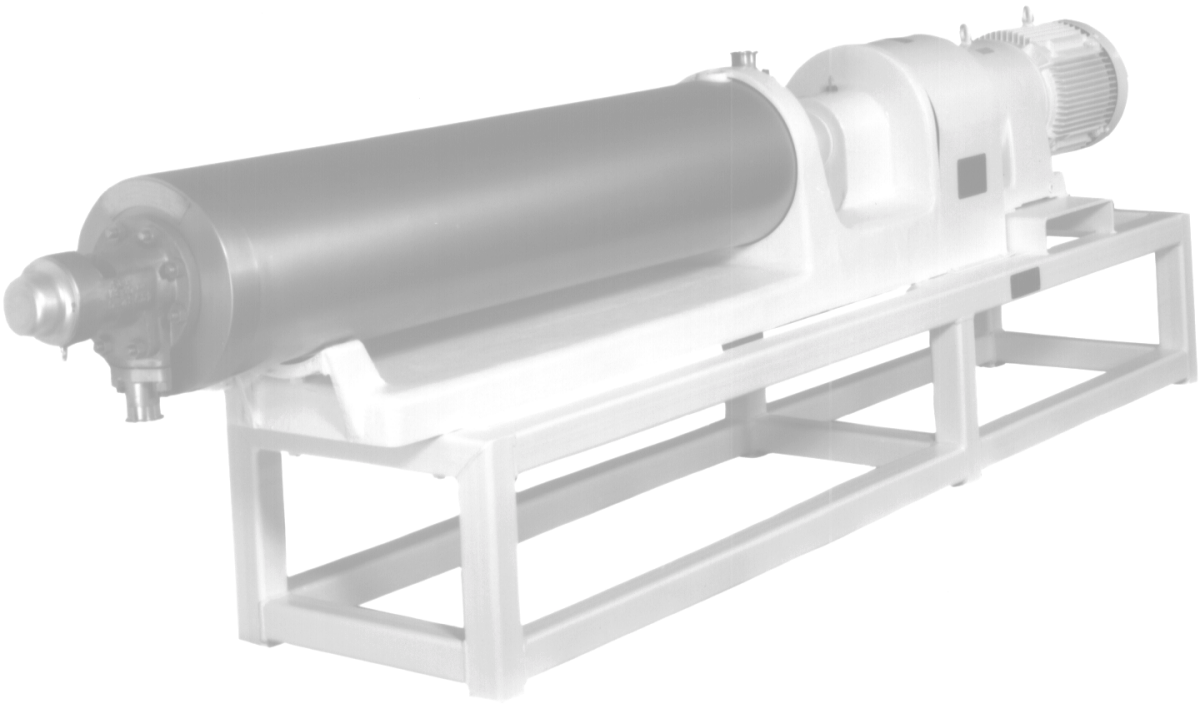
Waukesha Cherry-Burrell
A United Dominion Company

Votator

Scraped-Surface Heat Exchanger



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OPERATION & INSTRUCTION MANUAL

WARRANTY

Waukesha Cherry-Burrell warrants equipment of its own manufacture to be free from defects in materials and workmanship for a period of twelve (12) months from shipment. This warranty extends only to user, and in no event shall Waukesha Cherry-Burrell be liable for property damage sustained by a person designated by the law of any jurisdiction as a third party beneficiary of this warranty or any warranty held to survive Waukesha Cherry-Burrell's disclaimer. Replacement parts provided under the terms of this warranty are warranted for the remainder of the warranty period applicable to the Machine, as if such parts were original components of the Machine. With respect to equipment, materials, parts and accessories manufactured by others, Waukesha Cherry-Burrell will undertake to obtain for User the full benefits of the manufacturer's warranties, but in no event shall user or any other person have any remedy against Waukesha Cherry-Burrell for breach of a manufacturer's warranty. A defect in a part shall not condemn the whole machine. The warranty described in this paragraph shall be in lieu of all other warranties, express or implied, including, but not limited to, any implied warranty of merchantability of fitness for a particular purpose. Waukesha Cherry-Burrell makes no warranty of any kind with regard to this document, including but not limited to, implied warranties for fitness for a particular purpose. Waukesha Cherry-Burrell shall not be liable for errors contained herein or for incidental or consequential damages in connection with the performance or use of this document.

Manufactured in the United States of America

First printing, 1994

SAFETY

Various WARNINGS, CAUTIONS and NOTES appear throughout this manual. Each brief statement identifies certain conditions that require special attention.

WARNING Alerts personnel to potential safety hazards.

CAUTION Is used in situations where equipment could be damaged.

NOTE Emphasizes information considered to be especially important.

NOTE

INTRODUCTION

Votator® Heat Exchangers are designed and engineered to provide consistent performance in a continuous, pressurized system with simple, efficient and relatively trouble-free operation. Trouble-free operation is attainable only with proper handling, installation, operation and maintenance. Therefore, these instructions must be carefully read and retained for future reference.

SPARE PARTS

A. Much downtime can be eliminated if spare parts are stocked for ready installation.

B. All manufactured items and entire components purchased to assemble this equipment can be obtained from the factory. Individual repair parts of purchased components are not stocked. When these are needed, order directly from the manufacturer for quicker delivery at a lower cost.

C. Direct all inquiries and orders for replacement parts to:

Parts Order Department:
Waukesha Cherry-Burrell
P. O. Box 35600
Louisville, KY 40232
Phone: 1-800-626-7278
FAX: 1-800-243-7792

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

TABLE OF CONTENTS

RECEIVING & HANDLING

1. Carefully inspect the equipment for damage immediately upon receipt. 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. 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. Use adequately sized equipment to lift or move the unit.

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. Machined locating, centering and alignment surfaces may be exposed. During all handling operations protect these surfaces.

*See Bill of Lading

INSTALLATION

A. LOCATION

1. SPACE REQUIREMENT: The floor space requirement for the equipment in its operating position is shown on the drawings. Provide sufficient clearance around and above the unit for access and maintenance work.

2. MUTATOR SHAFT REMOVAL: Allow sufficient clearance for removing the shaft. The space required is specifically indicated on the drawings. 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.

3. OTHER EQUIPMENT: Carefully plan location of Votator® equipment in relationship to complementary equipment so as to arrive at the optimum processing arrangement.

4. UTILITY REQUIREMENTS: Refer to Equipment Proposal for the heat transfer medium and electrical requirements.

5. AMBIENT CONDITIONS: The equipment is not suitable for locating in a corrosive or extremely dusty atmosphere. If outdoor installation is contemplated, protection from the elements and from freezing conditions must be considered.

B. FOUNDATION

A concrete pad or substantial steel structure is advised. Anchor bolt or foot locations are shown on the drawings where applicable. Units provided with feet do not require anchoring.

C. MOUNTING

The units must be leveled so that the mutator shaft is in a true vertical or horizontal axis. Using shim plates, level equipment which must be anchor bolted and tighten the nuts on the anchor bolts. Equipment furnished with adjustable feet require only the adjustment of the feet to level the unit. Machined surfaces on the heat transfer cylinder or exposed portions of the mutator shaft provide ready leveling reference.

INSTALLATION

D. ELECTRICAL POWER CONNECTIONS (See Wiring Diagram)

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

1. MOTOR CONTROLLER: Properly sized to protect the motor against overload.

2. SAFETY SWITCH: Ahead of the motor controller to disconnect the equipment from the line while it is being maintained.

3. FUSES 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.

4. START-STOP SWITCH: Installed in the control circuit for easy operational control of the motor(s).

E. PRODUCT PIPING

1. Refer to drawings for size and location of piping.
2. Support **ALL** piping independently.
3. Provide for line expansion and contraction.
4. A safety valve should be installed on the discharge side of the product pump to protect the equipment and personnel.
5. Keep piping as short and as free of directional changes as possible.
6. Do not install any positive shut off valves downstream of Votator® unit.
7. Provide temperature indicators on both sides of Votator® unit. Provide a pressure gauge on the discharge side of the pump.

Refer to Section VI for information on pumping equipment.

F. SEAL FLUSHING CONNECTION

1. The connection size on head is indicated on cylinder assembly drawing.

2. Warm water at 40°C-45°C must be used as the flushing medium.

3. Provide unions close to heads to facilitate head removal.

4. Provide globe type valve on inlet side to control flow.

G. SHAFT HEAT ATTACHMENT CONNECTION (Not always provided)

1. Refer to manufacturer's instructions and cylinder assembly print for inlet and outlet connections.

2. Supply should be from tempered water mixing valve.

3. Do not use heater to support water piping. Use about one foot of hose or tubing at both inlet and outlet connections.

4. Install unions in both lines close to the heater to provide for easy disassembly.

5. Install a globe type valve in the inlet line. Do not restrict flow from the outlet connections.

JACKET MEDIUM PIPING

REFRIGERATION

A. GENERAL

Maintenance of maximum heat transfer and process control requires the following:

1. Piping sized to give a minimum pressure loss between compressor and Votator® unit control valves.
2. A refrigerant Liquid Seal in the Plant Receiver.
3. An Oil-Free refrigerant.

B. PIPING REQUIRED (Refer to Refrigeration System Drawing) Piping must be free from rust, scale, foreign matter, etc. Preferably, pipe should be internally sand blasted and cleaned.

Support ALL piping independently

1. VAPOR SUCTION: Connect suction line from top of surge drum to compressor suction. In this line and conveniently close to the freezer, install:
   a. The Vapor Back Pressure regulator, mounted horizontally.
   b. A suction line Hand Shut-off valve downstream of the regulator.

2. EXTERNAL EQUALIZER LINE: Connect 1/4" line from vapor line solenoid valve flange to vapor suction line downstream of back pressure regulator. In this line install a refrigerant pressure gauge and needle valve.

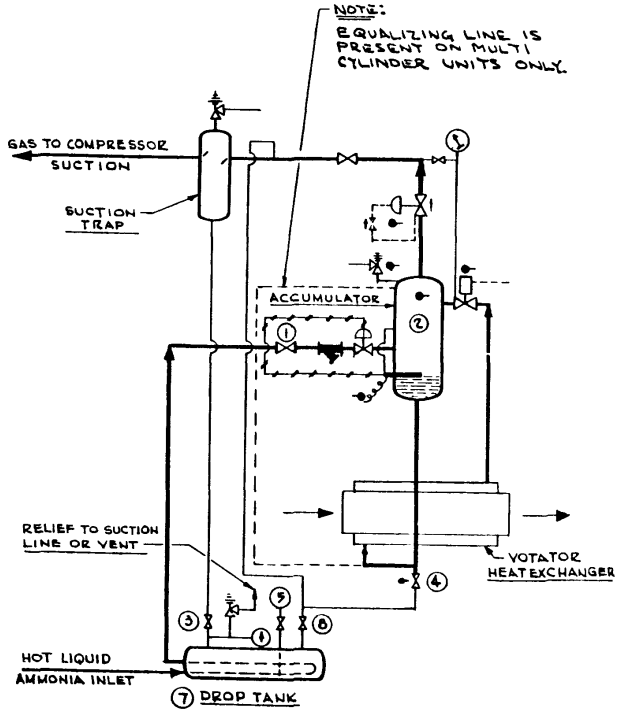
3. BACK PRESSURE REGULATOR PILOT: Mount pilot within 20 feet of regulator at a height and location convenient to operator. The direction and flow is indicated by an arrow on the pilot valve.

4. REFRIGERANT LIQUID: Connect line from liquid receiver to strainer on surge drum. Install hand shut-off valve near surge drum.

5. RELIEF VALVE: Connect valve discharge to atmosphere or downstream of SUCTION HAND SHUTOFF VALVE, depending upon local requirements.

C. AUXILIARY EQUIPMENT: See following page for suggested equipment to minimize contamination of system.

JACKET MEDIUM PIPING



NOTE: LOCATE DROP TANK BENEATH THE VOTATOR PROCESSING APPARATUS, PREFERABLY THE FLOOR BELOW. ITS PURPOSE IS TO REMOVE LIQUID AMMONIA FROM UNIT QUICKLY, IN CASE COMPRESSOR IS STOPPED BEFORE EVAPORATING ALL LIQUID AMMONIA AND TO REMOVE OIL AND OTHER IMPURITIES THAT ACCUMULATE IN SYSTEM.

WHEN OPERATING VOTATOR EQUIPMENT VALVE NO. 4 SHOULD BE CLOSED AND VALVES 3 & 8 SHOULD BE OPEN.

OPERATION: TO DROP AMMONIA CHARGE FROM VOTATOR HEAT TRANSFER EQUIPMENT.

1. Close Liquid Ammonia Valve 1 to Accumulator 2.
2. Valves 3 & 8 are open from normal operation.
3. Open Valve No. 4 to drain Accumulator & cylinder to Drop Tank.

A. IF COMPRESSOR RUNS CONTINUOUSLY (AUTOMATICALLY): Valves 3, 4, and 8 should remain open until the Votator processing apparatus is again put into operation

B. IF COMPRESSOR DOES NOT RUN CONTINUOUSLY: After charge is dropped, close valves 3, 4, and 8. This will prevent excessive pressure on suction side of system if suction valve at compressor is also closed.

C. WHEN COMPRESSOR IS STARTED: Open Valves 3 & 8 between Drop Tank 7 and Ammonia Compressor.

D. DRAINING DROP TANK: At frequent intervals oil and impurities should be purged from valve 5 from which a drain connection should be provided for this purpose.

NOTE: VOTATOR REFRIGERANT CONTROL ITEMS FURNISHED WITH CHILLER UNIT.

DROP TANK NOT FURNISHED AS PART OF STANDARD VOTATOR PROCESSING EQUIPMENT. INFORMATION FURNISHED ON REQUEST.

Tolerances Unless Otherwise Specified
Non-machining ± 1/16 in
Machining ± .005 in
Machining surf. finish 125
Deburr & break edges

CHERRY-BURRELL
AMCA INTERNATIONAL
ANCO/VOTATOR DIVISION

SUGGESTED ARRANGEMENT
USING AMMONIA DROP TANK
WITH VOTATOR PROCESSING APPARATUS

Scale	None	Product Code	
Date	4/23/86	Eng. Ref	
Drawn By	D.H.B.	Next Assem.	
Appr'd By			

21655-A

JACKET MEDIUM PIPING

B. STEAM

1. Refer to the typical jacket flow diagrams on the following page.

2. Refer to the drawings for jacket connection size and location.

3. Support ALL piping independently.

4. Provide for line expansion and contraction.

5. Provide a safety valve to protect the jacket.

C. LIQUID

1. Refer to the drawings supplied with the heat exchanger for jacket connection size and location.

2. Pipe heating fluid for bottom entry and counter flow with respect to the product.

3. Support all piping independently.

4. Provide for line expansion and contraction.

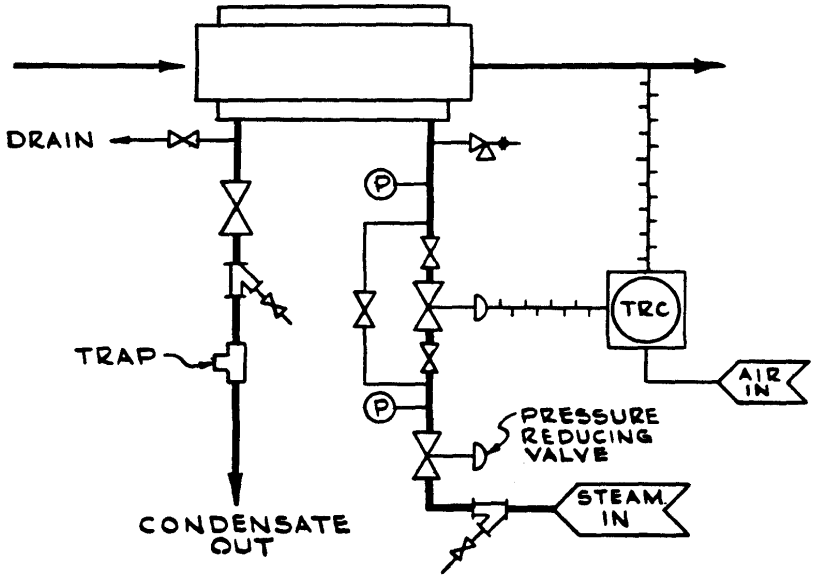
5. Provide a safety valve to protect the jacket.

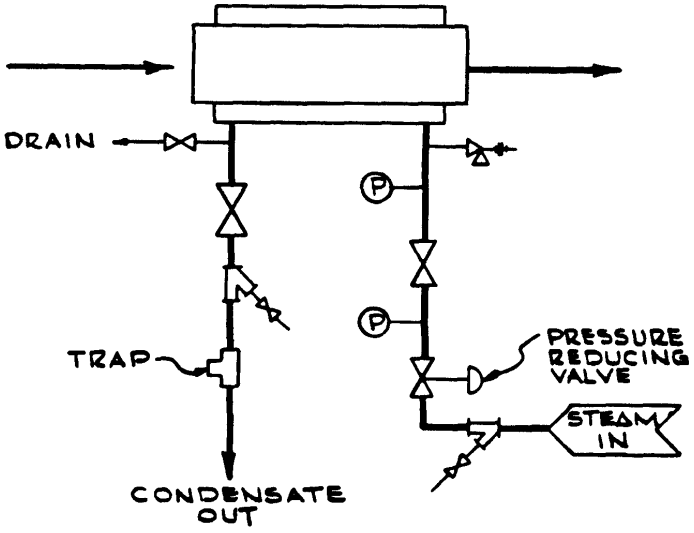
6. When using a liquid coolant, if practical, provide an arrangement to introduce a heating medium into the jacket to thaw an overcooled product.

7. A liquid coolant system should be provided with a bypass line around the Votator® unit so that the coolant system may be brought down to operating temperature without circulating coolant through the Votator® unit jacket.

8. Refer to instructions pertaining to fluid heating system being used for system piping recommendations, safety and operating instructions.

JACKET MEDIUM PIPING

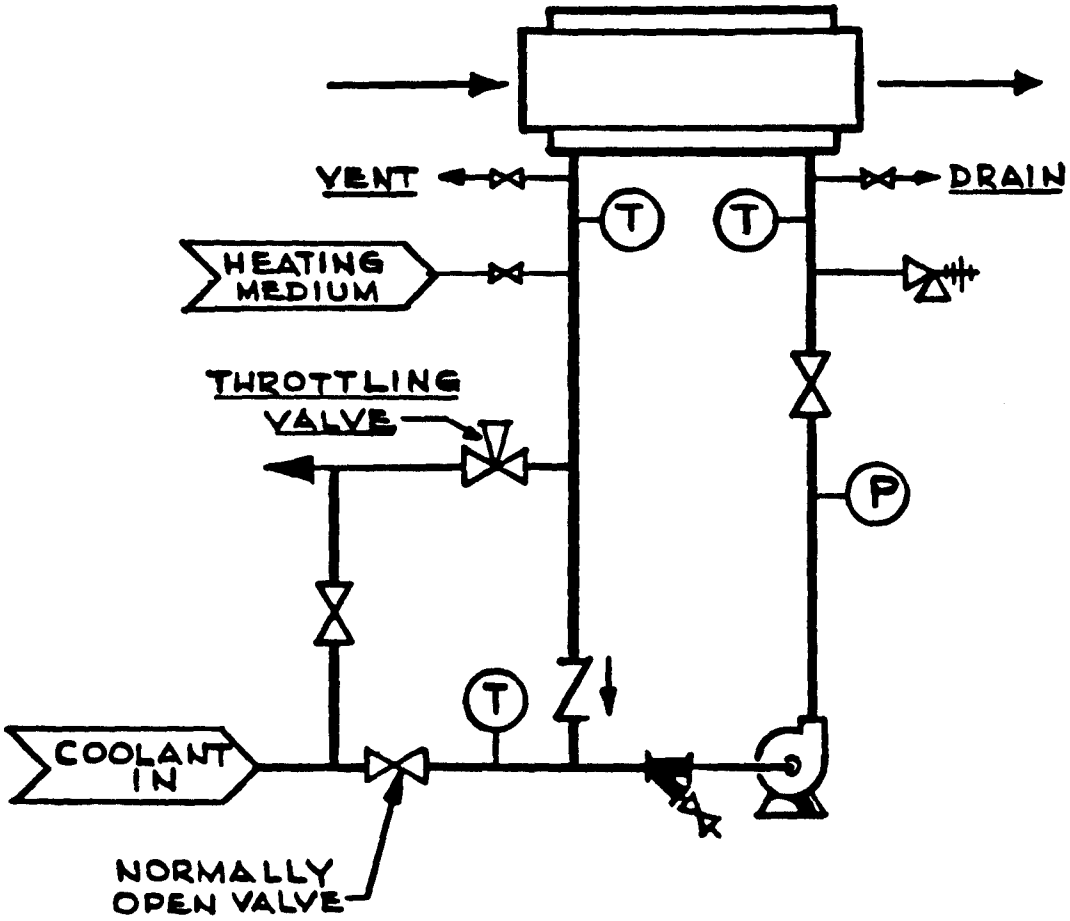




TYPICAL JACKET FLOW DIAGRAM - STEAM

VOTATOR DIVISION VM-23

JACKET MEDIUM PIPING



TYPICAL COOLANT DIAGRAM - Liquid

Votator®

VOTATOR DIVISION VM-22

OPERATION

WARNING

To ensure employee safety and to avoid equipment damage, NEVER operate equipment without safety guards and interlocks properly installed!!

A. GENERAL

Satisfactory life and performance depends not only on the proper application of the equipment, but also on the proper use of the equipment by the operator. Operation above the unit's rate capacity and on other than its rated product can cause damage to the unit and adversely affect performance.

1. Never turn shaft with motor unless product is flowing through unit.

2. Never try to put shaft under motor power until there is complete assurance the "freeze- up" in unit is completely cleared. "Freeze- ups" can be caused in the following manner:
   a. Excessive heating or over-cooling,
   b. Flow stoppage caused by pump failure, allowing supply tank to run dry or power failure,
   c. Processing product for which unit was not designed.

3. Never allow supply vessel to empty before unit has discharged product at a temperature which can be handled with bare hands, or in a cooling process, until the unit is empty of refrigeration. Anticipate shutdown by having available sufficient quantity of product or cleaning medium to cool unit below scorching or boiling conditions, or to warm it up above freezing.

Before initial operation, equipment should be dismantled and thoroughly cleaned.

OPERATION

WARNING

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B. **OPERATING INSTRUCTIONS** These instructions are general in nature and should be written to conform to actual in-plant processing conditions.

1. Start-up - Brine. Water or Steam

a. Turn shaft over by hand to determine if free.

b. Start product pump taking suction from product or a compatible liquid if the product cannot be circulated without irreversible changes or detriment to quality.

c. After system flow is established, start Votator® mutator shaft motor.

d. If heating, establish operating pressure.

e. Admit heating medium, or coolant to Votator® cylinder jacket gradually to attain approximate system operating temperature.

f. If running a material other than the product, switch pump suction to product supply, and adjust to desired processing rate.

g. Divert product to usage point or container after operating conditions have been reached.

2. Start-up - Refrigerant Coolant

WARNING

To ensure employee safety and to avoid equipment damage, NEVER operate equipment without safety guards and interlocks properly installed!!

a. Turn shaft over by hand to determine if free.

b. Start product pump, recycle through system and return to supply, or divert to waste container if product cannot be recycled. Start Votator® mutator shaft after flow is established.

d. Line condensing system valves for operation and start compressor.

e. Adjust back pressure control valve on Votator® accumulator approximately 20 psig above normal operating pressure.

f. Open liquid refrigerant from accumulator to Votator®cylinder jacket. Admit liquid refrigerant from accumulator to Votator® cylinder jacket.

h. Gradually reduce setting on back pressure control valve to obtain proper product temperature.

i. Divert product to usage point when system equilibrium is reached.

3. Shutdown

Shutdown procedure is normally the reverse of start-up procedure.

C. FREEZE-UP: CAUSE AND CLEARING

1. CAUSES: Power failure is the only unavoidable cause for freeze-up. The other causes are:

   a. Product outlet temperature TOO LOW.
   b. Product rate TOO LOW.
   c. Failure of pump.
   d. Allowing product to run out of supply tank prematurely.
   e. Incorrect start-up or shutdown procedure.

WARNING

Do not attempt to start mutator shaft or product pump when shaft is frozen

2. Freeze-up clearing

   a. Heat mutator shaft with hot water.
   b. After several minutes cautiously pump hot water or hot product through unit. Immediately shut down pump if excessive pressure is encountered.
   c. Continue pumping until shaft may be turned by hand in direction of rotation.
   d. Resume normal start-up procedure.
   e. Severe freeze-ups may necessitate disassembly of the equipment to remove blockage.

WARNING

To ensure employee safety and to avoid equipment damage, NEVER operate equipment without safety guards and interlocks properly installed!!

DISASSEMBLY & ASSEMBLY

MUTATOR SHAFT

A. DISASSEMBLY

1. Disconnect the electric power circuit from motor(s).
2. Disconnect product piping connections and seal flushing connections.
3. Loosen and remove shaft locknut at opposite the drive end. SHAFT LOCKNUT HAS LEFT HAND THREAD.
4. Remove head opposite drive end taking care not to damage seal parts.
5. Remove seal parts from shaft and place in a safe location on a soft surface.
6. Rotate shaft by hand so that shaft skid may be inserted between shaft body and bottom of tube wall. Insert skid the full length of the cylinder.
7. Pull shaft and shaft skid from cylinder as a unit. The purpose of the shaft skid is to protect the tube wall from damage during disassembly and assembly. Remove shaft carefully so as not to damage seal parts at the drive end.
8. Remove seal parts and place in a safe location on a soft surface.
9. Perform required inspection and servicing. Clean all parts before reassembly.

B. ASSEMBLY

1. Replace seal inserts in both heads. Lubricate insert “O” ring before installing.
2. Install drive end head.
3. Lubricate seal body “O” ring and install seal assemblies on shaft.
4. Carefully slide shaft on shaft skid into cylinder. Hold blades against shaft to prevent them from striking end of cylinder.
5. Rotate shaft slightly to engage spline. It will be necessary to raise shaft slightly at drive end to effect spline fit. DO NOT RAM “HOME” SHAFT. THIS CAN DAMAGE THE SEAL.
6. Remove shaft skid.
7. Replace opposite drive end head.
8. Replace and tighten shaft locknut. Check to be sure that shaft locknut has drawn shaft into proper position. The step on the shaft at opposite drive end must be tight against the inner race of the bearing.
9. Observe the position of the seal through the drive end head product connection. The seal body and insert must be mated.
10. Complete product piping, seal flushing piping and replace slinger rings.
11. Turn shaft in direction of rotation several times by hand to be sure the unit is properly assembled.
12. Connect electric power to motor and prepare unit for operation. Agitated holding units may be serviced in the same manner as the standard unit except that a shaft skid is not necessary.

WARNING

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B. TUBE REMOVAL INSTRUCTIONS - MEDIUM DUTY

A. Refrigeration Style Jacket Disassembly: Disconnect the electric power circuit from motor(s). It will first be necessary to prepare the unit for tube removal, if applicable. To do this, first pump down the refrigeration system and isolate the unit. Next, carefully open the refrigeration system of the unit to bleed off any remaining refrigeration gas pressure. Remove product heads, shaft and expansion joint cover. The unit is now prepared for tube removal.

B. Liquid and/or Vapor Style Jacket Disassembly Disconnect the electric power circuit from the motor(s). It will be necessary to prepare the unit for tube removal, if applicable. To do this, first drain and isolate unit. Next, carefully open the system of the unit to atmosphere to relieve any remaining pressure. Remove product heads, shaft and expansion joint. The unit is now prepared for tube removal.

1. Remove socket head cap screw, part #C26, from the drive end of the unit.

2. Use 1/2"-13 threaded rods (with nuts) screwed into the two tapped holes located at the drive end to jack out the tube.

3. Once the" "O" ring, part #C-2, is exposed at opposite the drive end of the cylinder, it should be possible to complete the tube removal by hand.

Reassembly:

It will now be necessary to prepare the unit for the installation of the tube. Do this by installing a new "O" ring, part #C-2, on the tube and lubricate it with soapy water. Next, clean all gasket surfaces and place a new gasket, #39, on tube using suitable gasket compound.

1. Slide the tube into the cylinder until the "O" ring, part #C-2, is just ready to enter the cylinder assembly. Rotate tube as necessary to align studs and hole.
2. Obtain three socket head cap screws of sufficient length and proper thread for use in pulling tube far enough into place to permit the use of the regular socket head screws.

3. Start pulling tube into place with these three cap screws. Be careful and guide tube into place at the drive end of the unit by hand. Also, have someone observing and correcting any pinching of the “O” ring as it enters the cylinder assembly.

4. When it is possible to use the regular socket head cap screws, do so and tighten screws in torque pattern to 50 ft/lb, and then retighten screws in torque pattern to 60 ft/lb.

WARNING

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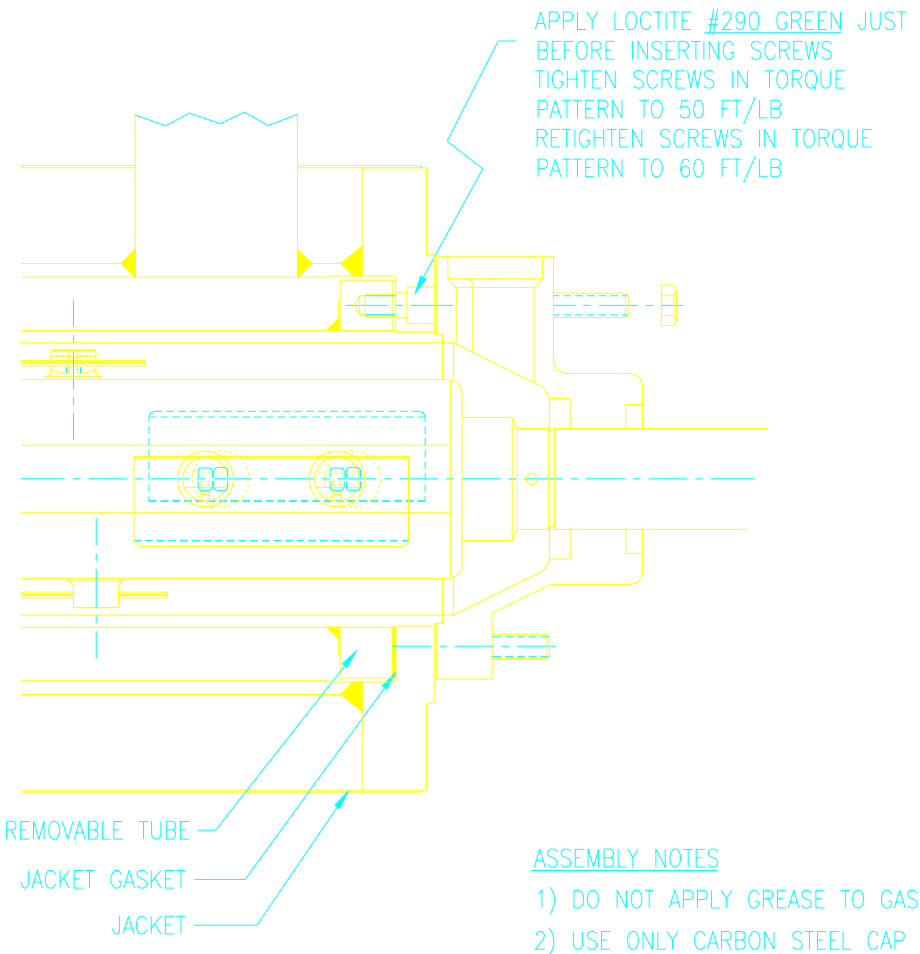
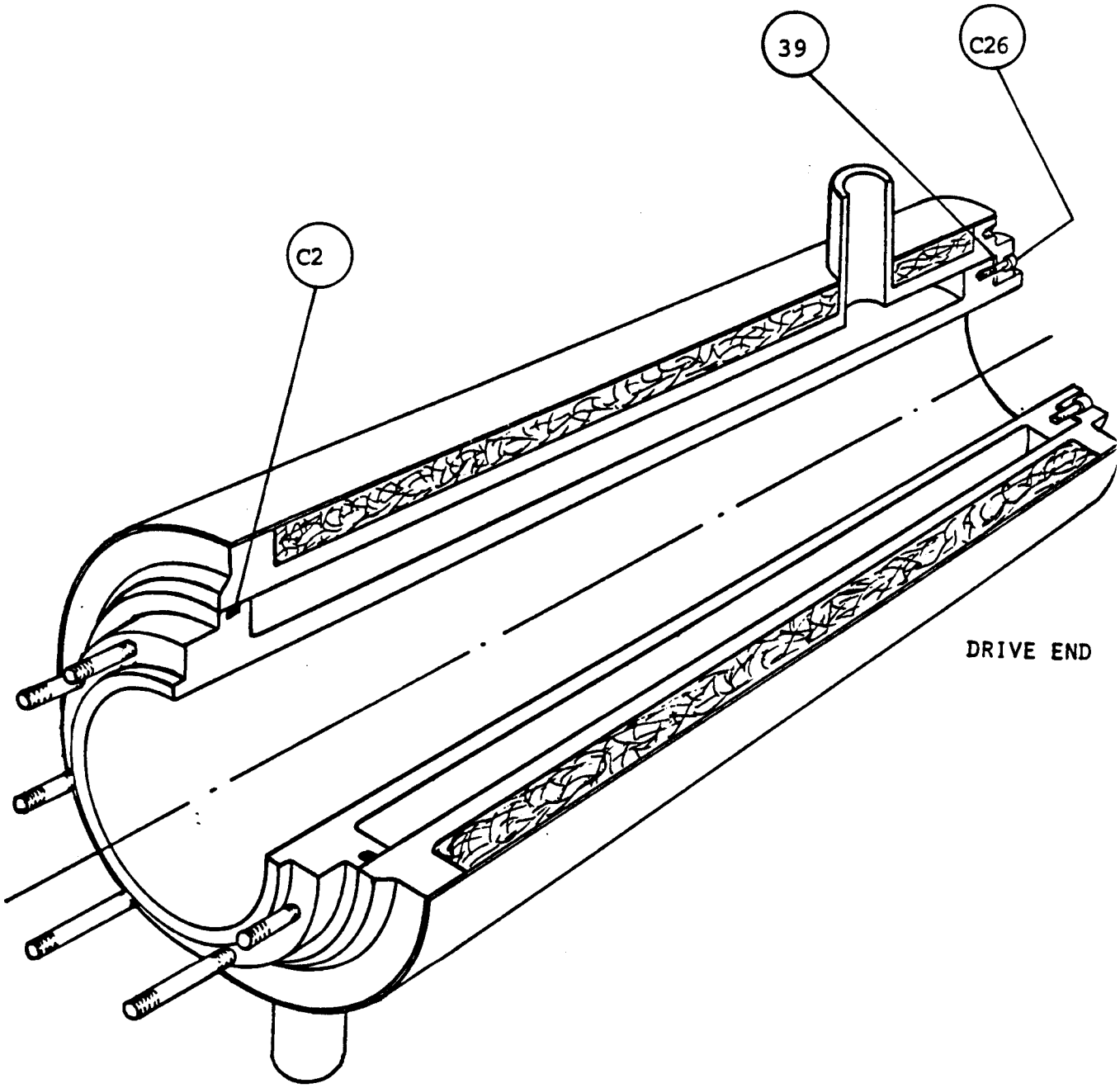


ASSEMBLY NOTES

1) DO NOT APPLY GREASE TO GASKET.
2) USE ONLY CARBON STEEL CAP HEAD SCREWS AS SPECIFIED IN THE BILL OF MATERIAL. NO SUBSTITUTIONS ALLOWED.

DISASSEMBLY & ASSEMBLY



HEAT TRANSFER TUBE REMOVAL

C. TUBE REMOVAL PROCEDURE OVAL

DISASSEMBLY: Heat Transfer Tube Removal

Note that design is somewhat different. Refer to the Cylinder Assembly Drawing for details of cylinder construction.

1. Remove product heads and shaft from unit.
2. Remove head studs from both ends of cylinder.
3. Remove split clamp ring (47) from opposite drive end of cylinder assembly.
4. Position tube puller.
5. Tighten hexagon nut of tube puller until tube is free of packing (C-41).
6. At this point tube should come out by hand. Perform servicing and/or cleaning.

REASSEMBLY:

1. Thoroughly clean "O" ring grooves in tube flanges.
2. Lubricate and replace "O" rings.
3. Insert tube with pins on opposite drive end flange on vertical. Slide tube into jacket until opposite drive end flange has just entered jacket opposite drive end flange housing. (Do not force entry at this point as damage can occur to "O" rings, C-2.) Hand support of tube at drive end will be necessary for tube to enter.
4. Remove spanner bracket from end of tube puller.
5. Insert tube puller in tube in reverse of removal position.
6. Install spanner bracket on tube puller of drive end of tube with short stubs against jacket housing.
7. Tighten hexagon nut slowly, making certain "O" rings remain in place. (Tube must be perfectly aligned with jacket while insertion is in progress.)
8. When pins are in proper position, remove tube puller and install split clamp ring.
9. Test jacket for leaks.
10. Reinstall head studs.
11. Replace shaft heads.

WARNING

To ensure employee safety and to avoid equipment damage, NEVER operate equipment without safety guards and interlocks properly installed!!

PUMPING EQUIPMENT

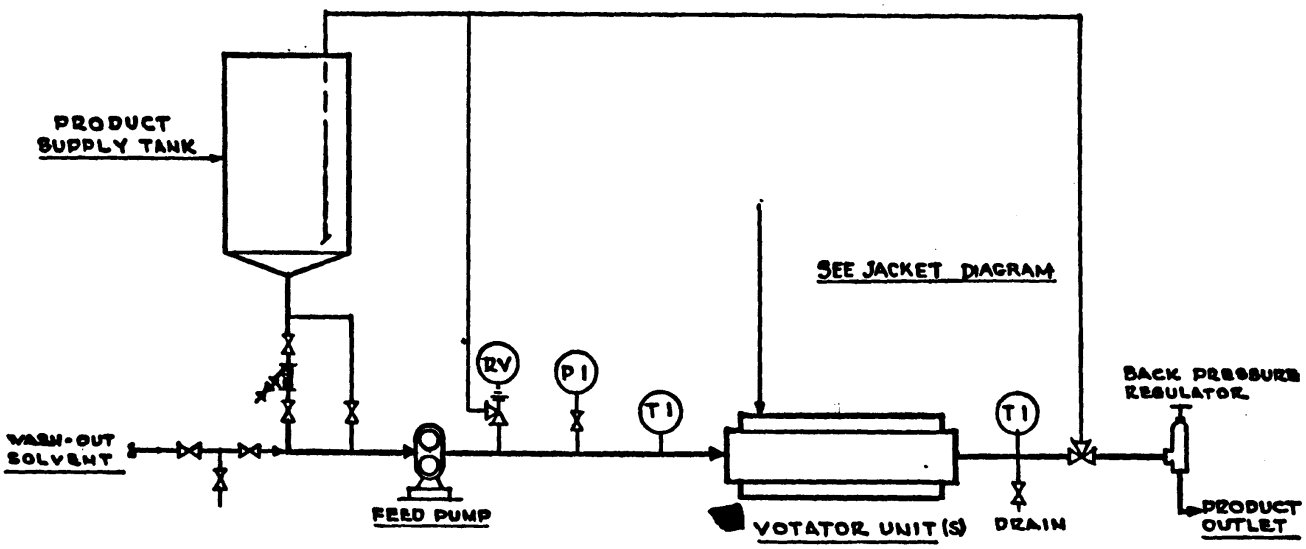
To obtain consistent results and maintain desired product quality it is mandatory that the product be delivered to the Votator® unit as a continuous, controllable rate. This requires the proper application of a pump capable of constant delivery of the product at elevated pressures. The pump should be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

Pumps used are either piston or rotary types. The piston pump is generally preferred if the product is such that it will allow the checking system to seat and seal. Rotary pumps do not exhibit true positive displacement characteristics, pumping against a constant discharge pressure is necessary to achieve a constant slippage and thereby a constant rate.

The pump and supply tank should be located reasonably close to the Votator® unit. The pump should be placed under the supply tank and connected 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.

The pump should always be protected by a safety relief valve in the discharge line. A pressure gauge should also be installed in this line.

PUMPING EQUIPMENT



TYPICAL PROCESSING ARRANGEMENT

VOTATOR DIVISION
CHEMETRON CORPORATION

2/65

CARE OF VOTATOR HEAT EXCHANGERS

Four simple rules for maintaining production efficiency:

1. Keep the scraper blades sharpened.
2. Keep scraped side of heat transfer tube smooth.
3. Keep the jacket side of tube clean.
4. Keep product seals in good repair.

CONTENTS OF THIS SECTION

A. CORRECT USE AND CARE OF BLADES

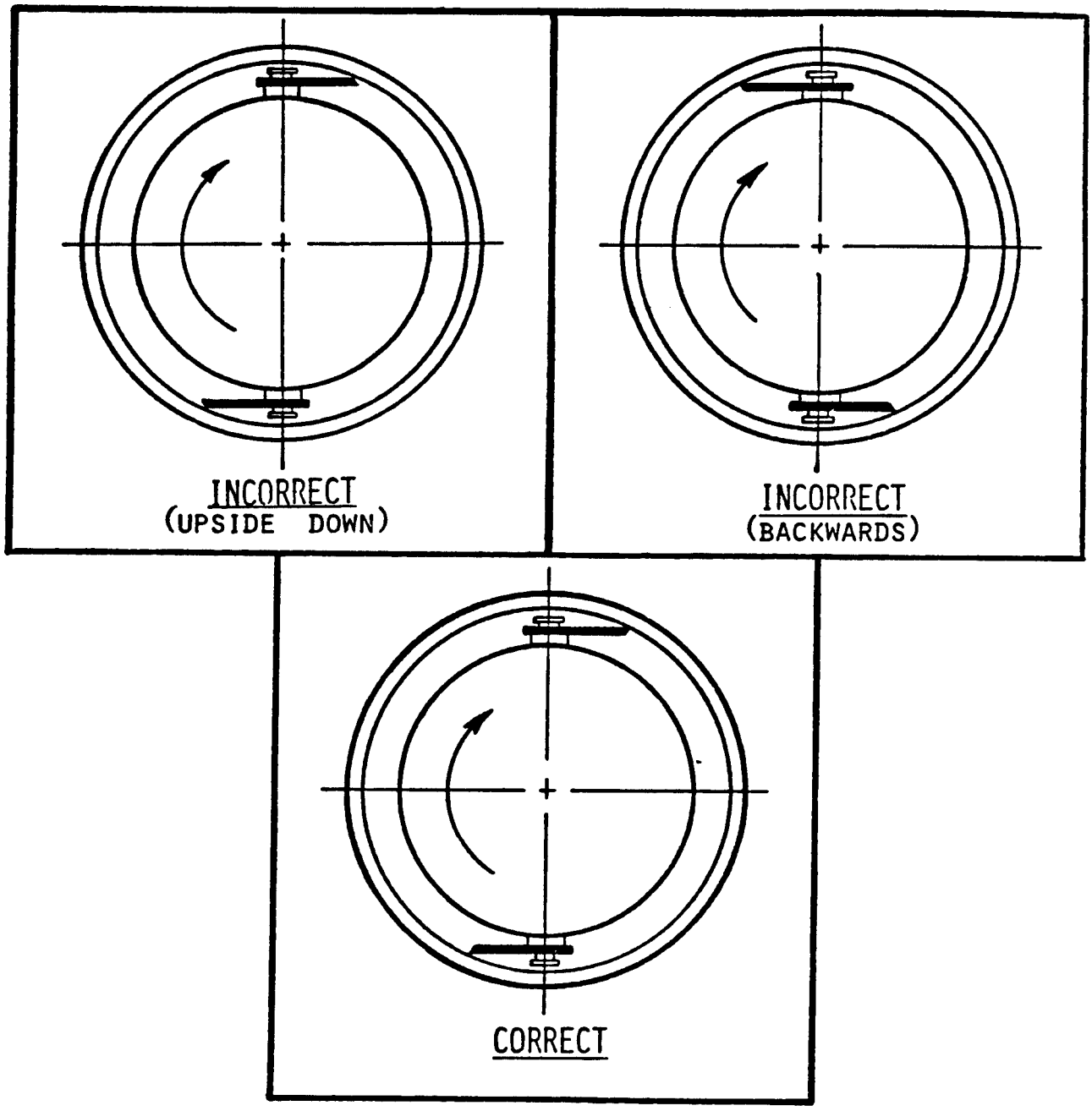
The scraper blades and heat transfer tube must be properly maintained to achieve continued maximum production. Abnormal blade and tube wear can be avoided.

CAUSES FOR UNNECESSARY BLADE AND CYLINDER WEAR

1. Scratching or gouging tube wall by FAILURE to use shaft skid.
2. Using blades other than those furnished by Waukesha Cherry-Burrell.
3. Dulling blades on tube end by careless shaft handling.
4. Careless assembly of blades, shafts, seals and heads.
5. Running shafts without product or product flow.
6. Starting shaft with stiffened or solidified product in cylinder.
7. Using blades after sharpening below minimum width specification.
8. Dull or improperly sharpened blades.
9. Causing excessive scraping pressure by unnecessary product pressure.
10. Causing blades to Skate instead of Scrape by insufficient product pressure.
11. Starting flow or jacket medium (Ammonia, Freon, Steam, Water, etc.) before establishing full product flow.
12. Failure to remove product from cylinder after every use.
13. Starting operation before completely dissolving such substances as salt, sugar, detergents, etc.
14. Use of wrong detergent or incorrect use of correct detergent.
15. Worn mutator shaft bearings.

USE THE FOLLOWING ILLUSTRATIONS FOR PROPER BLADE CARE.

CARE OF VOTATOR HEAT EXCHANGERS



ALL VIEWS FROM NON-DRIVEN END

CARE OF VOTATOR HEAT EXCHANGERS

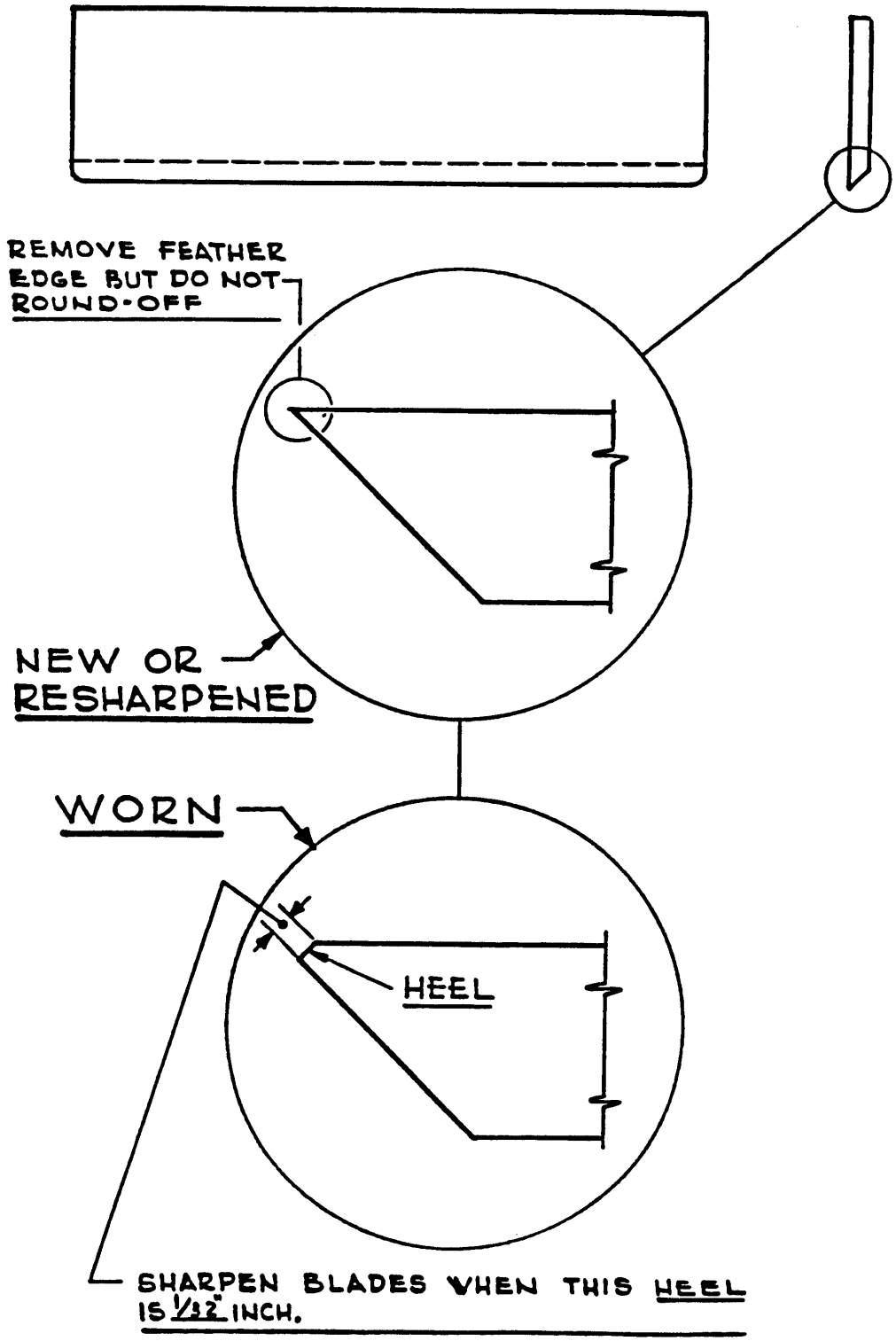
BLADE SHARPENING

It is recommended that blades be returned to the Louisville, Kentucky plant for resharpening. If this is not practical, this operation should be performed by a precision grinding concern experienced in similar sharpening requirements.

Metal blades are longitudinally surface ground utilizing an accurate fixture. It is important that the sharpened edge is absolutely parallel to the pin contacting surfaces. After grinding, the feather edge is removed by use of a stone or flattened, fine grit emery cloth. The corners contacting the tube wall are relieved. It is important the warping and/ or burning caused by too great a feed, lack of coolant or improper wheel, etc., be avoided. Nonmetallic blades are sharpened using a shaper or milling machine.

Improperly sharpened blades will, at best, provide less than optimum heat transfer and, at worst, can severely damage the tube wall.

CARE OF VOTATOR HEAT EXCHANGERS



VOTATOR DIVISION
CHEMETRON CORPORATION

7/963

VM-11

CARE OF VOTATOR HEAT EXCHANGERS

B. CARE OF HEAT TRANSFER TUBE - PRODUCT SIDE

1. Causes for unnecessary tube wear
   a. Scratching or gouging tube wall by failure to use shaft skid.
   b. Careless assembly and installation of blades,
   c. Running shafts without product or product flow.
   d. Use of wrong detergent or incorrect use of detergent.
   e. Starting shafts against stiffened or solidified product in cylinders.
   f. Starting flow of jacket medium (Ammonia, Freon, Steam, Water, etc.) before establishing full product flow under operating pressure.
   g. Failure to clear cylinders of product after every use.
   h. Starting operation before dissolving particles such as salt, sugar, detergents, etc.
   i. Using blades after sharpening below minimum width specification.
   j. Using blades other than those furnished by Waukesha Cherry-Burrell.
   k. Using excessive sharpening pressure by unnecessary product pressure.
   l. Worn mutator shaft bearings.
   m. Review causes for blade wear.

2. Chrome Plated Tube
   When the surface of plating is damaged, there is only one repair method. The tube must be re-chromed.

3. Non-plated Tube
   At each inspection of the scraper blades, the product contacting surface should be carefully inspected for gouges, scoring rings and roughness and small shallow score marks may be honed out and polished manually using a hone.

C. CARE OF HEAT TRANSFER TUBE - JACKET SIDE

1. Steam, Water or Brine
   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. Removal of the tube from the cylinder assembly and mechanically cleaning the jacket side surface with a wire brush and/or emery cloth is recommended. The frequency of this cleaning procedure will vary greatly from one installation to another. Past experience with similar problems and records of the Votator® unit's performance will be your best guide. The period between cleanings may be from six months or less to several years.

2. Refrigerant
   Since it is practically impossible to completely prevent compressor oil carry-over and because the Votator® heat exchanger operated on the flooded system or direct refrigerant "boil off," the jacket side tube surface will eventually become fouled with compressor oil and sludge. The severity and rapidity of the fouling (insulating film buildup) depends entirely on how much or how little compressor oil is "thrown" into the refrigerant by the compressor and the cleanliness of the entire refrigerant system. The unit cooling capacity fall-off necessitates cleaning of the jacket side tube surface. The cleaning frequency depends on how efficiently compressor oil is separated from the refrigerant. However, at least once every 12 to 18 months the tube should be removed for cleaning. Longer periods between cleaning will make the film and dirt removal more difficult because, with time, this film becomes polymerized and tough.

CARE OF VOTATOR HEAT EXCHANGERS

D. CORRECT USE AND CARE OF ROTARY SEALS

The Votator® rotary seals have only one job: To prevent product from coming through the Votator® heads around the spinning mutator shaft stubs. There are only three (3) possible product escape or leak routes. To escape or leak the product must go through or by at these points:

1. Between lapped or polished faces of the seal body and the seal insert.
2. Past or around "O" ring between head and head seal insert.
3. Past or around "O" ring between mutator shaft stub and seal body.

There are several reasons why leakage occurs: However, each of these reasons can be avoided or corrected to prevent and/or stop seal leakage. For this purpose refer to SEAL LEAKS: CAUSES AND REMEDIES, and the seal assembly instructions on the following pages.

CARE OF VOTATOR HEAT EXCHANGERS

ROTARY SEAL LEAKS:
CAUSES AND REMEDIES
Seal Body and Seal Insert

These are the most pertinent portions of all rotary seals. Leakless operations results because and when:

1. The running surfaces are precision lapped or polished.

2. The running surfaces are absolutely flat.

3. The running surfaces are held absolutely parallel.

4. The pressure holding the running surfaces together is sufficient, but not excessive.

The following are the most prevalent causes and remedies for product leakage.

CAUSE	REMEDY
Votator® head drawn-up evenly onto tube end.	Remove, inspect, clean, replace and draw up evenly by crisscross tightening of bolts or wing nuts little at a time.
Seal Body and/or Seal Faces worn or damaged.	Replace. Contact the Louisville plant for repairing feasibility.
Seal Insert cocked when installed.	Remove and reinstall making sure insert “O” ring is not twisted. See insert “O” ring below.
Seal Insert cracked.	Replace.
Seal Insert face and shoulder worn.	Replace with new seal insert.
Seal springs weakened.	Rebend or replace.
Seal Backing Ring deformed.	Replace with new Backing Ring.
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 pieces and reassemble.

CARE OF VOTATOR HEAT EXCHANGERS

CAUSE	REMEDY
Seal Body and Seal Insert mismatched.	Always replace Seal Body against the Seal Insert it has been running with until new parts replacement is necessary.
Seal Drive Pin Worn or missing.	Replace with new seal driving pin.
Seal Retaining Ring out of place.	Replace in groove or replace with new "O" ring.
Insufficient spring pressure to hold Body and Insert together after several hours of a daily run.	Replace weakened springs. For adding additional springs contact the Louisville Plant.
Seal body and/or Seal Insert damaged by rough handling: dropping slamming, tossing, careless storage etc.	Always lay seal faces on clean, soft cloth. Move mutator shaft into position gently. DO NOT slam it "home".
New or repaired Seal Body installed against worn or damaged Seal Insert and vice versa.	One good seal face against a worn or damaged face will not work.
Mutator shaft not being fully drawn and locked into operating position.	Tighten shaft locking nut, collar, or bolt after each assembly.
Excessive wear of Seal Body and/or Seal Insert.	Do not operate shaft without product flow. These are not gas seals. They operate on liquids only. Excessive spring pressure.

CARE OF VOTATOR HEAT EXCHANGERS

Seal Insert “O” Ring”

CAUSE	REMEDY
Twisted when Installed.	Lubricate before installing (Edible Lubricant)
Wrong size, distorted, deformed or cut.	Replace with new “O” ring
Wrong “O” ring compound	Replace with specified “O” ring
Damaged Seal Insert Cylinder	Replace with new or undamaged seal insert
Obstruction or dirt in Head Recess for Seal Insert	Clean Recess
Head Recess for Seal Insert damaged	Contact the Louisville Plant about repairing.

Seal Body “O” Ring

CAUSE	REMEDY
Twisted when Installed.	Lubricate before installing
Wrong “O” ring compound	Replace with specified “O” ring
Wrong size, distorted, deformed or cut	Replace with new “O” ring
Damaged Seal Body	Replace Seal Body
Damaged Seal Backing Ring	Replace Seal Backing Ring
Damage on shaft at “O” ring sealing area	Contact the Louisville Plant about repairs.
Obstruction on shaft stub (uncleaned shaft)	Remove obstruction, clean and lubricate shaft prior to seal body installation.
Same as above in Seal Body Recess for “O” ring and Seal Backing Ring	Remove obstruction, clean and lubricate recess prior to seal body installation.

CARE OF VOTATOR HEAT EXCHANGERS

E. CORRECT USE AND CARE OF PACKING

To obtain optimum performance, packing rings must be run-in very slowly. Improper run-in will cause the rings to overheat, char and possibly damage the shaft sleeve. The cylinder assembly drawing illustrates the arrangement of the packing gland.

Run-in procedure

At the initial start-up of the unit, or at any other time when new packing rings have been installed, the following run-in procedure is suggested.

1. Before starting unit, loosen gland retainer and follower so that the packing rings are under no load.
2. If possible, block the seal flushing outlet and allow the flushing medium to leak into the product space of the unit. As an alternate, pass a high rate of flushing medium through the packing gland. In either case, some leakage of the flushing medium will occur.
3. Approximately 40 hours operating time is recommended to run-in and seat the packing rings. Do not hasten this process. From time to time, as the unit is running, take up on the gland retainer and follower. The packing should leak during this run-in.
4. After the run-in period is complete, adjust the flushing medium flow rate as required for packing lubrication. Dry packing tends to overheat, burn and score the shaft sleeve.
5. Do not pull down retainer and follower any more than necessary to seal shaft. To prolong packing life, a small amount of seal leakage should be allowed to assure adequate packing lubrication.

Repacking is most easily accomplished when the unit is dismantled for an inspection. It is suggested that the packing be replaced on a periodic schedule rather than waiting until excessive leakage forces a shutdown.

GENERAL MAINTENANCE
OPERATIONAL CHECKS

This equipment contains rotating, rolling, rubbing and reciprocating parts. How frequently they must be repaired or replaced depends on the thoroughness of regular periodic cleaning, inspection and lubrication. Frequency of performing preventative maintenance is dictated by the process, the operating conditions and the local sanitation codes. Use the following Tables I and 11 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 Votator® processing unit and not by some other process component.
2. Determine if the process pump(s) are operating or being operated correctly.
3. Determine whether Votator® unit is being adequately supplied with the necessary utilities (electricity, refrigeration, air, etc.)
4. Determine whether the duty imposed is that for which unit was originally rated.
5. Check if daily start and stop procedures are correctly followed.
6. Make sure all instruments and controls are functioning properly. (“telling the truth”)
7. Does trouble exist on all working shifts, with all unit operators?
8. Excessive wear: Excessive wear and damage of parts usually results when unit is operated beyond requirements specified at time of purchase. Before operating unit outside specified limits, contact the Louisville plant.

GENERAL MAINTENANCE
OPERATIONAL CHECKS

Table 1 - Operational Trouble Shooting

TROUBLE	CAUSE	REMEDY
Loss of Unit Performance or Capacity	Product "IN" temperature high/low	Pre-cool or heat to normal
	Product pump rate too high	Reduce to specified rate
	Scored or rough heat transfer tube	See Section VII. B.
	Blades dull or worn out	See Blade Instructions
	Blades: upside down; backward	Install correctly
	Insufficient supply of liquid refrigerant	Consult refrigeration engineer
	Refrigerant valving inoperative	Consult manufacturer's bulletins
	Variation of refrigerant evaporator temperature	Check low side gases, low compressor capacity possible
	Insufficient supply or incorrect temperature of liquid heat transfer medium.	Correct source of supply
	Insufficient supply or low quality steam	Correct source of supply
Motor Overloading	Process flow rate too low	Increase process 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 drive shaft or motor bearings	Replace bearings
	Jacket temperature too low	Increase temperature

GENERAL MAINTENANCE
OPERATIONAL CHECKS

Table 1 - Continued

TROUBLE	CAUSE	REMEDY
Excessive Vibration	Loose adjustable feet	Tighten lock nuts
	Worn motor bearings	Replace worn bearings
	Worn drive shaft bearings	Replace worn bearings
	Worn bearings at opposite drive end mutator shaft	Replace worn bearings
	Motor loose on its mount	Tighten motor anchor bolts

Table 11- Periodic Servicing And Inspection

INSPECTION FOR SERVICE	FREQUENCY
Removal of mutator shaft to inspect scraper blades, shaft seal parts and heat transfer tube surface	Bimonthly - more frequently depending upon sanitation requirement
Check spare parts stock vs. Spare Parts List	Quarterly or as needed
Change of gear box oil	See Lubrication Section
Lubrication of all points having grease fittings	Quarterly or as needed
Complete dismantling of unit for general inspection	Annually

LUBRICATION

A. MUTATOR SHAFT BEARING

Use the highest quality neutral mineral bearing grease. Do not over-lubricate. Excessively packed bearings will run hot and fail prematurely.

Frequency of lubrication will depend upon operating conditions. If the bearing, runs in a clean, dry atmosphere, bimonthly greasing should suffice. If subjected to high moisture and direct splashing, the bearing should be greased weekly.

B. MOTOR BEARING

Follow the manufacturer's recommendations.

C. GEAR REDUCER

Follow the manufacturer's recommendations.

CLEANING & SANITIZING VOTATOR HEAT EXCHANGERS

Please do not construe the following as anything but suggestions, recommendations and guides regarding the cleaning and sanitizing of all types of Votator® 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 and up, there is no substitute for cleaning by flushing with cool, clean, potable water, disassembly and manual scrubbing at least once a week.
3. The cleaning procedure and the detergent efficiency depend on the following factors:
   a. Time allotted for cleaning solutions to do the job.
   b. Temperature of cleaning solutions while doing the job.
   c. Turbulence of cleaning solution while being pumped through or recycled through equipment being cleaned.
   d. Detergent Concentration and Composition: This is dictated by nature of the soil to be removed and the surface from which the soil must be removed. In short, the detergent or detergents must remove the soil without impairing the equipment.
   e. 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 drop-out and/or coating of surfaces due to the 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 material may produce a brown deposit plus weaken the detergent strength. Ideally, the water should be soft or softened.

The following is a suggested guide for developing an in-place cleaning procedure for Votator® heat exchangers.

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 Votator® heat exchanger is diverted from production, cleaning period starts.
3. Continue to flush equipment with clean water prior to introducing cleaning solution.
4. If product supply tank is going to be used as a detergent supply tank, it must be washed down to eliminate contamination of 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 Votator® 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 (gal./min.) 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 for moving solution through the systems to be cleaned at 25 to 35 gpm (approximately).

CLEANING & SANITIZING VOTATOR HEAT EXCHANGERS

7. The duration of 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.
9. It is not always necessary to drain this flushing water from units.
10. 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.
11. Mutator Shafts: To minimize blade and tube wear, do not spin the shaft continuously throughout the flushing, cleaning and rinsing operations. However, they should be spun periodically to dislodge soil. How frequently shaft should be turned on and off (jogged) during this operation is best determined by trail and inspection.
12. Reversing Mutator Shafts: Reversing of mutator shafts is a valuable adjunct to cleaning. It accomplishes the following:
    a. It is an effective method for removing product which tends to adhere or drape around mutator pins and blades.
    b. Allow running of shafts throughout cleaning operation.
    c. Additional turbulence is created by driving blunt trailing edge of blade through cleaning medium, thus helping to reduce amount of cleaning time necessary.

Once a week, the equipment must be completely disassembled, manually cleaned, thoroughly inspected, maintenanced and reassembled. Once a week disassembly for cleaning offers an excellent opportunity to practice preventative maintenance and maintaining an adequate spare parts supply (especially shaft blade sets).

DETERGENT REQUIREMENTS

1. Burn-on resulting from cooking protein (vegetables, starches, dairy products, etc.) usually requires a dual cleaning treatment - flush, alkali wash, flush, acid wash, flush.
2. Burn-on resulting from cooking acidic foods will usually yield to an alkali.
3. Detergent must be thoroughly soluble and thoroughly dissolved to prevent damage to running parts.
4. Detergent 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. In other words, guard against "If one pound does well, two pounds will do better", "If hot is good, hotter is better."
6. Heating detergent solution with steam jacketed Votator® heat exchangers must be avoided unless automatic control of jacket steam is provided.

NOTE

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