. American National Standards Institute, Section B11

**Attention:** Servicing energized industrial equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Recommended practice is to disconnect and lockout industrial equipment from power sources, and release stored energy, if present. Refer to the National Fire Protection Association Standard No. NFPA70E, Part II and (as applicable) OSHA rules for Control of Hazardous Energy Sources (Lockout-Tagout) and OSHA Electrical Safety Related Work Practices, including procedural requirements for:

- Lockout-tagout
- Personnel qualifications and training requirements
- When it is not feasible to de-energize and lockout-tagout electrical circuits and equipment before working on or near exposed circuit parts

**Locking and Interlocking Devices:** These devices should be checked for proper working condition and capability of performing their intended functions. Make replacements only with the original manufacturer's renewal parts or kits. Adjust or repair in accordance with the manufacturer's instructions.

**Periodic Inspection:** Industrial equipment should be inspected periodically. Inspection intervals should be based on environmental and operating conditions and adjusted as indicated by experience. At a minimum, an initial inspection within 3 to 4 months after installation is recommended. Inspection of the electrical control systems should meet the recommendations as specified in the National Electrical Manufacturers Association (NEMA) Standard No. ICS 1.3, Preventative Maintenance of Industrial Control and Systems Equipment, for the general guidelines for setting-up a periodic maintenance program.

**Replacement Equipment:** Use only replacement parts and devices recommended by the manufacturer to maintain the integrity of the equipment. Make sure the parts are properly matched to the equipment series, model, serial number, and revision level of the equipment.

Warnings and cautions are provided in this manual to help avoid serious injury and/or possible damage to equipment:



**DANGER:** marked with a stop sign.

Immediate hazards which WILL result in severe personal injury or death.



**WARNING:** marked with a warning triangle.

Hazards or unsafe practices which COULD result in severe personal injury, death, or damage to product or property.



**CAUTION:** marked with a warning triangle.

Hazards or unsafe practices which COULD result in minor personal injury or damage to product or property.



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## Care of Stainless Steel

### Stainless Steel Corrosion

Corrosion resistance is greatest when a layer of oxide film is formed on the surface of stainless steel. If film is disturbed or destroyed, stainless steel becomes much less resistant to corrosion and may rust, pit or crack.

Corrosion pitting, rusting and stress cracks may occur due to chemical attack. Use only cleaning chemicals specified by a reputable chemical manufacturer for use with 300 series stainless steel. Do not use excessive concentrations, temperatures or exposure times. Avoid contact with highly corrosive acids such as hydrofluoric, hydrochloric or sulfuric. Also avoid prolonged contact with chloride-containing chemicals, especially in presence of acid. If chlorine-based sanitizers are used, such as sodium hypochlorite (bleach), do not exceed concentrations of 150 ppm available chlorine, do not exceed contact time of 20 minutes, and do not exceed temperatures of 104°F (40°C).

Corrosion discoloration, deposits or pitting may occur under product deposits or under gaskets. Keep surfaces clean, including those under gaskets or in grooves or tight corners. Clean immediately after use. Do not allow equipment to set idle, exposed to air with accumulated foreign material on the surface.

Corrosion pitting may occur when stray electrical currents come in contact with moist stainless steel. Ensure all electrical devices connected to the equipment are correctly grounded.

### Elastomer Seal Replacement Following Passivation

Passivation chemicals can damage product contact areas of the equipment. Elastomers (rubber components) are most likely to be affected. Always inspect all elastomer seals after passivation is completed. Replace any seals showing signs of chemical attack. Indications may include swelling, cracks, loss of elasticity or any other noticeable changes when compared with new components.

## Introduction

Votator® 4x120 heat exchangers are designed and constructed to provide consistent performance in a continuous, pressurized system.

**NOTE:** *These instructions cover installation, operation and maintenance (including recommended spare parts) of the equipment described herein. They should be carefully reviewed and understood by all personnel involved in operating and maintaining the equipment.*



**WARNING:** *Use of the equipment in product applications for which it is not designed, failure to operate and maintain the equipment in accordance with these instructions, or use of unapproved replacement parts, may result in injuries to persons and damage to property.*

## Receiving and Handling

1. Carefully inspect the equipment for damage immediately upon receipt.
2. It is your responsibility to file a damage claim with the carrier immediately.
3. Cover and store in a safe, clean, dry place if the equipment is not to be installed immediately.
4. Leave the unit on the shipping skids when moving it from one location to another.
5. During all movement, protect the equipment from sudden jars, shocks, dropping, etc.
6. See Bill of Lading for weight.
7. Never make a single point hitch to the unit when handling with a hoist. Attach lifting cable or chains to unit frame, or skids only. Do not attach lifting cables or chains to cylinders.
8. Some equipment is shipped disassembled into major components to be reassembled on location. When handling, protect any machined surface that may be exposed.
9. Units shipped without a frame must be removed from their shipping crates using a double hitch lifting method. This method assures even lifting and prevents possible equipment damage.

## Spare Parts

A recommended spare parts list is included with the equipment prints and specifications. Much down time can be eliminated if the suggested parts are stocked for ready installation in case of difficulties. SPX Flow Technology can furnish all Votator® 4x120 manufactured items and purchased components to assemble this equipment.

To secure operational information, repair assistance, or to order replacement parts, contact:

SPX Flow Technology  
611 Sugar Creek Road  
Delavan WI 53115  
Telephone: 1-800-252-5200 or 262-728-1900  
Fax: 1-800-252-5012 or 262-728-4904  
E-mail: wcb@spx.com; Website: www.spxft.com

Give a complete description and the number of each part. Always include the serial number of the unit stamped on the nameplate.





## Installation

### Location

1. See equipment drawings for general dimensions.
2. Space Requirement: The floor space requirement for the equipment in its operation position is shown on the above-referenced drawings. Provide sufficient clearance around and above the unit for access and maintenance work.
3. Mutator Shaft Removal: Allow a minimum of 10'-6" (3.19 m) clearance for removing the shaft. For vertical units provide a lifting mechanism of the monorail or traveling type to allow the shaft to be lifted clear of the unit and moved to a nearby maintenance area.
4. Other Equipment: Carefully plan location of this equipment in relationship to complementary equipment so as to arrive at the optimum processing arrangement.
5. Utility Requirements: Appropriate heat transfer medium and electrical requirements must be provided.
6. Ambient Conditions: This equipment is not suitable for locating in a corrosive or extremely dusty atmosphere. When considering outdoor installation, ensure that the equipment is protected from the elements and from freezing conditions.
7. Drainage: Level the unit by adjusting the feet on the frame. Leave a slight pitch towards the opposite drive end for good drainage.

### Foundation

A concrete pad or substantial steel structure is advised. Anchor bolt or foot locations are shown on the drawings where applicable.

**NOTE:** Units provided with bullet feet do not require anchoring.

### Alignment of 4x120 Cylinder Assemblies

Units which are sold with appropriate bases or frames are pre-aligned at the factory during final assembly but still may suffer misalignment.

**NOTE:** Units which are sold without mounting stands include brackets which must be installed approximately two (2) feet from the non-driven end to properly support the tube and shaft assembly. The bracket is designed for support only and must be installed in a manner which does not put undue stress on the locating bore in the mounting pedestal.

Prior to running under power, check the alignment.



**WARNING:** Checking Alignment: Check heights from horizontal frame member and distances from vertical frame members at both ends of each 4x120 cylinder to be sure they are aligned. Adjust mounting strap position if necessary.

Check that all mounting surfaces are properly seated in their locating bores or counter bores and that all mounting nuts and bolts are tightened.

If difficulty still persists with assembly, contact:

Waukesha Cherry-Burrell Technical Services  
Phone: 1-800-252-5200 or 1-262-728-1900  
Fax: 1-800-252-5012 or 1-262-728-4904  
E-mail: wcb@spx.com

## Electrical Power Connections

(See Wiring Diagram in Equipment Prints)

Provide the following items in the branch electrical circuit from the line to the drive motor(s).

1. Start-Stop Switch installed in the control circuit for easy operational control of the motor(s).
2. Motor Controller properly sized to protect the motor against overload.
3. Safety Switch ahead of the motor controller to disconnect the equipment from the line while it is being maintained.
4. Fuse or Circuit Breaker to protect the branch against short circuits or grounds which may result in an over-current far in excess of the motor rating.

## Product Piping

See Figure 1 on page 9 for a typical arrangement.

1. Refer to the equipment drawings for size and location of piping connections.
2. Support ALL piping independently.
3. Provide for line expansion and contraction.
4. The product interconnecting piping supplied between cylinders requires no additional support unless specified in drawings.
5. A safety valve must be installed on the discharge side of the product pump.



**WARNING:** The maximum internal product pressure rating is 200 psig (13.8 bar) at 375°F (190°C). Failure to install a relief valve or operating at pressure above the design maximum can result in damage to property and injuries to personnel.

6. Refer to "Pumping Equipment" on page 8 for information.
7. Keep piping as short and as free of directional changes as possible.
8. Do not install any positive shut-off valves down-stream of the feed pump.
9. Provide temperature indicators on both sides of the 4x120 unit. Provide pressure gauge on the discharge side of the pump

## Seal Flushing Connection

1. The seal flushing connections on the drive end are 3/8" FNPT.
2. Choose a flushing medium compatible with the product. Do not pressurize the seal flushing chamber, as this could cause the flushing medium to leak into the product zone.
3. Provide unions close to the heads to facilitate head removal.
4. Provide a globe-type valve on the inlet side only to control flow.

## Pumping Equipment

To obtain consistent results and maintain desired product quality, the product must be delivered to the 4x120 unit at a continuous, controllable rate. This requires the proper application of a pump capable of constant delivery of the product at elevated pressures. The pump should be provided with a variable drive to effect rate changes.

Locate the pump and supply tank reasonably close to the 4x120 unit. Place the pump under the supply tank and connect it using a minimum length of piping and turns. A flushing line is normally installed in the line between the tank and pump. This line should be closed, using a double block and bleed arrangement, to prevent inadvertent contamination of the product.



**WARNING:** The pump should always be protected by a safety relief valve in the discharge line. This pressure must not exceed the internal rating of 200 psig for the Votator® 4x120.

## Jacket Medium Piping - Liquid or Steam

1. Refer to Figure 2 on page 10 and Figure 3 on page 11 for typical arrangements.
2. Refer to the equipment drawings for jacket connection sizes and locations.
3. Support ALL piping independently.
4. Provide for line expansion and contraction.
5. Install a safety valve to protect the jacket.
6. 4x120 jacket connections can be independently rotated every 90 degrees for piping convenience.
7. When using a liquid coolant, if practical, provide an arrangement to introduce a heating medium into the jacket to thaw an over-cooled product.
8. Provide a liquid coolant system with a bypass line around the 4x120 unit so that the coolant system may be brought down to operating temperature without circulating coolant through the 4x120 unit jacket.
9. When using steam, the opposite drive end jacket port must always be at the 6 o'clock position for condensate removal.



**WARNING:** Consult the unit data plate for maximum jacket pressure rating. Failure to install a relief valve or operation pressures above the design maximum can result in damage to property and injuries to personnel.

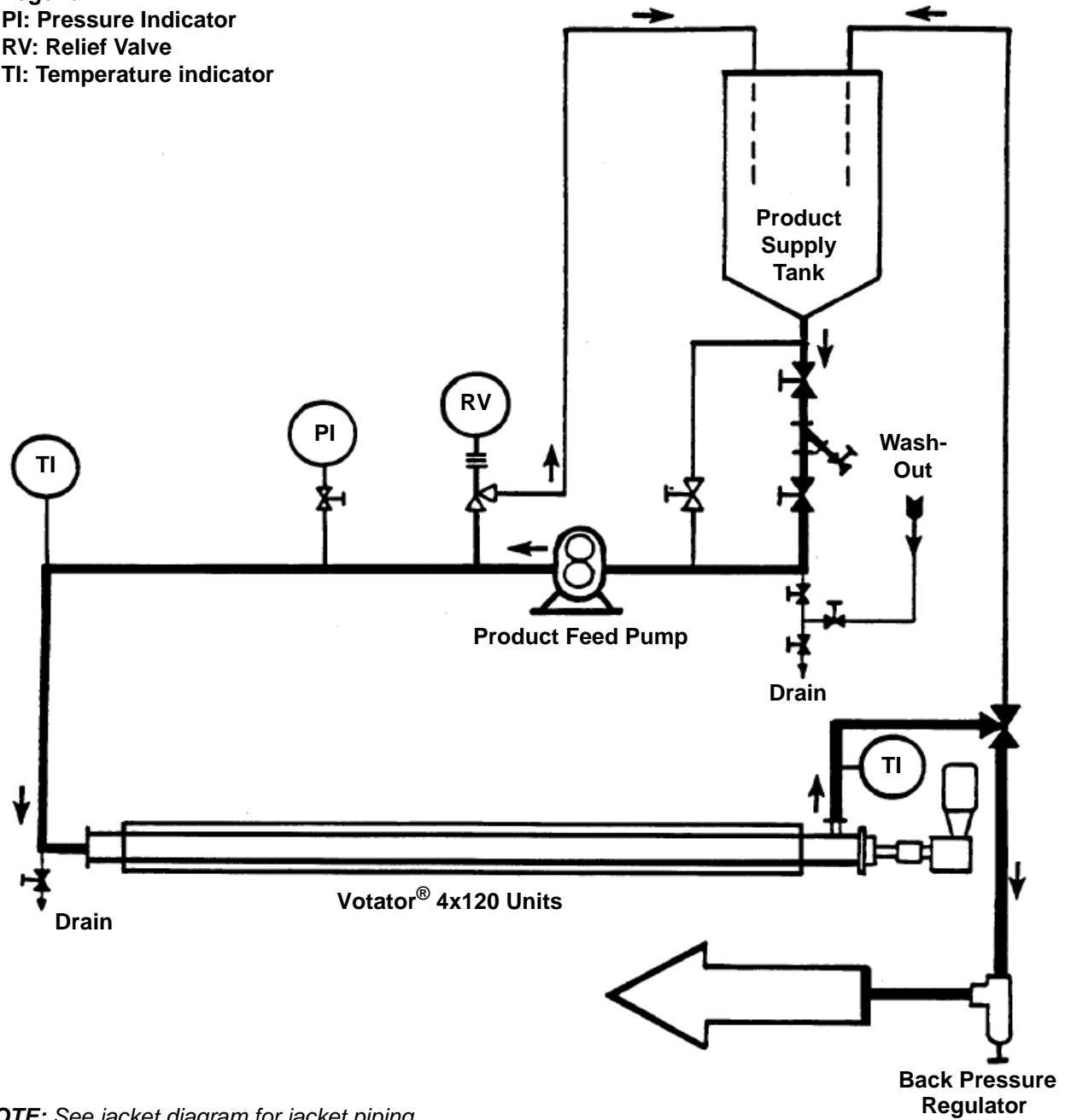
*Take particular care to prevent a volume of liquid from being isolated in the jackets without relief protection. When the liquid warms up, thermal expansion can generate enough force to crush the tube, possibly causing damage to the internal components and drive system as well.*

*Figure 1: Typical Product Piping Arrangement***Legend:**

PI: Pressure Indicator

RV: Relief Valve

TI: Temperature indicator



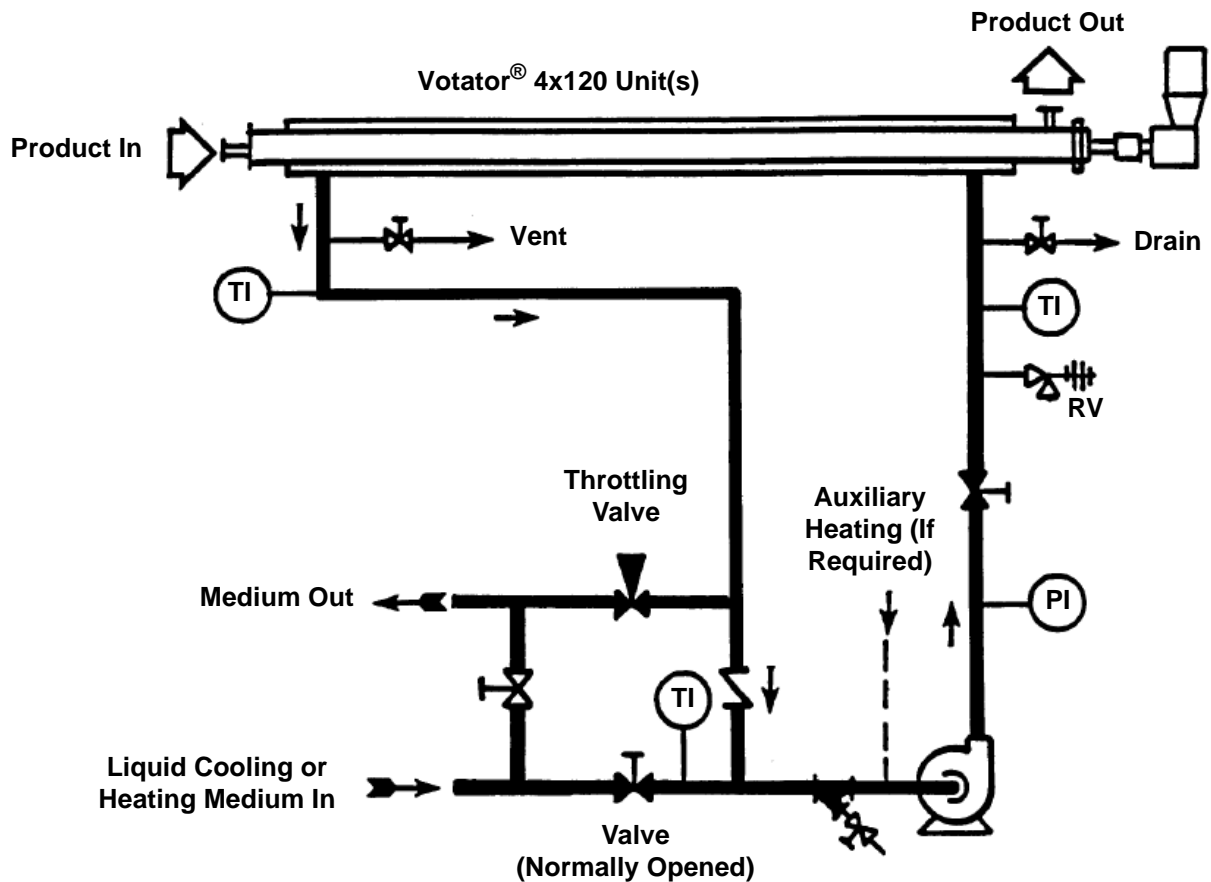
**NOTE:** See jacket diagram for jacket piping.

*Figure 2: Typical Jacket Flow Diagram, Liquid***Legend:**

PI: Pressure Indicator

RV: Relief Valve

TI: Temperature Indicator



**NOTE:** For multiple units, it is recommended that the jacket medium flow direction be counter-current to the product flow direction.

*Figure 3: Typical Flow Diagram, Steam*

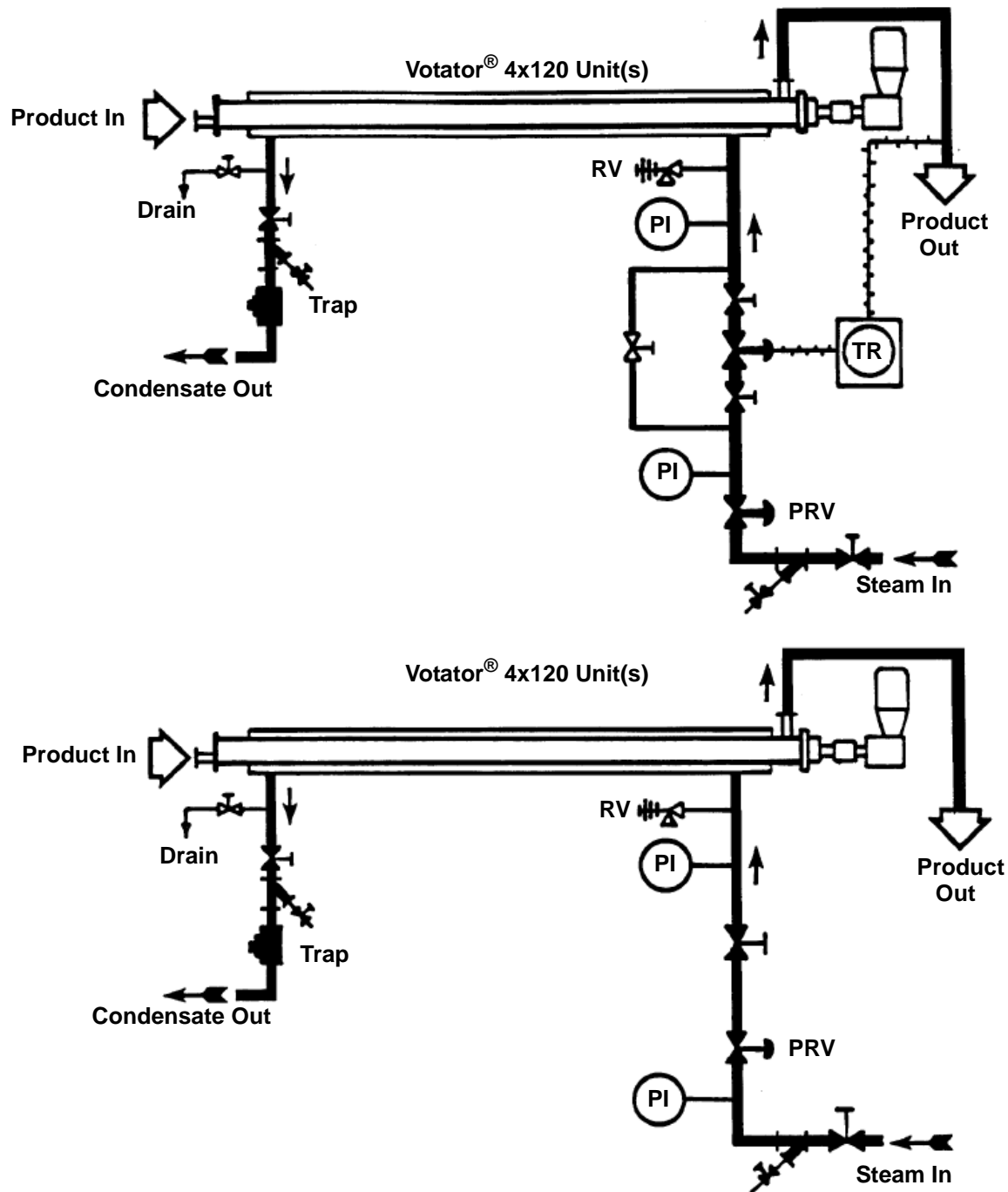
**Legend:**

PI: Pressure Indicator

RV: Relief Valve

TR: Temperature Recorder-Controller

PRV: Pressure Reducer Valve



## Operation



**WARNING:** Use of the equipment in product applications for which it is not designed, failure to operate and maintain the equipment in accordance with these instructions, operation with safety guards removed, or use of unapproved replacement parts, may result in injuries to personnel and damage to property.

*The Mutator shaft rotates clockwise, when viewed from the opposite drive end. The blades scrape, they do not wipe. NEVER RUN THE SHAFT BACKWARD, as damage to unit will result.*

Never allow the Mutator shaft to run continuously unless product is flowing through the unit.

In case of freeze-up or shaft seizure, never try to put the shaft under motor power until there is complete assurance the freeze-up in the unit is completely cleared.

Freeze-ups can be caused by:

1. Over-cooling (freezing) or overheating, (burn on, coagulation, etc.).
2. Flow stoppage caused by pump failure, allowing the supply tank to run dry, or by power failure.
3. Processing the product for which the unit was not designed.

## Operating Instructions

These instructions are general in nature and should be superseded by daily start and stop procedures written to conform to actual in-plant processing conditions.

### Liquid Coolant or Steam-Jacketed Votator® 4x120 Units

#### Start-Up

1. Jog the Mutator shaft to ensure freedom of movement.
2. Start the product pump, recycle through the system, and return to the supply or divert to a waste container if the product cannot be recycled.
3. Start the 4x120 Mutator shaft after flow is established. (The shaft should rotate clockwise when viewed from the non-driven end.)
4. Admit coolant (or steam) to cylinder jacket gradually.
5. Establish the operating pressure.
6. Divert the product to the usage point when system equilibrium is reached.
7. Readjust the operating pressure if necessary.

#### Shutdown

Shutdown procedure is normally the reverse of start-up procedure. The following approaches are recommended:

1. Air or high pressure gas may be used to blow the equipment free of product after the cooling (or heating) medium has been secured and product circulated to approach ambient temperature.
2. Compatible fluids, i.e., water, oil, or other solvent, may be used as a flushing media after the jacket medium has been secured and the product circulated.



**WARNING:** Make sure the steam jacket is completely drained of condensate before admitting steam. Uneven heating may cause damage to the tube and other components.

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MaintenanceDisassembly &  
Assembly of  
Product Side

## Disassembly



**WARNING:** Do not disassemble the unit without first shutting off electrical power to the equipment at the main disconnect switch and making sure no product or jacket medium at elevated temperature or pressure is present in the unit.

1. Disconnect the product piping connections and seal flushing connections, if used.
2. Remove the clamped head at the opposite drive end, recovering gasket.
3. Remove the stainless steel shaft guard, retained by one screw.
4. Remove the plastic drive bolt cover at the rear of the gearbox.
5. Remove the drive bolt and retainer washer from the end of the shaft. Use a sharp rap on the wrench handle to break loose the drive bolt threads.
6. Pull the shaft forward and remove the key from the keyway.
7. Remove the two-piece plastic bushing from the opposite drive end of the shaft.
8. Pull the shaft completely out of 4x120 tube, taking care that the seal ring does not drop off the drive end of the shaft.
9. Remove the blades from the pins by holding them up at an angle to disengage from the pin teeth, then sliding them to the side to unlock them from the pin jaws.
10. Remove the seal ring, o-ring, washer, and coil spring from the shaft.
11. Remove the clamped drive end head, recovering gasket, and remove the seal head insert and o-ring if required.
12. Perform required inspection and servicing. Clean all parts before reassembly.

**NOTE:** The blades act as a shaft skid, preventing the pins from scoring the tube surface.

## Assembly

1. Replace the seal head insert in the drive end head. Lubricate the o-ring before installing the insert.
2. Install the blades on the shaft pins, reversing the procedure in step 9, above.
3. Liberally apply anti-seize compound to the shaft stub, covering all areas that will be inserted into the gearbox hollow shaft.
4. Carefully slide the shaft into the tube, holding the blades against the shaft to keep them from hitting the open end of the tube.
5. Install the coil spring, washer, o-ring, and seal ring on the drive end of the shaft. Do not lubricate this o-ring.
6. Slide the drive end head over the end of the shaft, taking care not to damage the seal face, and clamp the head in place with a gasket.
7. Install the key in the end of the shaft.
8. Install the two-piece bushing at the end of shaft, align the key with the keyway in the gearbox shaft, and continue inserting the shaft until it stops. Do not ram it home.



**NOTE:** The drive bolt will draw up the shaft to compress the seal spring.

9. Install the retainer washer and drive bolt in the drive end of the shaft. The end of the shaft is positioned against a retaining ring inside the gearbox hollow shaft.
10. Install the plastic drive bolt cover on the gearbox.
11. Install the shaft guard with a screw over the shaft.
12. Clamp the opposite drive end head in place with a gasket.
13. Replace the product and flush the piping connections.

## Care of the Votator® 4x120 Heat Exchanger

Four simple rules for maintaining production efficiency:

1. Keep the scraper blades sharp.
2. Keep the scraped side of the heat transfer tube smooth.
3. Keep the jacket side of the tube clean.
4. Keep the rotary seals and rotary seal areas in good repair.

## Correct Use and Care of Blades

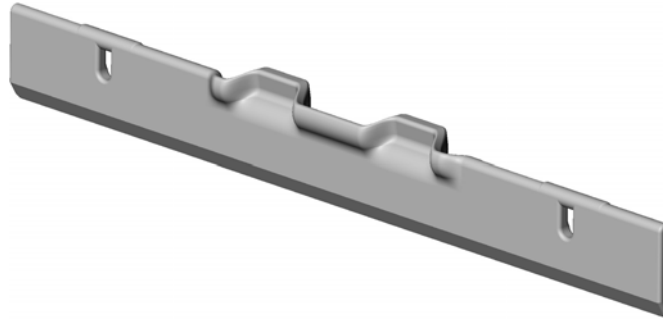
The scraper blades and heat transfer tube must be properly maintained to achieve continued maximum production. Abnormal blade and tube wear can be avoided.

### Causes of Unnecessary Blade and Cylinder Wear

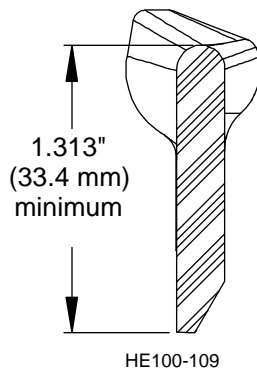
- Using blades other than those furnished by SPX Flow Technology (Votator®).
- Dulling the blades on the tube end by careless shaft handling.
- Careless assembly of blades, shafts, seals and heads.
- Running the shafts without product or product flow.
- Starting the shaft with stiffened or solidified product in cylinder.
- Using blades below minimum width specification.
- Using blades with bearing surfaces below a minimum radius specification.
- Dull blades.
- Causing excessive scraping pressure by unnecessary product pressure.
- Starting flow of jacket medium (Ammonia, Freon, Steam, Water, etc.) before establishing FULL product flow.
- Failure to remove the product from the cylinder after every use.
- Starting the operation before completely dissolving such abrasive substances as salt, sugar, detergents, etc.
- Use of wrong detergent or incorrect use of right detergent.
- Operating the unit without the mutator bushing or with a worn mutator bushing.

## Votator® 4x120 Blade and Bushing Checks

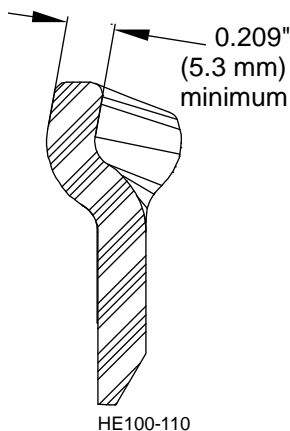
### Votator® 4x120 PEEK™ Scraper Blade



**Figure 4: Votator® 4x120 PEEK™ Scraper Blade**



**Figure 5**



**Figure 6**

Maintain good transfer and maximum tube life by keeping your new PEEK™ scraper blades within specifications.

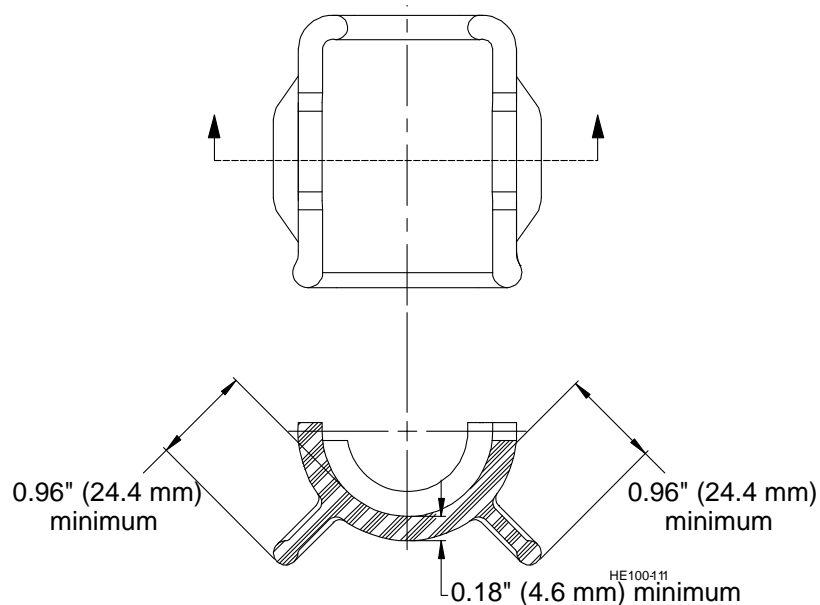
- The Votator® 4x120 uses 16 blades, part number **LL119712**.
- Each blade is 13.7 inches (348 mm) long, 1.5 inches (38 mm) wide, and 0.25 inches (6 mm) thick.

For best performance, we recommend establishing a scheduled maintenance program and replacing the scraper blades in complete sets when the critical width and thickness dimensions of one or more blades reach the minimum values shown in Figure 5 and Figure 6.

Measure the width dimension shown in Figure 5 at several points along the blade. Check the thickness dimension in Figure 6 at both ends of the tube contact surfaces. Replace any blade that shows chipping, cracking, or uneven wear.

### Bushing Checks

Replace worn bushings when any dimensions are less than the minimum specifications shown in Figure 7.



**Figure 7: Wear Limits- Votator® 4x120 Bushing**

**Care of Votator®  
4x120 Heat  
Transfer Tube****Product Side**

The product contacting surface is polished 316 stainless steel.



**WARNING:** When this surface is appreciably damaged, honing is not recommended, since the pressure capability of the 4x120 could be reduced, resulting in possible injuries to personnel through rupture of the equipment and release of the contents. The Heat Transfer Tube should be replaced and is designed to be economically replaceable. Causes for tube wear or damage are listed in "Causes of Unnecessary Blade and Cylinder Wear" on page 14.

**Jacket Side (Steam or Liquid)**

The jacket side of the heat transfer tube will become coated with foreign matter over a period of time. The magnitude of the resultant loss of heat transfer will depend upon the quantity and type of coating. Steam or liquid jacketed units must be cleaned by periodic recirculation of an automobile radiator type cleaner. We do not recommend using the rust inhibitor which is sold with some radiator cleaners. A water pump and 55-gallon drum can be utilized to circulate the cleaning solution through the jacket. A steam coil, or portable heating plates, can be used to heat the cleaner in the drum, if required.

The frequency of this cleaning procedure will vary greatly from one installation to another. Past experience with similar problems and records of the 4x120 unit's performance will be your best guide. The period between cleanings may be from six months or less to several years.

**Jacket Removal  
Procedure**

**WARNING:** Do not disassemble the unit without first shutting off the electrical power to the equipment at the main disconnect switch and making sure no product or jacket medium at elevated temperature or pressure is present in the unit.

**Prepare the Unit for Jacket Removal****Liquid and/or Steam Style Jacket:**

1. Drain and isolate the unit.
2. Carefully vent the jacket of the unit to atmosphere to relieve any remaining pressure. The unit is now prepared for jacket removal.

**Disassembly**

1. Remove the product heads, shaft and all piping connections from the unit.
2. Remove the two (2) jacket cover retaining screws from the opposite drive end of the cylinder assembly.
3. Place a temporary support under the cylinder at the opposite drive end near the support bracket.
4. Remove the cylinder mounting strap.
5. At this point, the jacket cover will slide off the tube in the direction of the opposite drive end.
6. Remove the exposed jacket o-rings.
7. Repeat the steps for the jacket cover at the drive end.
8. Perform servicing or cleaning.

**Reassembly**

1. Thoroughly clean the jacket o-ring grooves and the inside of the jacket covers.
2. Lubricate and replace the o-rings at the drive end.
3. Slide the jacket cover over the tube and onto the o-rings at the drive end, being sure to properly align the retaining screw holes. (Do not force it at this point, as damage can occur to the o-rings.)
4. Reinstall the jacket cover retaining screws.
5. Repeat the steps for the jacket cover at the drive end.
6. Reinstall the cylinder mounting strap.
7. Test the jacket for leaks.
8. Reassemble the 4x120 according to the procedure on page 13.

**Correct Use and Care of Rotary Seals**

The Votator® 4x120 rotary seal has only one function: preventing the product from coming through the 4x120 drive end head around the spinning mutator shaft stub.

The rotary seal consists of:

- A seal body (wedge-shaped seal ring)
- A seal insert
- Two o-rings
- A seal spring
- A seal backing ring

**Rotary Seal Leaks: Causes & Remedies****Seal Insert O-Ring**

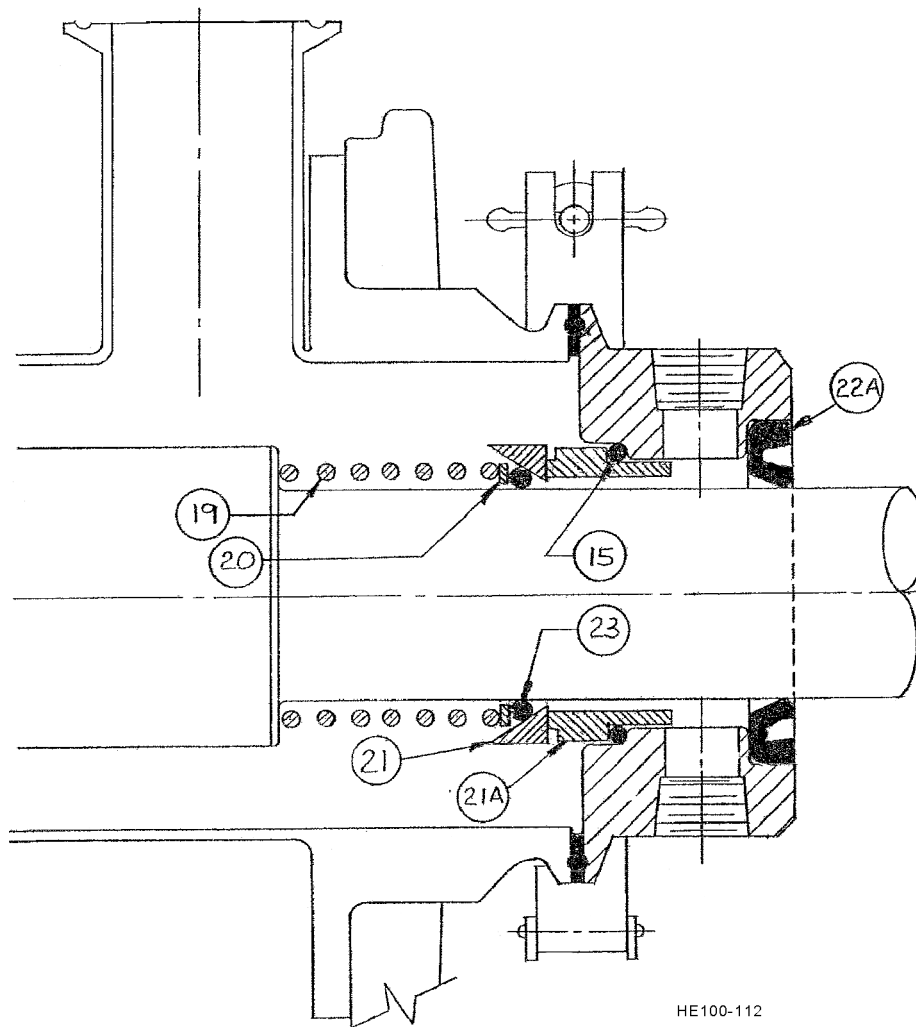
Cause	Remedy
Twisted when installed	Lubricate before installing (edible lubricant)
Wrong size, distorted, deformed or cut	Replace
Wrong o-ring compound	Replace with specified compound
Damaged seal insert	Replace
Obstruction or dirt in head recess for seal insert	Clean recess
Head recess for seal insert damaged	Replace

**Seal Body O-Ring**

Cause	Remedy
Twisted when installed	Lubricate with water only, if needed.
Wrong size, distorted, deformed or cut	Replace
Wrong o-ring compound	Replace with specified compound
Damaged seal body	Replace
Damaged seal backing ring	Replace
Damage on shaft at o-ring sealing area	Contact SPX Flow Technology
Obstruction on shaft stub (uncleaned shaft)	Remove obstruction, clean and lubricate shaft prior to seal body installation

**Periodic  
Servicing and  
Inspection**

Frequency	Inspection or Service
Weekly	Remove mutator shaft to inspect scraper blades, shaft seal parts and heat transfer tube surface
Quarterly or as needed	Check spare parts stock vs. spare parts list
Quarterly or as needed	Change gear box oil
As needed	Clean jacket

**Parts Lists****Votator® 4x120 Single Mechanical Seal**

**NOTE:** This is the standard seal arrangement for all 4x120 Votators.

**Votator® 4x120 Single Mechanical Seal**

ITEM	DESCRIPTION	QUANTITY	MATERIAL	PART NUMBER
15	Insert O-Ring	1	EPDM	E75227
			FKM	V70227-680
			Buna	N70227
19	Seal Spring	1		LL122393A01
20	Seal Washer	1		LL13177A
21	Seal Ring	1	Ceramic	LL13174A01
			Carbon	LL112691A
21A	Seal Insert	1	Ceramic	LL112691C
			Carbon	LL112691A
22A	Lip Seal	1	Buna	LL700030A38
23	Seal O-Ring	1	EPDM	E75327
			FKM	V70327-680
			Buna	N70327

## Troubleshooting

This equipment contains rotating and wearing parts. How frequently they must be repaired or replaced depends on the thoroughness of regular periodic cleaning, inspection and lubrication. How frequently to perform Preventative Maintenance is dictated by the process, the operating conditions and the local sanitation codes. Use the following Troubleshooting Chart on page 22 and operation experience as a troubleshooting guide.

Operational Troubles usually have multiple causes.

Make the following checks before shutting down for repairs:

1. Make sure faulty operation is caused by the heat exchanger and not by some other process equipment.
2. Determine if the process pump(s) are operating or being operated correctly.
3. Determine whether the 4x120 unit is being adequately supplied with the necessary utilities (electricity, refrigeration, air, etc.).
4. Determine whether the duty imposed is that for which the unit was originally rated.
5. Check if the daily start and stop procedures are correctly followed.
6. Make sure all instruments and controls are functioning properly.
7. Does trouble exist on all working shifts, with all unit operators?
8. Excessive Wear: Excessive wear and damage of parts usually results when the unit is operated beyond requirements or specified limits; contact SPX Flow Technology.

See also "Periodic Servicing and Inspection" on page 18.



## Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
<b>Loss of Unit Performance or Capacity</b>	Product "IN" temperature high/low	Pre-cool or heat to normal.
	Product pump rate too high	Reduce to <b>specified rate</b> .
	Scored or rough tube	See "Correct Use and Care of Blades" and "Care of Votator® 4x120 Heat Transfer Tube" on page 16.
	Jacket side surface fouled with dirt, scum or oil	Drain oil and/or clean out jacket space. See "Jacket Removal Procedure" on page 16.
	Blades dull or worn out	See blade instructions.
	Insufficient supply or incorrect temperature of heat transfer medium	Correct source of supply
<b>Motor Overloading</b>	Process flow rate too low causing freezing or burn on	Increase flow rate
	Product "OUT" thermometer out of calibration	Recalibrate, correct or replace
	Faulty electrical supply	Check voltage and contacts
	Product pressure gauge out of calibration	Recalibrate or replace
	Excessive process pressure	Decrease process pressure
	Worn bearings	Replace bearings
	Jacket temperature too low or too high	Correct temperature
<b>Excessive Vibration</b>	Loose adjustable feet	Tighten lock nuts
	Worn bearings	Replace gear box
	Motor or cylinder loose on its mount	Tighten mounting bolts

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
Seal Leaks	4x120 head drawn up unevenly onto tube end	Remove, inspect, clean, replace any defective parts, and draw up evenly
	Seal Body or Insert Seal Faces worn or damaged	Replace
	Seal Insert cocked when installed	Remove and reinstall making sure insert O- ring is not twisted
	Seal Spring weakened	Stretch or replace
	Seal backing ring deformed	Replace
	Seal Body freedom diminished or stopped due to unclean shaft, seal body o-ring recess, seal backing ring, or faulty seal body o-ring	Disassemble, clean, inspect, lubricate piece and reassemble
	Seal Body and Seal Insert mismatched	Always use authorized replacement parts
	Mutator shaft not being fully drawn and locked into operating position	Check installation of drive bolt to be sure it is tight and has not been cross-threaded. Check surface of shaft stub and gearbox hollow shaft for burrs, corrosion products, or other obstructions. Repair or replace if needed.
	Excessive Wear of Seal Body and/or Seal Insert	Do not operate shaft without product, water, or detergent flow. <b>These are not gas seals.</b> They operate on liquids only
	Seal Insert or Seal Body o-ring twisted when installed	Lubricate Insert o-ring before installing (edible lubricant); lubricate Body o-ring with water only, if needed.
	O-ring wrong size or compound	Replace with specified compound
	O-ring not sealing properly because of obstruction or dirt	Remove obstruction, clean, and lubricate prior to installation

## Cleaning and Sanitizing

The following are suggestions, recommendations, and guides regarding the cleaning and sanitizing of 4x120 Heat Exchangers used in the food industry.

The cleaning procedure should comply with the existing sanitation codes, in addition, it should be designed for a specific product and process.

Prior to determining a daily CIP cleaning procedure and the detergent, it must be stated and understood that:

1. Areas such as o-ring grooves, sealed rotating shafts, areas occupied by shaft within a bushing, capillary clearances between running parts, etc., are best cleaned by disassembly and manual scrubbing.
2. For all food processing equipment, especially for processing temperatures of 240°F (116°C) and up, there is no substitute for cleaning by flushing with cool, clean, potable water, disassembly, and manual scrubbing at least once a week.

The cleaning procedure and the detergent efficiency depend on the following factors:

- Time allotted for cleaning solutions to do the job.
- Temperature of cleaning solutions while doing the job.
- Turbulence of cleaning solution while being pumped through or recycled through the equipment being cleaned.
- Detergent concentration and composition: This is dictated by the nature of the soil to be removed and the surface from which the soil must be removed. In short, the detergents must remove the soil without impairing the equipment.
- Water Composition: This is one item frequently overlooked. Good clean, potable water alone does not always suffice. In high temperature processing, the water must be soft enough to prevent mineral salt dropout and/or coating of surfaces due to high heat. Additionally, the mineral content of the cleaning water must be such that it does not detract from the detergent's effectiveness. For example, water containing large amounts of iron, manganese and certain other metals may produce a brown deposit, plus weaken the detergent strength. Ideally, the water should be soft or softened.

The following page is a suggested guide for developing an in-place cleaning procedure (CIP) for 4x120 Heat Exchangers on applications compatible with water-based cleaning solutions.

## Daily CIP Cleaning

1. If possible, avoid product waste at the end of the daily shift run by chasing product with potable water at a flow rate and initial temperature that will not cause the outlet temperature of the product within the system to rise or fall. This does not apply to freezing equipment.
2. When flow from 4x120 Heat Exchangers is diverted from production, the cleaning period starts.
3. Continue to flush the equipment with clean water prior to introducing the cleaning solution.
4. If the product supply tank is used as a detergent supply tank, it must be washed down to eliminate contamination of the detergent solution with product clinging to tank sides, agitators, etc.
5. If a detergent solution is supplied by a central CIP system, detergent flow through or recycle through 4x120 Heat Exchangers is started as soon as initial flush water runs clear.
6. The efficiency of the detergent and the time required to clean are direct functions of the flushing water and the detergent water flow rates. This should be accelerated to as high a flow (gallon/minute) as practically possible.

The detergent recycle method is the most preferable. This requires a detergent solution tank (jacketed) to hold solution at proper temperature, and a high flow rate pump of mixing solution through the systems to be cleaned at approximately 85 gpm (322 liter/minute).

7. The duration of the detergent solution flow through the system ranges from 30 to 45 minutes. It is best to determine this by trial and inspection.
8. Following the washing period, the entire system should be thoroughly flushed with clean, warm, potable water. It is not always necessary to drain this flushing water from the units.
9. Sanitizing: Following the last rinse, the equipment may be further treated by flushing with a bactericide solution and left overnight, or a bactericide solution can be run through the following day just prior to production start up.
10. Mutator shafts: To minimize blade and tube wear, do not spin the shafts continuously throughout the flushing, cleaning and rinsing operations. However, they should be spun periodically to dislodge soil. How frequently shafts should be turned on and off (jogged) during this operation is best determined by trial and inspection.

## Once a week disassembly for cleaning

Once a week disassembly for cleaning offers an excellent opportunity to practice preventative maintenance and maintenance of an adequate spare parts supply.

Once a week:

- Completely disassemble the equipment
- Manually clean
- Thoroughly inspect
- Maintain
- Reassemble

**Detergent Requirements**

**NOTE:** Burn-on refers only to that minor amount accumulated during normal operation. The burn on resulting from power failure, pump failure, and failure to keep feed tank full necessitates complete unit disassembly.

1. Burn-on resulting from cooking protein, (starches, dairy products, etc.) usually requires a dual cleaning treatment-flush, alkali wash, flush, acid wash, flush.
2. Burn-on resulting from cooking acidic (tomato paste, fruit purees) foods will usually yield to an alkali.
3. Detergent must be thoroughly soluble and thoroughly dissolved to prevent damage to running parts.
4. Detergents must be used within manufacturer's limits of temperature and concentration.
5. Detergent must not be corrosive to the equipment when used within the manufacturer's limits of temperature and concentration. To avoid damage to the equipment, do not use a more concentrated or hotter detergent solution than is recommended by the manufacturer.
6. Avoid heating the detergent solution with steam jacketed 4x120 Heat Exchangers.







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Issued: February 2010 95-03075

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