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FIBERPREP CONTINIOUS SCAVENGER
MODEL NUMBER: SJC-2
SERIAL NUMBER: SJC-167

CUSTOMER PURCHASE ORDER NUMBER: 48538
FIBERPREP JOB NUMBER: 5074

FIBERPREP

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INSTALLATION, OPERATION AND

MAINTENANCE

MANUAL

CONTINUOUS SCAVENGER

12/2/92

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GENERAL INFORMATION

INTRODUCTION

The Fiberprep/Lamort Continuous-Type Scavenger is an auxiliary combination Pulper and Junker, which continuously removes both light and heavy contaminants and trash, when installed with most Continuous Pulpers. The Scavenger improves over-all defibering efficiency, furnishes cleaner stock, and reduces the work required in downstream processing steps. A Scavenger may be used to clean a single Pulper, or in some cases, a single unit may be used to clean two Pulpers. (In this case, the Scavenger would be fitted with two inlet connections and designated as a Dual Scavenger.) Figure 1 shows a typical installation of a Scavenger and a Pulper.

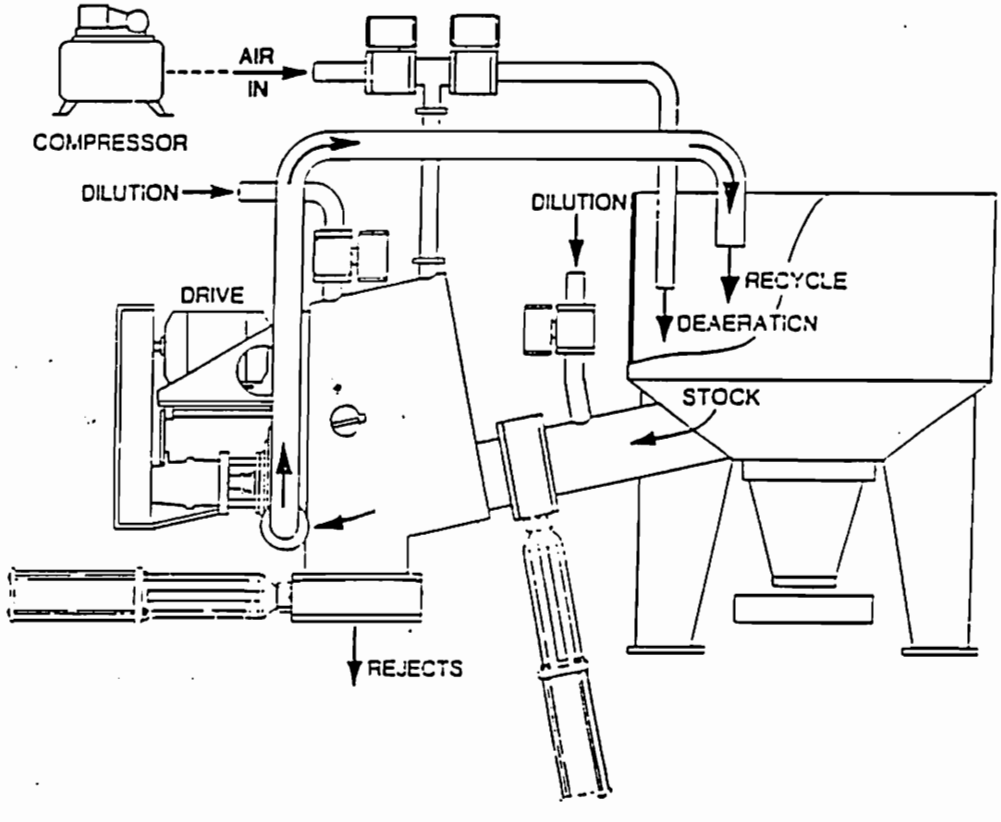

Figure 1. Typical Installation

GENERAL INFORMATION - CONTINUOUS SCAVENGER

SCOPE OF THIS HANDBOOK

This handbook provides installation, operation, and maintenance instructions for the Scavenger. It also includes a schedule of recommended maintenance procedures, which, if adhered to, will prevent or significantly reduce the incidence of breakdowns or failures, minimizing production interruptions. A parts list lists all parts of maintenance significance and identifies those parts recommended for spares. For the user's convenience, all foldout drawings are included at the end of the handbook rather than being interspersed within the text at the point of first reference.

PHYSICAL DESCRIPTION

The Scavenger is available in three (3) sizes, which are designated as Models I, II, and III.

The Scavenger consists of a tub, rotor assembly with drive belts and pulleys, an air blower, six pneumatically operated valves, and may come equipped with a control panel and/or a conveyor for reject transport. For a Dual Scavenger four additional pneumatically operated valves are required.

The tub is a cylindrical stainless steel weldment mounted with its axis twelve (12) degrees to the horizontal to match the reject outlet of the main Pulper with which the Scavenger is used. On a

PHYSICAL DESCRIPTION (CONTINUED)

Scavenger used to clean a single Pulper, there are six openings into the tub. They are the stock inlet, the reject discharge, rotor assembly installation, dilution washing inlet, air inlet/deaeration outlet, and inspection hatch. For a Dual Scavenger, serving to clean two Pulpers, an additional stock inlet connection is added.

The rotor assembly consists of a rotor which rotates inside a housing secured to the tub. Cutters on the outer face of the rotor, which projects into the tub, serve to provide stock deflaking; Vanes, on its inner face, draw the good fiber through a small annular passage formed by the rotor shroud and the rotor, and pump this fiber out of the rotor housing and back to the main Pulper through piping provided by the customer.

The blower, if provided, is a conventional blower which supplies air to the tub to evacuate liquid from the Scavenger prior to dumping rejects.

Motors required to operate the Scavenger are a Scavenger drive motor and a blower motor. A third motor, the conveyor (or other reject handling device) drive motor, is required if a conveyor is employed to transport rejects away from the unit.

PHYSICAL DESCRIPTION (CONTINUED)

For a Scavenger used to clean a single Pulper, six (6) pneumatically operated valves are used to operate the Scavenger. They are:

(V1) Stock Flow - Isolate Scavenger & Pulper

(V2) Reject - Dump Scavenger Reject

(V3) Fill/Wash - Fill Scavenger Tub & Wash Rejects to recover good fiber

(V4) Blower Air - Supply air to Scavenger to evacuate water before dumpings reject

(V5) Vent - Allow air to vent from Scavenger

(V6) V1 Flush - Supply dilution to prevent plugging of the feed pipe between the Pulper and (V1)

For a Dual Scavenger, there are two (V1) Valves (V1A & V1B), and two (V6) Valves (V6A & V6B) for each respective Pulper. Also, two additional Valves to direct Scavenger accepts to either Pulper, V8A & V8B, are required. If Valves for your Scavenger were purchased from Fiberprep, the valve descriptions, drawings, maintenance instructions, and parts lists are included in this manual.

There are four limit switches which are operated by the stock and reject valves to provide feedback for control of the Scavenger, and to prevent accidental opening of the Reject Valve (V2), and the Stock Flow Valve (V1) at the same time. These switches are as follows:

PHYSICAL DESCRIPTION (CONTINUED)

LS1 - TRIPS WHEN STOCK VALVE (V1) CLOSES

LS2 - TRIPS WHEN STOCK VALVE (V1) OPENS

LS3 - TRIPS WHEN REJECT VALVE (V2) CLOSES

LS4 - TRIPS WHEN REJECT VALVE (V2) IS NOT CLOSED (PNEUMATIC)

Valve schematics are included in drawings DSJC - 1102 for a Scavenger operating on a single Pulper, or if you have a Dual Scavenger for operation on two (2) Pulpers DSJC - 1103.

If you have purchased valves from Fiberprep, these limit switches will come pre-mounted to V1 and V2.

If you have purchased a control panel to control sequencing of the Scavenger from Fiberprep, you will have a complete Scavenger Control Panel Operating Manual. Please refer to this manual for details of control panel operation.

INSTALLATION

SYSTEM CONSIDERATIONS

The Scavenger is available in sizes suitable for all pulpers of up to 2650 cubic feet capacity; it requires relatively little floor space and is easily adaptable to installation on virtually all existing pulpers - vertical and horizontal, continuous and batch.

UTILITY REQUIREMENTS

Electrical power of 440 volts, 60 cycles, 3 phases, is required for the rotor drive motor and the compressor motor.

A supply of white water at 10 psi maximum is required for diluting and washing the stock. Volume requirements vary with size of Scavenger as follows:

Size I - 200-300 GPM
Size II - 300-400 GPM
Size III - 400-500 GPM

Clear water at 25 psi for lubricating the packing in the stuffing box gland is also required. If control valves are supplied by Fiberprep, they will require an 80 psi instrument air supply for operation. A suitable filter regulator/lubrication and shut-off valve should be installed ahead of the valve operators.

PIPING

Piping between the outlet of the main pulper and the stock valve of the Scavenger should be as short as possible and with downward slope to insure "heavies" do not settle out. (12 degrees slope is suggested.)

PIPING (CONTINUED)

Piping from the rotor housing outlet to the main pulper (recycle line), from the air inlet/deaeration outlet connection at the top of the Scavenger to the blower and pulper (deaeration line), and from the dilution washing inlet at the top of the Scavenger and the auxiliary dilution connection in the feed pipe to the white water source is to be made in accordance with the installation drawing. Note that the deaeration line must be located at least 24 inches above the recycle line. A check valve must be installed in the piping from the blower to prevent water from entering blower.

Pneumatic piping to the valves is to be made in accordance with good standard practice for such piping. A suitable filter-regulator/lubricator and a shut-off valve should be installed ahead of the valves.

MOUNTING

The Scavenger can be mounted with the motor mount supported from the floor and/or suspended from the ceiling (See Installation Drawing). In either case, the floor or the ceiling should be so constructed that no vibration will occur when the Scavenger is

MOUNTING (CONTINUED)

operating. The mounting dimensions of the Scavenger are shown on the Installation drawing. A free space (See **INSTALLATION DRAWING)** must be provided at the drive end of the Scavenger so that the rotor assembly can be removed. (See **Corrective Maintenance** chapter).

The blower must be installed in an area that is free of water and stock. It should be mounted to a firm foundation so that it does not vibrate during operation. Use of shop compressed air is not recommended. The system must be designed so pressure never exceeds 15 psi.

CAUTION: CARE MUST BE TAKEN IN DESIGN OF THE SYSTEM TO PREVENT OVER PRESSURIZING OF THE SCAVENGER. OVER PRESSURIZATION MAY VOID YOUR WARRANTY. Maximum Allowable Case Pressure = 15 PSIG.

The control panel can be mounted on any suitable vertical structure near the Scavenger.

The **minimum clearance** recommended for underneath the Scavenger is **48 inches** as measured from the flow to the bottom side of the reject valve. This typically provides sufficient space for any of the methods for reject handling - hopper, belt conveyor, bucket conveyor or compactor, (ram press). Figure 2 shows a typical bucket conveyor arrangement.

INSTALLATION - CONTINUOUS SCAVENGER

SAFETY NOTE!!

Auxiliary equipment is required to complete the installation for the Scavenger. This equipment may include valves, conveyors, and other items. This auxiliary equipment may or may not be supplied by Fiberprep. Installers and users must be aware that safety in the installation of these auxiliary components is extremely important. Therefore, it is the user's responsibility to make certain that such auxiliary equipment, whether supplied by Fiberprep or others, is properly guarded to assure the safety of workers. This is particularly important with regard to conveyors. Often, conveyors are placed in limited space and, when the bucket is in the raised position or in an alternate position, the hazard may not be apparent. In these cases, users are advised to make certain that adequate guarding is provided to prevent accidental injury.

TYPICAL AUXILIARY APPLICATIONS

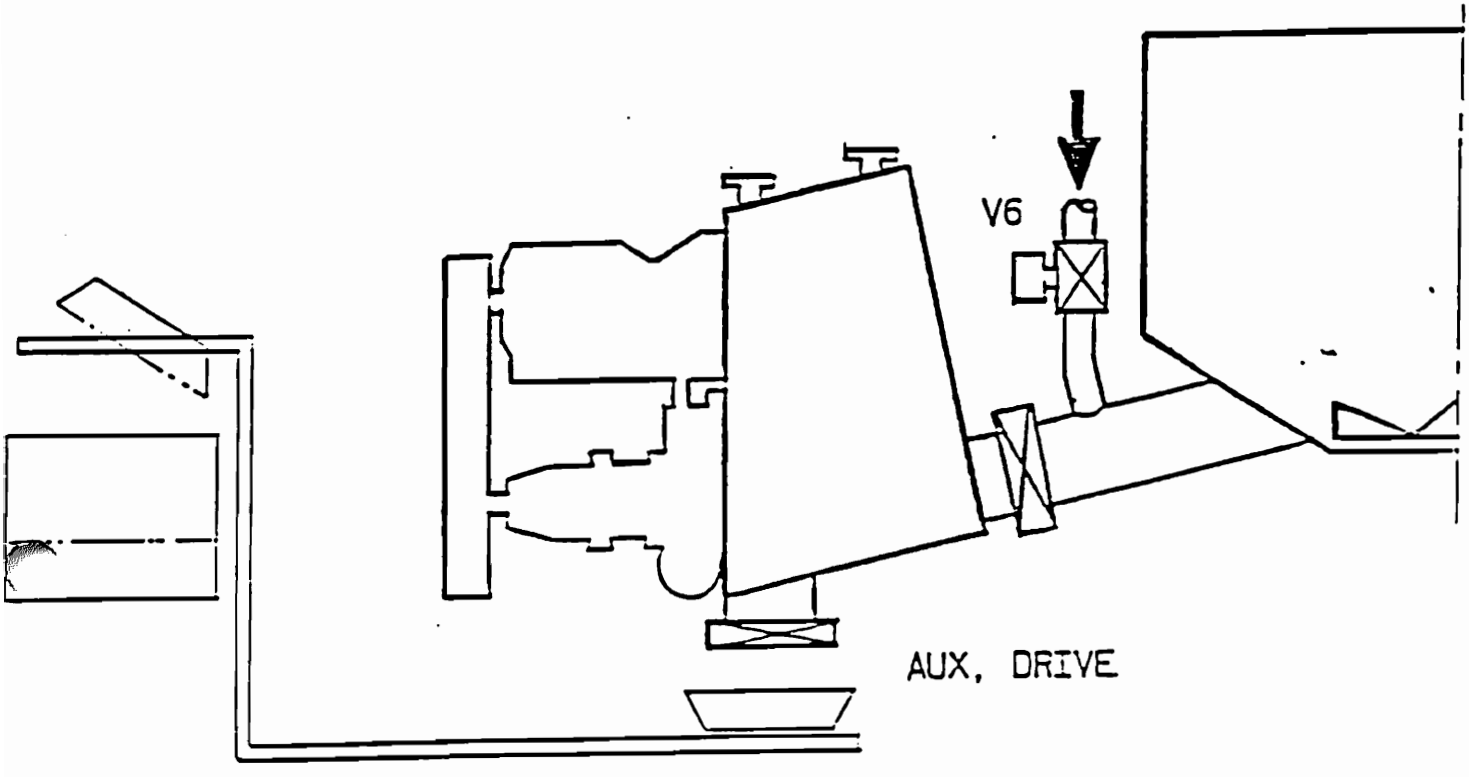

Figure 2. Typical Auxiliary Application, contact Fiberprep for bucket conveyor system.

INTRODUCTION

The Scavenger requires little or no operator action during operation other than startup, monitoring, and shutdown. During the run and following large variations in system stock feed, it may be necessary to readjust the timers. Figure 3 is a table of operation for the Scavenger, which shows the positions of the valves and operating conditions of the motors for the various phases of the cycle.

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TABLE OF OPEATION

STEP	DESCRIPTION	V1	V2	V3	V4	V5	V6	M1	M2
0	STANDBY	C	O	C	C	O	C	OFF	OFF
1	CYCLE START	C	C	C	C	O	C	OFF	OFF
2	SCAVENGER FILL	C	C	O	C	O	C	OFF	OFF
3	STOCK FLOW	O	C	C	C	O	O*	ON	OFF
4	SCAVENGER WASH	C	C	O	C	O	C	ON	OFF
5	AIR DRY REJECTS	C	C	C	O	C	C	ON	ON
6	REJECT	C	O	C	C	O	C	OFF	OFF

* – V6 IS OPENED ONLY DURING THE OPENING AND CLOSING OF V1.

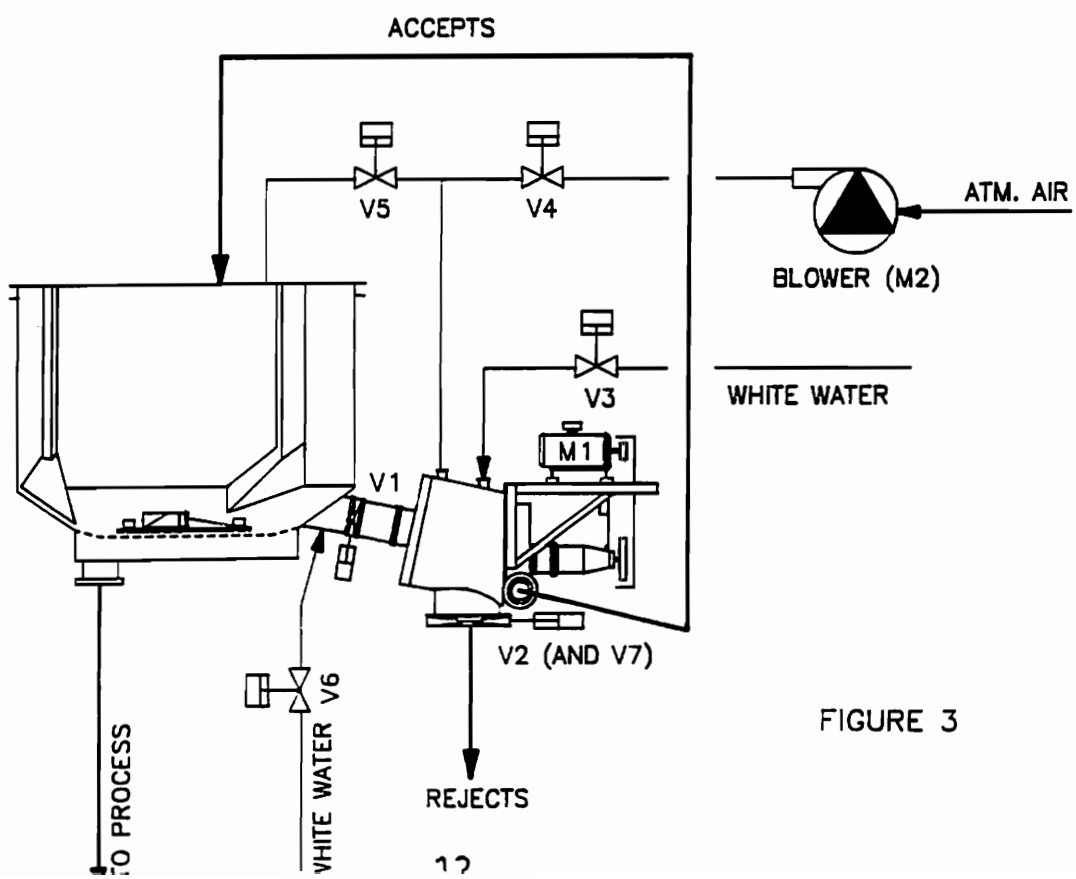


FIGURE 3

OPERATION - CONTINUOUS SCAVENGER

PRESTART CHECK

Before starting the Scavenger for the first time, make the following checks to be sure that the installation is complete and that the unit is ready for operation.

1. Check that bearings are properly lubricated.
2. Check that pulleys rotate counterclockwise when facing drive end of Scavenger.
3. Check belt tension. (See **PREVENTIVE MAINTENANCE** chapter).
4. Turn on clear water supply to stuffing box and check tightness of packing gland. There must be some leakage from gland to assure proper lubrication of packing. After Scavenger has run for several hours, it will be necessary to adjust gland to allow for initial wear-in and seating of packing.

FUNCTIONAL DESCRIPTION

Contaminants, (plastic, polyethylene, heavyweights, etc.) are always present in varying quantities in the main Pulper tub. The extraction plate becomes obstructed with these contaminants, resulting in a reduction of flow and Pulper capacity.

To eliminate this problem, the Scavenger operates on an entirely automatic cycle to continuously unload the Pulper of these contaminants. This automatic cycle is described below.

NORMAL SCAVENGER OPERATION

The Continuous Scavenger is controlled by a PLC, which is programmed to recognize inputs from limit switches on the on/off valves and the operation of several timers to control the outputs and the control logic sequence. The PLC is programmed in a sequence (or step-like) logic which organizes the sequence of events which are to occur during a specific step. The specific details of the PLC operation, as well as the design of the control panel, are provided in the section **CONTROL PANEL DESCRIPTION** which is included at the end of this manual if a control panel is being supplied with the Scavenger.

NORMAL SCAVENGER OPERATION (continued)

The following is a description of the Scavenger operation. The following valve designations will be used in the description:

V1	-	Stock Flow Valve
V2	-	Scavenger Reject Valve
V3	-	Scavenger Fill/Wash Valve
V4	-	Air/Drying Valve
V5	-	Vent Valve
V6	-	V1 Flush Valve
V7	-	V2 Air Supply-Pneumatic Safety Switch
V8	-	(A or B) Scavenger Accepts Valve (dual pulper system only)

Step 0 - Standby

The Scavenger is not operating. The following valves are closed: V1, V3, V4, V6, V7. The following valves are open: V2, V5, V8 (A or B - dual system only).

Step 1 - Cycle Start, Close V2

1.1 The reject valve, V2, closes and must close the contacts on the V2 closed limit switch, LS3. Positive feedback from LS3 will permit the cycle to continue. In order to close V2, it is necessary to energize both V7 to supply air to V2 and the V2 close solenoid to supply air to close V2.

1.2 Should the limit switch on V2, LS3, not be met, the cycle will freeze at that position and an alarm will indicate to the operator that V2 has not closed. Typically, a timer is used to provide the alarm contact should sufficient time pass without LS3 being met. Normally, it takes 20-30 seconds for V2 to move to the closed position.

NORMAL SCAVENGER OPERATION (continued)

Step 2 - Scavenger Fill

2.1 With feedback from LS3, the Scavenger fill/wash valve, V3, opens and the fill timer starts. The fill timer runs long enough to insure that the Scavenger is full of water. This is important to minimize operating problems when the stock valve opens. It is not recommended to start stock flow to the Scavenger without filling the Scavenger first.

2.2 When the fill timer times out, V3 is closed and the cycle advances.

Step 3 - Stock Flow

3.1 Following the fill step, the stock flow valve, V1, is told to open. As V1 leaves its seat and the V1 close limit switch, LS1, is no longer met, the Scavenger drive starts. Since the Scavenger rotating assembly has a pumping effect, it is preferred not to start the Scavenger until V1 has moved to avoid pumping the water out of the Scavenger before stock is introduced.

NORMAL SCAVENGER OPERATION (continued)

3.2 As V1 is told to open, the V1 flush valve, V6, opens to help wash any debris away from the inlet side of V1. Typically, V6 is open for 10-15 seconds or until V1 reaches its open position (whichever is less).

3.3 When V1 reaches its open position, and limit switch LS2 is met, the stock flow timer starts.

3.4 When the stock flow timer times out, V1 is told to close. As V1 is closing, the V1 flush valve, V6, opens to flush debris away from the seat of V1. When the V1 closed limit switch, LS1, is met, the cycle is allowed to continue. If LS1 has not been met after a period of time, V1 is opened and closed again with V6 dilution assisting in the valve closing. If V1 fails to close a second time, V1 will open and close one more time, and should V1 fail to close the third time, a V1 alarm will occur, and the cycle will not advance.

NORMAL SCAVENGER OPERATION (continued)

3.5 At any time during the stock flow step should the Scavenger drive stop for any reason, V1 will close, a drive alarm will appear, and the system will remain in standby with the exception that V2 will remain closed.

Step 4 - Scavenger Wash

4.1 When V1 has closed, the program advances to the washing step. The Scavenger fill/wash water valve, V3, opens, and the wash timer starts. After the wash timer has timed out, V3 closes, and the cycle advances.

4.2 Should the Scavenger drive fail at any time during the wash step, V3 closes, a drive alarm will appear, and the system will remain in standby with the exception that V2 will remain closed.

Step 5 - Air Dry Rejects

5.1 After the wash step, the blower is told to start, V5 closes, and V4 opens. With feedback from the blower auxiliary contacts, the reject drying timer starts. When the timer times out, V5 opens, V4 closes, the blower stops, and the cycle advances.

NORMAL SCAVENGER OPERATION (continued)

5.2 Should the blower drive fail for any reason, the cycle freezes, V4 closes, V5 opens, a blower alarm appears, and the system remains in standby with the exception that V2 is closed. Likewise, the same is true should the Scavenger drive fail for any reason during the drying step.

Step 6 - Reject

6.1 At the end of the drying step, the reject valve is told to open. The reject valve can be told to open partially to allow, first, draining of some of the residual water from the rejects, and then opening to the full position to discharge the remaining reject material.

6.2 Before the reject valve is told to open, there must be feedback that the reject handling device is ready. If a standard, belt-type conveyor is used, then the conveyor should be running prior to opening V2. If a bucket conveyor is used, the bucket must be in the down position prior to opening the reject valve.

6.3 The Scavenger drive should stop when V2 leaves its seat (LS3).

6.4 The reject timer runs when V2 is told to open to the full position.

NORMAL SCAVENGER OPERATION (continued)

Step 0 - Standby

After the reject step, the cycle can automatically repeat immediately, can repeat after a brief pause, or can stop and remain in standby until the operator initiates the next cycle. If the cycle is to repeat without a pause, then the cycle should step to Step 1. Should a pause be required between cycles, the pause timer will time out prior to the cycle automatically repeating. If operator intervention is required to start the next cycle, then the start button must be pressed.

TIMERS

The process timers are set at start-up and vary with specific applications and conditions. Typical timer settings are as follows:

1.	Fill Timer	60 -120 sec.
2.	Stock Flow Timer	90 -180 sec.
3.	Wash Timer	120-240 sec.
4.	Reject Drying Timer	120-180 sec.
5.	Reject Timer	10 - 20 sec.

ABNORMAL SCAVENGER OPERATION

STOCK VALVE NOT COMPLETELY CLOSED

In automatic operation, if the stock valve is prevented from closing completely because of plugging by contaminants, it will open and attempt to close again after a delay in the open position of 3 seconds. This will continue for three attempts, then the V1

ABNORMAL OPERATION (CONTINUED)

ALARM will appear on the control panel, and the automatic cycle freezes. When this occurs, the following steps should be taken:

1. Pump out pulper
2. Pump out Scavenger
3. Dump debris from Scavenger

WARNING: Before entering pulper to clean stock valve, ensure that power to pulper and to Scavenger has been shut off and circuit breakers tagged to guard against accidental pulper or Scavenger startup. (As an added precaution, it is also recommended that electrical leads be disconnected at Pulper and Scavenger drive motors). Also make sure that air supply to Scavenger is shut off and locked/tagged.

Close and secure manual isolation valves in all stock, water, chemical, steam, etc., lines feeding into pulper and Scavenger.

4. Inspect stock valve through reject valve.
5. Disconnect air supply to "close" side of air cylinder. Open stock valve, and from inside Pulper, thoroughly clean all material from valve.
6. Reconnect disconnected air lines. Turn on power and air supply.
7. Check that stock valve closes and opens completely.

ABNORMAL OPERATION (CONTINUED)

REJECT VALVE NOT COMPLETELY CLOSED

In automatic operation, if the reject valve is prevented from closing completely because of plugging by contaminants, the V2 ALARM on the control panel lights after a delay of 20 - 30 seconds, and the automatic cycle stops. When this occurs, the following steps should be taken:

WARNING: Before attempting to clean reject valve, ensure that V1 (stock inlet valve) is closed and air supply to "open" side of air cylinder is disconnected.

1. Open reject valve.
2. Turn off and secure manual valve in Scavenger system air supply.
3. Disconnect air supply line to "close" side of reject valve air cylinder.
4. Thoroughly clean all material from valve.
5. Reconnect reject valve air line.
6. Turn on air supply.
7. Check that reject valve closes and opens completely.
8. Reconnect V1 (stock valve) air line.

SAFETY DEVICES

Along with various interlocks built into the sequential program, the Scavenger is also protected against overpressure and simultaneous opening of the stock valve V1 and the reject valve V2.

OPERATION - CONTINUOUS SCAVENGER

OVERPRESSURE

Overpressure is protected against by means of a pressure switch (located inside Fiberprep supplied control panels), which has been preset to trip at 8 psi, when activated, stops the program sequence in whatever step it is in and returns all valves to their fail-safe condition.

The pressure in the Scavenger tub is monitored by a small transducer mounted on the tub wall. If for some reason, such as excessive dilution water pressure, the tub pressure rises above 8 psi, the transducer signals the pressure switch in the cabinet and the shutdown procedure is initiated.

CAUTION: BEFORE RESTARTING THE SYSTEM, THE CAUSE OF THE OVERPRESSURE SHOULD BE DETERMINED.

V1/V2 SAFETY INTERLOCKS

A safety device involving V1 and V2, consists of a three-way solenoid valve feeding supply pressure to these two valves. This is referred to as V7. This valve is energized during the cycle to supply air to open or close V2. In the de-energized condition, air can only be supplied to V1. Since it can only supply one valve at a time, it prevents the simultaneous opening of both of these valves should a spurious voltage spike or module failure attempt to do this.

V1/V2 SAFETY INTERLOCKS (continued)

The second safety device involving V1 and V2 is a pneumatic limit switch. This is mounted on V2 (when supplied by Fiberprep) and prevents V1 from opening when V2 is not closed.

PREVENTIVE MAINTENANCE

MAINTENANCE PHILOSOPHY

The objective of a planned maintenance program is to maintain the Scavenger in a state of optimum readiness and performance and to ensure uninterrupted production.

To achieve these ends, it is recommended that a sequence of periodic maintenance inspections and procedures be developed and followed.

The factors having the greatest impact on reliable operation are lubrication, cleanliness, the drive belts, and to a degree, the shaft packing. If these items are cared for properly, on a routine basis, the Scavenger will give continuous, trouble-free service.

RECOMMENDED MAINTENANCE SCHEDULE

Table 1 is a recommended schedule for routine maintenance of the Scavenger. It is based on past experience with similar equipment and represents the anticipated minimum requirements for keeping the Scavenger in good operating condition. The frequencies indicated

PREVENTIVE MAINTENANCE - CONTINUOUS SCAVENGER

RECOMMENDED MAINTENANCE SCHEDULE

in the schedule assume nearly continuous operation under normal load conditions. They may be adjusted to suit local operating conditions, but the intervals between maintenance actions should not be increased unless there is good data to support the change

ROUTINE MAINTENANCE PROCEDURES

WARNING: Before any maintenance procedure, de-energize the drive motor and tag its circuit breaker to alert other personnel that work on the Scavenger is in progress.

BEARING LUBRICATION

Once each week, lubricate both bearings with a moderate amount of grease (approximately two or three squirts from a hand-held grease gun). Use only a No. 2, water-resistant grease. Before applying the grease gun, wipe the grease fittings clean to prevent entry of any contaminant with the grease. After lubricating, wipe up any excess grease with clean, lint-free wipers.

TABLE 1. RECOMMENDED MAINTENANCE SCHEDULE

ITEM	FREQUENCY	ACTION
Packing Gland	Each Shift	Check for excessive water leakage. Adjust gland or replace packing as needed.
Bearings	Weekly	Lubricate.
Drive Belts	Weekly	Check belt tension and adjust if needed. Inspect for wear or cracks and replace as needed.
Seals and Gaskets	Weekly	Check sealed and gasketed joints or replace seals and gaskets as needed.
Scavenger	Annually	Disassemble and inspect. Replace parts as needed. Pay particular attention to bearings, seals, gaskets, and drive belts.
Rotor	Monthly	Remove inspection hatch and examine rotor cutters for excessive wear. Replace cutters as necessary. (See **Corrective Maintenance** chapter).

BEARING LUBRICATION (CONTINUED)

Refer to the motor manufacturer's instructions for motor bearing lubrication requirements.

DRIVE BELTS

INSPECTION

Once each week, inspect drive belts for excessive slack or wear. If belts are frayed, cracked, or otherwise damaged, replace them. Recheck the tension of new belts several times during the first 50 hours of operation and readjust tension as necessary. Thereafter, the weekly check is adequate.

To check belt tension, refer to Figure 4 and measure the force required to deflect each belt 1/64-inch (0.4-mm) for each 1-inch (25.4-mm) span. The deflecting force should be applied with a spring scale pulling perpendicular to the midpoint of the belt span; the force should be between 10.6 lb (4.8 kg) and 15.9 lb (7.2 kg.).

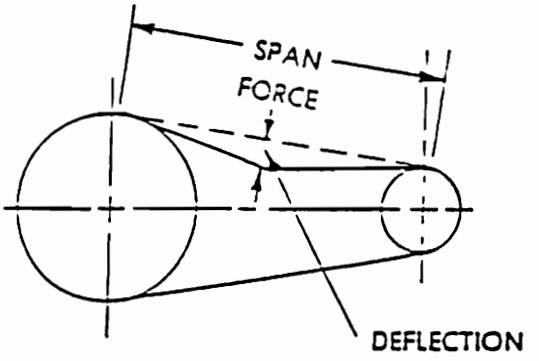


Figure 4. Belt Tension Measurement

ADJUSTMENT

To adjust belt tension:

1. Increase tension as follows:
   A. Loosen locking nuts above motor plate several times.
   B. Raise motor evenly by turning all four jacking nuts under motor plate in small equal increments.
   C. When motor has been raised enough to provide required tension, tighten locknuts above motor plate.

2. Decrease tension as follows:
   A. Turn jacking nuts under motor plate equally and alternately, approximately one turn at a time, to lower motor evenly.

   B. When motor has been lowered enough to provide required tension, tighten locknuts above motor plate.

REPLACEMENT

To replace drive belts:

CAUTION: DRIVE BELTS USED WITH SCAVENGER ARE A MATCHED SET. DO NOT REPLACE INDIVIDUAL BELTS; REPLACE ENTIRE SET EVEN IF ONLY ONE BELT IN SET IS WORN OR DAMAGED.

REPLACEMENT (CONTINUED)

1. Shut down Scavenger and tag/lockout controls and drive motor circuit breakers to prevent inadvertent starting.

2. Remove belt guards.

3. Using jacking nuts under motor plate, lower motor evenly until belts are slack enough to allow them to clear grooves of drive pulley.

4. Remove and discard old belt set.

5. Install new belt set on pulleys, and adjust tension as described above.

6. Replace guards and remove tags from controls.

7. During first 50 hours of operation with new belts, check and adjust tension several times. This is required because new belts will stretch.

PREVENTIVE MAINTENANCE - CONTINUOUS SCAVENGER

SEALS AND GASKETS

Once each week, make a visual inspection of all external seals and gasketed joints to assure that leakage is kept to an acceptable level. Some leakage from the shaft packing is required to lubricate the shaft as it turns in the packing. When properly adjusted, the packing gland will just weep; no more than a few drops of water per minute. Tighten the gland as needed by taking up evenly and alternately on the gland nuts. When tightening the gland can no longer control the leakage, replace the packing.

PACKING REPLACEMENT

To replace the packing:

1. Shut down Scavenger and tag/lockout controls and drive motor circuit breakers to prevent inadvertent starting.

2. Shut off fresh water supply to packing gland.

3. Remove gland adjusting nuts, and slide gland out of and away from stuffing box. Allow gland to hang on shaft.

PACKING REPLACEMENT (CONTINUED)

4. Using a suitable tool, reach in and pull packing and lantern ring out of space between seal sleeve (on shaft) and stuffing box. Note number of packing rings on either side of lantern ring.

5. Clean lantern ring to remove any corrosion or contamination that could restrict water distribution to packing.

6. Insert new packing and reinstall lantern ring being careful to insert it at proper location between packing rings. Gland can be used as a tamping tool to seat rings and lantern ring.

7. Reinstall gland and gland nuts loosely. Restore fresh water flow to seal, and adjust leakage.

8. Return Scavenger to operation and maintain a close watch for seal leakage. As packing rings wear in and adjust to sleeve and housing, it will become necessary to retighten gland nuts.

CORRECTIVE MAINTENANCE

INTRODUCTION

The corrective maintenance procedures in the following sections assume that major corrective maintenance tasks will be limited to removing, disassembling, and reassembling major components or parts of the Scavenger. Although some parts may be refurbished or repaired when severely worn or damaged, the down time required while waiting for parts to be repaired usually is more expensive then replacing the parts with new or factory reconditioned spares. For this reason, no instructions are included for refurbishing parts.

The following general procedures apply to all maintenance actions and are not repeated with each individual procedure. The maintenance technician should be thoroughly familiar with the general procedures before starting any disassembly or other maintenance action.

GENERAL PROCEDURES

PREPARING FOR DISASSEMBLY

Before starting to disassemble the Scavenger, make certain that the following preparatory steps are taken; they will simplify the operation and also make it safer.

PREPARING FOR DISASSEMBLY (CONTINUED)

WARNING: De-energize the drive motor and tag its circuit breaker before starting any maintenance procedures. Voltages capable of inducing severe shock are present in the motor. An accidental start during maintenance could cause severe injury to the maintenance technician. Do not attempt to manhandle parts weighing more than 45 lbs (20 kg.) without the help of another person or a hoist. Two-man lifts should not exceed 100 lbs (45 kg.).

1. Determine that Scavenger was properly cleaned and flushed as part of last shutdown. Insure that all related valves are in proper fail-safe position and that necessary steps have been taken to prevent valve operation.
2. De-energize power supply to drive motor and tag its circuit breaker to guard against accidental startup. (It is good practice to disconnect electrical leads at motor as an added precaution).
3. Disconnect water supply to stuffing box.

CLEANING AND INSPECTING PARTS

After disassembling the Scavenger, clean all parts in a suitable solvent to remove scale or contaminants. After cleaning, allow the parts to air dry or wipe them dry with clean, lint-free rags.

CLEANING AND INSPECTING PARTS (CONTINUED)

Cover reusable bearings with grease-resistant paper or plastic sheets until time for reassembly. Protect all other parts with suitable coverings to avoid damage until time for reassembly.

After cleaning parts, inspect each part for signs of wear, corrosion, galling, or pitting. Bearings that show signs of any of these faults must be replaced. Other parts may be kept in service provided the fault will not interfere with operation. Deep scratches, gouges, or deformations are causes for replacing parts.

O-RINGS, GASKETS, SEALS, AND PACKING

It is good maintenance practice to replace O-rings, gaskets, seals, and packing each time they are disturbed for disassembly. The decision to replace or reinstall such parts must be made individually on a basis of cost, availability, and condition. It is frequently false economy to reassemble a machine with new or refurbished parts only to have a faulty O-ring fail shortly after the job has been completed. Should an inspection of an O-ring or other seal reveal any sign of deterioration, cracking, change in color, embrittlement, or other abnormal condition, replace it immediately.

ROTOR CUTTER WEAR

The clearance between the rotor cutters and the rotor shroud should be from 0.5 to 1.5 mm as shown in Figure 5. Cutter clearance on a new Scavenger is set at .5-.7mm. This clearance can be checked through the inspection hatch in the tub. As the cutters wear, the clearance increases; when it exceeds 1.5 mm, the cutters should be replaced. If clearance exceeds 1.0mm when new cutters are installed, it indicates that the rotor shroud has worn. This wear can be compensated for by reducing the thickness of the shims between the rotor head and seal sleeve spacer (Figure 5). Shims can be removed by removing the rotor, as described under ROTOR REMOVAL in the DISASSEMBLY section which follows, and the rotor key. Cutters can be replaced as described under ROTOR CUTTER REPLACEMENT in the DISASSEMBLY section below.

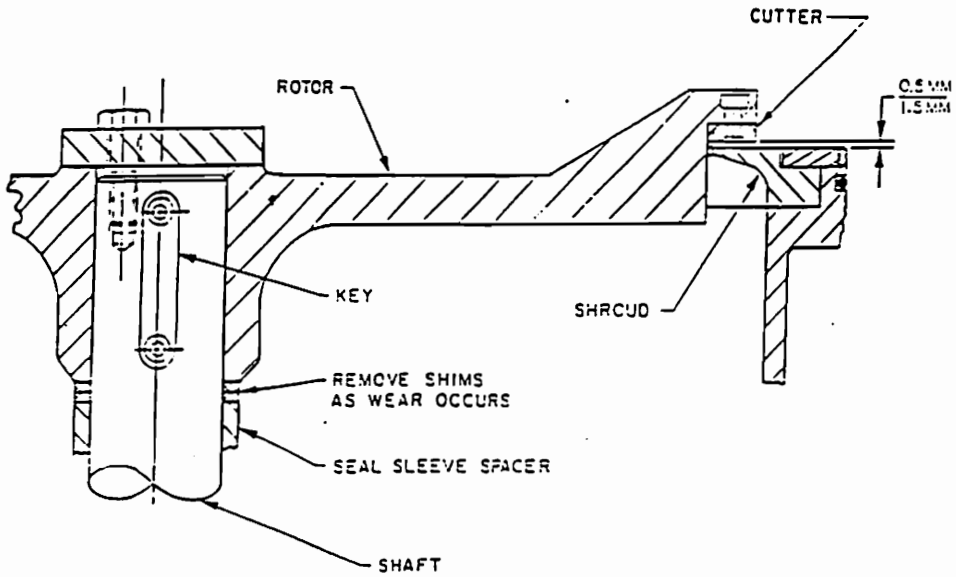


Figure 5. Rotor Cutter/Rotor Shroud Clearance Adjustment

PREPARATION FOR LONG TERM STORAGE OF FIBERPREP EQUIPMENT

1.0 Purpose

The purpose of this bulletin is to provide instructions for preparing equipment for long term storage. This enables the user to store the equipment for a long period of time and be confident that it will be ready for use when desired.

2.0 General

All equipment shall be stored inside a heated building. The minimum recommended temperature is 45° F. All equipment shall be covered with a suitable waterproof cover. Heavy polyethylene or a plastic tarp is ideal for this purpose.

2.1 Preparation of Gearboxes for Long Term Storage

It is always desirable, when possible, to have the supplier prepare the gearbox for long term storage. If this is not possible, all the oil must be drained from the box and the unit filled with Mobil Vaportech light or equivalent.

All external machined surfaces must be coated with heavy grease to prevent rusting.

The input shaft on the gearbox must be rotated a minimum of twenty turns once every fourteen days to distribute the lubricant and relocate the bearing elements.

2.2 Long Term Storage of Valves and Cleaners

All external machine surfaces and moving elements including cylinder rods, etc., must be coated with heavy grease.

This type of equipment does not require any attention during storage beyond examination, to make sure that rusting is not taking place.

3.0 Preparation of Machines Utilizing Greased Bearings

Machines using grease in the bearings need only be prepared and packed as for normal operation.

All external machined surfaces must be coated with heavy grease to avoid rusting.

Every fourteen days the machine must be rotated about ten turns to distribute the grease and the bearing roller positions.

CVS/kaq

INSTALLATION AND MAINTENANCE MANUAL

FOR ROVANG VALVES.

FIBERPREP CUSTOMER: _____

CUSTOMER PURCHASE ORDER: _____

ROVANG SERIAL NUMBER: _____

DATE OF INSTALLATION: _____

ROVALVE

Rovang, Inc.

Thank you for purchasing one of the fine valves from the ROVALVE product line. With proper installation and maintenance your valve can provide years of trouble free service.

This instruction manual is intended as a guide to the installation and maintenance of the standard ROVALVE valve. If further information is required please feel free to contact our Sales or Engineering Departments at the following address and telephone number:

Rovang, Inc.
PO Box 17177
1945 N. Columbia Blvd.
Portland, OR 97217
(503) 285-4527

Installation Instructions for Rovalve valves are detailed on the following pages. IT IS VERY IMPORTANT TO:

1. Properly support the cylinder on all valves installed in vertical lines. Be sure the cylinder supports do not place undo stress on the valve bonnet and that the cylinder is kept on an even plain with the valve body, so that gate will not be angled.

2. Air lines must be of equal size to cylinder ports. Solenoids should have at least a minimum Cv of 1.0.

3. All cylinders are sized for a minimum of 70 PSIG supply. 80-90 PSIG is more desireable.

4. Keep a positive pressure on the cylinder when valve is closed to be sure the gate doesn't "creep" open.

TABLE ONE. KNIFE GATE VALVE DIMENSIONS, PER MSS-SP81

VALVE SIZE	FLANGE O.D.	RAISED FACE	BOLT CIRCLE	NO. HOLES* A	B	C	TAP SIZE	FACE-FACE	FLANGE THICKNESS
2	6	3-5/8	4-3/4	4	2	2	5/8-11	1-7/8	1/2
3	7-1/2	5	6	4	2	2	5/8-11	2	1/2
4	9	6-3/16	7-1/2	8	6	2	5/8-11	2	1/2
5	10	7-5/16	8-1/2	8	6	2	3/4-10	2-1/4	5/8
6	11	8-1/2	9-1/2	8	6	2	3/4-10	2-1/4	5/8
8	13-1/2	10-5/8	11-3/4	8	6	2	3/4-10	2-3/4	5/8
10	16	12-3/4	14-1/4	12	8	4	7/8-9	2-3/4	3/4
12	19	15	17	12	8	4	7/8-9	3	3/4
14	21	16-1/4	21-1/4	12	8	4	1-8	3	13/16
16	23-1/2	18-1/2	21-1/4	16	10	6	1-8	3-1/2	7/8
18	25	21	22-3/4	16	10	6	1-1/8-7	3-1/2	15/16
20	27-1/2	23	25	20	12	8	1-1/8-7	4-1/2	1
24	32	27-1/4	29-1/2	20	12	8	1-1/4-7	4-1/2	1
30**	38-3/4	33-3/4	36	28	18	10	1-1/4-7	4-5/8	1-5/16
36**	46	40-1/4	42-3/4	32	20	12	1-1/2-6	5-3/4	1-5/8

Notes: All dimensions are in inches. Flange dimensions and bolt sizes duplicate ANSI B16.5/150. Flange thicknesses include 1/16" raised face. All bolts are National Coarse.

* A-Number of holes.
  B-Number of through tapped holes.
  C-Number of blind tapped holes, stubs are recommended.

**Dimensions for L-series valves only.

General Maintenance

Rovang, Inc. recommends that all ROVALVE products be inspected at least every 60 days. The following points should be examined and corrected as required.

1. Stem Threads: Look for excessive corrosion, galling or lack of lubrication. If a valve stem requires lubrication, utilize the grease fitting provided and pump standard bearing grease through the yoke boss to lubricate the stem and stem nut assembly. Additional lubrication may be applied directly onto stem.

2. Packing Gland: Check for leaks or worn packing. If leakage is occurring around the packing gland, tighten the packing gland bolts, being careful not to overstress the bolting. On some valves this will require two wrenches, one to tighten the nut and the other to hold the packing bolt from turning. If the valve requires repacking, you may use any standard square braided packing as suitable for your service. See additional instructions for repacking on page 8 for Bonnetless valves and page 9 for Bonneted valves.

3. Resilient Seats: The ROVALVE Figures R8, 17, W17, and L17 are provided with a replaceble resilient seat. If possible, examine the seat for cracks, cuts, corrosion or swelling. Evidence of any of the above will be cause for replacement of the seat. The new seat can be installed without removing your ROVALVE from the line, however, it is much easier to replace the seat with the valve out of the line. See page 11 for the complete procedure for replacing this seat.

4. Body Gaskets: ROVALVE bonneted valves and bolted body check valves have body gaskets between the body flanges. It is recommended that you do not disassemble the valve to examine the gasket, normally this would destroy the gasket and make it unusable. If there are leaks between the body flanges, tighten the body bolts, taking care not to overstress the bolting. If the leak cannot be stopped, replace the gasket as required. See page 21 for instructions on replacing gaskets on the bonneted ROVALVE valves.

5. If possible stroke the valve through the full open and closed position to make sure it is functioning properly.

Note 1: Stop all small leaks as soon as possible as considerable damage can be done to the valve and the surrounding area if leakage is allowed to continue or grow.

Note 2: Only the bonneted ROVALVE valve has a back seat feature allowing repacking under pressure. Valves in critical applications, such as dangerous liquids, gasses, steam or high pressures, should never be repacked under pressure. On cylinder operated valves, turn the cylinder rod with the flats provided to bring the back seat into the fully closed position.

Note 3: Replacement parts including handwheel and yoke assemblies, gates, packing glands and packing can be provided from our factory. If valve requires further repair please contact our office for an estimate of fesibility and cost of repair.

TABLE THREE. OPERATING STROKE FOR STANDARD ROVALVE VALVES

FIGURE NUMBERS

VALVE SIZE	L17
2	2-5/16
3	3-5/8
4	4-5/8
6	6-7/8
8	8-15/16
10	10-5/8
12	12-5/8
14	14-1/8
16	16-1/8
18	18
20	19-3/4
24	23-3/4
30	29-5/8
36	35-7/8

Note: All dimensions are in inches. Cylinder operator strokes, add 1/8" to above

Special Instructions:

1. Gate guards on Fig. 215's should be removed and cleaned out periodically.

2. Minimum air supply to cylinders: 70 PSIG.

3. Solenoid valves and tubing should match cylinder connecting size, but in no case less than 1/2" for valve sizes 16" and above. If this is not adhered to, the valve will operate very slowly. We recommend the solenoid selected to have a Cv of 1.0 or more.

Spare Parts

If service conditions necessitate maintaining spare parts the following are recommended:

Valves:

- Packing - 1 set
- Seat - 1
- Gasket - 1

Atlas cylinder operator:

- Repair kit - 1

Not all of the above parts are required for all ROVALVE products. When ordering replacement parts for a ROVALVE product or **Atlas** cylinder operator please include valve or cylinder size and complete description including serial number with your request.

Additional replacement parts such as handwheels, stem nut assemblies, yokes, stems, packing glands, and gates are available from factory stock. Again, please provide complete description with serial number when ordering.

Instructions for Repacking, Bonnetles Knife Gate

Model Numbers L17 and 215

Tools and materials required:

1. Open end wrenches, (2)
2. Packing, four or five rows of the required packing. ROVALVE standard is a petroleum impregnated flax.
3. Knife, to cut packing.
4. 3/8" x 2" flat bar approximately 2' long with rounded end.
5. Tool with radius end to fit inside of packing box.

Prepare valve:

1. Relieve pressure on valve or remove valve from line.
2. Close the valve.
2. Disconnect the gate lifter.
4. Remove yoke bolts, pull yoke off of valve.
5. Remove packing gland bolts, packing gland, and old packing.

Installation of New Packing

1. Cut packing to exact length for each row. Starting on the side of the gate opposite the seat (note the flow arrow attached to the valve or the word "seat" stamped on the top of the gate indicating the seat side of the valve), install the packing on both sides of the gate one row at a time. Alternate sides of the gate where the ends of the packing meet against each other. Packing must be forced into the slightly narrower portion of the packing box on each end between the seat and the side of the box. Reassemble packing gland and bolt to valve.

2. Reassemble the yoke assembly and bolt the valve gate to the lifter.

3. Apply pressure to line and adjust packing, see Note 2.

Note 1: On standard resilient seated valves where seat seals around the perimiter of the gate, it is not required to start the packing on any particular side of the valve. ROVALVE standard resilient seated valves are bidirectional.

Note 2: Important, do not tighten packing gland bolts any more than required to stop packing gland leaks after line pressure is applied.

TABLE FOUR. ROVALVE PACKING SIZES

ROVALVE standard packing is special flax, impregnated with amber petroleum and petroleum waxes with caustic resistance. It is a soft and easy flowing material that fills voids and irregularities with minmum resistance. The material has a PH range of 7 to 9 and is effective to a maximum temperature of 212 degrees F. Other packings are available from our factory as required.

ROVALVE Figure 215

Valve Size	No. of Rows Packing Gland*	Packing Size
2" through 8"	4	3/8" Square
10" and 12"	5	3/8" Square
14" through 20"	4	1/2" Square
24"	5	1/2" Square

*Note: The ROVALVE Figure 215A two packing assemblies, multiply the above numbers of rows by two.

ROVALVE Figure L17 and L20

Valve Size	No. of Rows	Packing Size
3" and 4"	3	3/8" Square
6" and 8"	4	3/8" Square
10" through 20"	5	3/8" Square
24"	5	1/2" Square
30" and 36"	5	5/8" Square

PROCEDURE FOR REPLACING RESILIENT SEATS IN ROVALVE FIGURE L17 Series.

Tools & Material Required:

1. Wrenches
2. Liquid silicone or soap suds
3. Swab or rag
4. 1/2" x 2" F-B approximately 3' long with rounded end
5. Knife
6. Hack saw or bolt cutter
7. Packing
8. New seat
9. Two metal cups for holding wire in seat
10. Tool with radius to fit inside end of packing box

Disassemble:

1. Relieve pressure from line.
2. Open valve approximately 1" from full open
3. Disconnect blade clevis
4. Remove yoke assembly
5. Remove packing gland (stuffer)
6. Remove valve gate
7. Remove old packing and seat
8. Clean out seat retaining groove

Install New Seat:

1. Bend new seat material into horse shoe shape, open end up.
2. Force middle section of seat through packing box into seat groove in extreme lower portion of valve body (liquid silicone or soap solution on seat material will eliminate binding). Use flat bar tool.
3. After seat is firmly in place in lower section of valve, work upward toward the packing gland pushing seat into its groove taking care not to stretch or elongate seat material.
4. When seat is firmly in place, the ends will extend above the packing box on both sides by several inches.
5. Soap seat surface and gate edges. Insert gate, forcing it to complete closed position.
6. When seat is in place pull gate up until the bottom of the gate is near the top of the port, like when the valve is open. With the gate in this position check the gate to seat contact at each end of the packing box. The gate should be penetrating into the seat 1/32" to 1/16" on each side. If engagement is correct (tight) go to 8, if engagement is incorrect (loose) go to 7.

7. Install packing on both sides of gate, one row at a time. Cut packing exact length of packing box. Packing must be forced into slightly narrower portion of box on each end between seat and side of packing box.
8. Trim seat material on each side of gate at top of packing box. Leave approximately 1/2" to 5/8" of material extending above the packing. Material can be cut with hacksaw or knife and bolt cutters, since it has a stainless steel reinforcement wire.
**9. Reassemble packing gland and yoke assembly. IMPORTANT Do not take up packing gland bolts any more than necessary to stop packing gland leaks.

**Special attention to these instructions should be taken to insure proper seat and long seat life.

DO NOT cycle the L17 Series DRY. For long life, keep moisture on seats during cycling if at all possible.

TABLE FIVE. RESILIENT SEAT SIZES

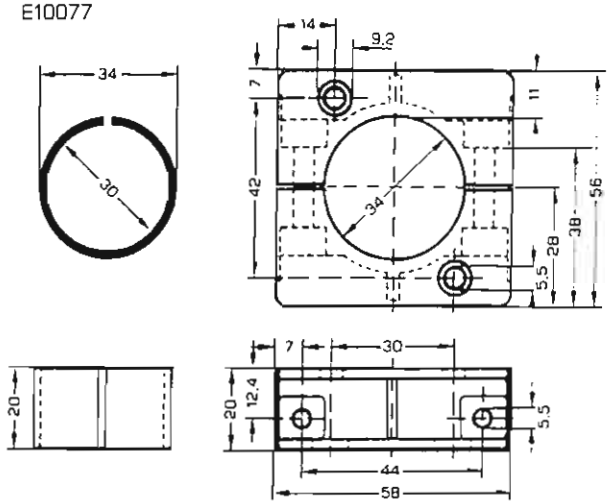
Figure L17

Valve Size	Cross Section	Length
2	3/8	14
3	3/8	18
4	3/8	23
6	1/2	32
8	1/2	39
10	5/8	47
12	3/4	56
14	3/4	61
16	1	69
18	1	76
20	1	81
24	1 x 1-1/4	97
30-50	1 x 1-1/4	120
36-50	1 x 1-1/4	142
30-125	1 x 1-1/2	120
36-125	1 x 1-5/8	142

Note: All dimensions are in inches. Lengths may vary, (+/-) 1/2". All seats, with the exception of the TEFLON, are reinforced with T-316 SS wire. Some seats may require shimming or grinding to fit valve channel.

Accessories (continued)

Optional
Mounting clamp
E10077



efector, inc.
a subsidiary of **ifm electronic**
805 Springdale Drive, Exton, PA 19341
215-524-2000 • FAX 215-524-2010

Application Engineering and Product Assistance 800-348-8899
Ordering Assistance and General Business 800-441-8246

12/92

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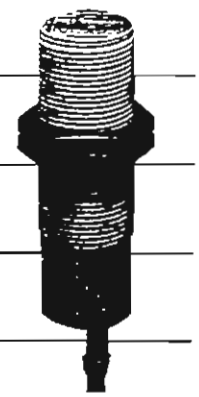
Type II
Inductive Proximity Switch

II-3010-BPKG	DC PNP	
II-3010-APKG	DC PNP	
II-3010-ANKG	DC NPN	
II-2010-ABOA	AC/DC	
II-2010-BBOA	AC/DC	



Description

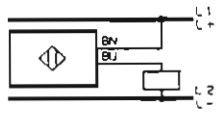
A 30 mm x 1.5 threaded tubular inductive proximity switch that senses all types of metal. Provides a solid state switched output.

These units are normally supplied with a 2 meter (6 ft.) long cable and color coded wires.

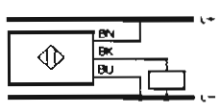
Wiring

2 wire **AC/DC**

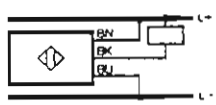
color code
black: BK
brown: BN
blue: BU



3 wire **DC PNP**



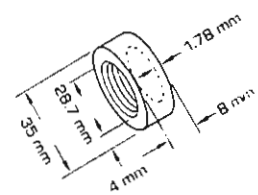
3 wire **DC NPN**



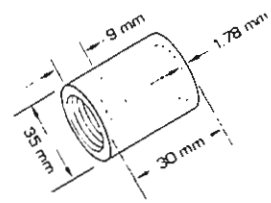
Concerning Safety: **efector** makes every effort to build a dependable product, but every product will eventually fail and so your equipment must be designed to prevent property damage and personal injury if our products fail.

Accessories

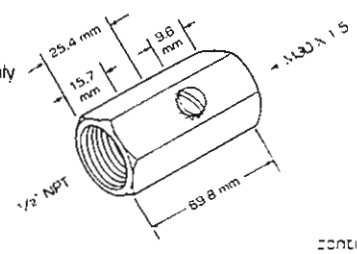
Teflon top
II-STFL-TOP



Teflon cap
II-STFL-CAP



Conduit adapter
for cabled units only
II NPT METAL



Continued)

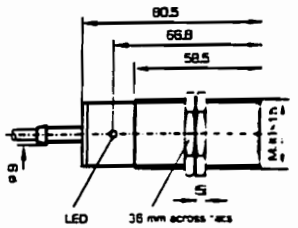
Technical Data at +20°C

	DC PNP	DC NPN	AC/DC dual voltage
operating voltage	10–36 V DC incl. residual ripple	10–36 V DC incl. residual ripple	20–250 V AC 50–60 Hz 20–250 V DC
max. load current continuous	250 mA	250 mA	350 mA AC to +50°C 250 mA AC to +80°C 100 mA DC
inrush:	250 mA	250 mA	i:2.2 A/20 ms at f:0.5 Hz
voltage drop at max. load	typ. <2.5 V	typ. <2.5 V	<6.5 V AC; <6.0 V DC
leakage current (2 wire)			<1.3 mA at 120 V AC <0.8 mA at 24 V DC
supply current (3 wire)	<5 mA at 24 V	<5 mA at 24 V	
minimum load current	–	–	5 mA
max. switching rate	typ. 50 Hz		25 Hz on AC 30 Hz on DC
switching status indication	LED	LED	LED
housing rating	IP 67 ⊡ NEMA 3, 4, 6, 12, 13		
ambient temperature	–25°C to +80°C (–13°F. to +176°F.)		
nominal sensing ranges	**10 mm, flush mountable**		
switching hysteresis	1%–15% of the sensing range		
correction factors (approx.)	mild steel: 1; stainless steel 0.7; brass 0.4; aluminum 0.4; copper 0.2		
switch point drift/repeatability	< ±10% of s_r over entire temperature range and voltage range/<1%		
housing	plastic: polybutyleneterephthalate		

Dimensions

Cabled Units

Flush-mountable



Design/Mounting Instructions

MECHANICAL

Mounting:

This 30 mm unit is easy to mount with the two jam nuts provided. Do not overtighten. This unit can be torqued to about 70 inch-pounds. For heavy vibration resistance, use a thread locker such as Loctite 242. It may be flush mounted in metal; (it is not sensitive to the sides of its tubular construction).

ELECTRICAL

DO NOT test the unit with a lamp load higher than 6 watts on an AC unit since inrush current could damage the unit. **DO NOT** use a lamp load to test a DC switch without consulting factory.

DO NOT operate this unit without a load (for example, plugged into a wall outlet).

2-wire AC/DC

The 2-wire AC/DC model features very low leakage and voltage drop, allowing the unit to be used directly into PC's without interfacing concerns in most cases.

3-wire DC

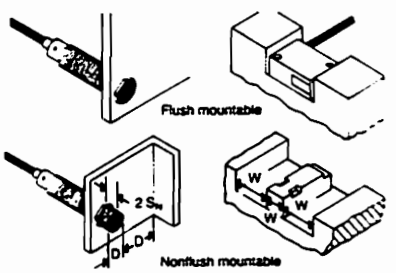
Two models are available. The PNP (sourcing, positive switching) switches the positive supply line (brown) referenced to ground (blue) (minus a small, internal voltage drop) through the output wire (black). The NPN (sinking, negative switching) pulls down the output wire (black) to ground (blue), minus a small voltage drop and is referenced to positive supply (brown).

(continued)

Design/Mounting (continued)

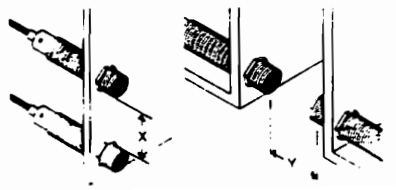
Installation

Flush-mountable models can be mounted so they are completely surrounded by metal, except for the sensing face. Nonflush-mountable models must have an open zone around them.



S_n = Nominal detection range

Inductive units can interfere with each other if they are mounted too close. The X distance must be greater than twice the diameter for nonshielded units and one times the diameter for shielded units. Y must be greater than eight times the nominal detection range.

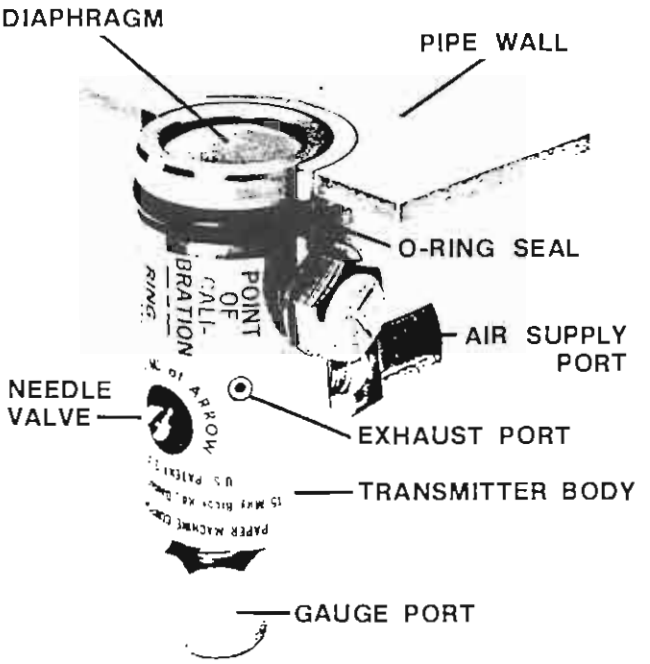


PAPER MACHINE COMPONENTS, INC.

15 MIRY BROOK ROAD DANBURY, CONN., U.S.A. 06810

TEL. (203) 743-9729

MINIATURE PRESSURE TRANSMITTER INSTALLATION & OPERATING DATA



(1) CUT HOLE FOR NIPPLE

Drill or cut a hole slightly smaller than the nipple outside diameter (1-5/16"), in the top or side of the pipe where the transmitter is to be located. The hole should be close to a flange or opening so that the inside wall of the pipe can be cleaned up after the nipple is welded in place. File the hole so that the stainless steel nipple fits tightly in the hole. The fit must be snug otherwise the nipple will cock when it is welded in place. Some customers have made up a collapsing internal steel mandrel, and slipped it into the nipple during the weld operation. This helps prevent distortion of the nipple.

NOTE: Marvel* or similar nipple hole saws 1-5/16" O.D. (33mm) may be used with a slow speed drill (150 RPM) to cut out the proper size hole. The saw teeth should be continuously cooled and lubricated while cutting the hole with a water soluable cutting oil such as Rustlick WS-500. (*Armstrong-Blum Mfg. Company, 5700 W. Bloomingdale Avenue, Chicago 39, Illinois, manufacture Marvel hole saws.)
Hole saw kit PT - HSK is available from stock $75. It includes a ground Marvel hole saw, mandrel, drill, guide dowel, SCR speed control, cutting oil concentrate, applicator and case. Needs 1/2" electric drill.

(2) WELD NIPPLE IN PLACE

Position the nipple and transmitter with set screw installed, into the hole so that the diaphragm on the transmitter is flush with the inside wall of the pipe. Mark the nipple both inside and out. On small diameter pipes (4" and less) the nipple and transmitter will protrude into the pipe due to crown of the pipe. **(The transmitter must be removed from the nipple before welding.)** Weld the nipple in place with either Heliarc (inert gas arc process) or with arc and stabilized 316 stainless steel rods. This will prevent carbide precipitation and subsequent corrosion at the weld.

(3) GRIND NIPPLE FLUSH

Finish grind the nipple flush with the inside of the pipe. Clean up the inside edge of the nipple at the pipe end with a fine half-round file. Remove all burrs but do not make any ridges or grooves on the inside nipple wall, otherwise material inside the tank will leak past the O-ring seal.

(4) **INSTALL TRANSMITTER**

Capsules of Dow Silicone grease (Valve Seal) are furnished with each order. Apply a thin wipe to the O-ring, diaphragm ring, edge of the nipple, and the remainder to the inside wall of the nipple at the bottom end where it connects into the pipe wall. The purpose of applying silicone grease at this point is to prevent galvanic cell corrosion between the diaphragm ring and the nipple wall. Silicone grease is stable from -40° F to 500° F and does not readily dissolve. Install the transmitter and locate with set screw. The transmitter diaphragm should be flush with the inside wall of the pipe if the nipple was properly positioned in the first place.
NOTE: Avoid contact with the eyes when using silicone grease.

(5) **CONNECT SUPPLY AIR**

Connect dry filtered air to the SUPPLY port. The standard transmitter has been calibrated with 100 PSIG (6 ATMOSPHERE) supply air and consumes approximately 3 standard cubic feet of air per hour. It will also operate at any specified range providing supply air 5 PSIG (0.35 ATMOS.) greater than the maximum reading desired is available. The air must be clean and dry otherwise the flow control needle will become plugged and fail to operate. **A 2" supply pressure gauge should be connected to the supply line** to ensure that the flow control valve and transmitter are being supplied with adequate air pressure.

(6) **MAKE GAUGE CONNECTION**

Connect a pressure gauge, manometer or recorder to the GAUGE port. If remote operation is desired, readings up to 100 feet away may be obtained if continuous 50 foot lengths of ¼" O.D. copper tubing are used (we say continuous because this avoids connections which invariably are not tightened and therefore leak, and the transmitter does not yield proper readings). **Special care must be taken to tighten all connectors and use thread seal on all pipe connections between transmitter and remote indicator or recorder, in order to avoid air leaks.** Leaks can be detected with children's soap bubble solution.

(7) **TURN ON SUPPLY AIR**

Turn on the air supply. Air should be exhausted at a slight rate from exhaust port.

(8) **ADJUSTMENTS TO FLOW CONTROL VALVE**

Normally, there is no need to make any adjustment. The flow control valve has been set approximately ½ turn open to deliver 3 SCFH (standard cubic feet per hour). A rota-meter-taper flowmeter, part PMC-FML @$8.00 may be used for checking proper flow rate. If better response is required, be sure to check for air leaks in the connecting tubing with a soap bubble solution before making any adjustments to the needle valve. **Excess use of air and unsatisfactory operation will occur if the needle valve is opened beyond ONE FULL TURN.** The factory setting is marked in line with the needle valve slot.

(9) **LOW READINGS**

If gauge readings appear low, close the needle valve then re-open approximately ½ turn to point where the slot lines up with the calibration vee mark. This action clears residual carbon and oil gum and restores proper air flow through the transmitter.

ADDITIONAL INFORMATION

- Do not use a pipe wrench on the body of the transmitter during installation. The fit between nipple and transmitter should be free enough to permit installation and removal by hand. Avoid excessive clearance.
- Avoid excess use of thread seal, otherwise the gauge connection and supply connection filter discs may become plugged and prevent the transmitter from operating properly.
- PVC DUMMY TRANSMITTERS — One or more PVC dummy transmitters are furnished to each user. They can be substituted for regular transmitters in case repairs or changes are necessary. They may also be used to check pressure at any point by connecting a pressure gauge to the outboard 1/8" NPT connection. The gauge and dummy should be water purged through a tee connection to prevent pulp from plugging the dummy and gauge. Additional PVC dummies are available from stock.
- The transmitter body O-ring may be removed with a scriber or small screw driver.

- **EXHAUST SILENCER:** A Delrin or silicone plug has been pressed into the ⅛" exhaust port. The plug is equipped with a .052" D hole to limit transmitter exhaust rate and thereby eliminate undesirable exhaust whistle.

- **SERIAL NUMBER:** Each transmitter is marked on the end opposite the diaphragm. Please refer to this number when ordering parts.

- **EXTREMELY IMPORTANT:** A white cap has been installed over the diaphragm to protect it during shipment and installation. **Keep this cap in place until the final tubing connections are made.**

- **DIAPHRAGM REPLACEMENT:** *Replacement diaphragms are available only as* BONDED ASSEMBLIES, *and consist of retainer ring, diaphragm bonded in place, and inner o-ring. These assemblies provide long term dependable readings, eliminate the possibility of blow out and errors due to accumulation between the diaphragm and lip of the retainer ring.*

- **BONDED ASSEMBLY INSTALLATION:** Remove the outer o-ring. Unscrew the diaphragm retainer ring by hand or by fitting a hose clamp over the ring and loosen by hand or with pump pliers. Clean face and threads of body. Remove inner o-ring from new assembly and run ring up by hand until diaphragm contacts face **(avoid force)**. Magic mark ring opposite arrow on body. Remove ring, install inner o-ring then thread assembly until ring mark lines up with existing calibration V or dot mark on body. Transmitter is ready for use. Use PMC Field Test Panel for precise calibration.

- **FILTER DISC INFORMATION:** All transmitters are equipped with a filter adapter in the air supply port and gauge port. The air supply filter traps out final traces of dirt and oil that may clog the flow control needle valve. **This filter adapter is not intended as the main line instrument air filter.*** The gauge port filter traps out dirt and metal particles that may originate from the remote gauge connection. The filter discs are sintered from 316 stainless steel particles and have an average pore size of 20 microns (.001"). The standard adapter is chrome plated brass. All stainless adapters are available—see PT-10-SS & PT-12-SS on parts list page 4.

- **REPLACEMENT INFORMATION: Air Supply Port Filter**

  In the unplugged state the filter disc will pass 30 x more air than is required to operate the transmitter. If it becomes necessary to open the needle valve beyond 1 turn, the filter disc should be replaced in the following manner:

  (a) Shut off supply air and disconnect line at air supply port.
  (b) Remove adapter fitting and push out plugged filter disc with a punch.
  (c) Insert new disc and drive into place with a clean punch approximately 5/16" (8mm) in diameter.
  (d) Re-assemble adapter fitting and air supply line. Avoid getting dirt in supply port.

  NOTE: Transmitter can be worked on while under pressure without fear of damaging diaphragm.

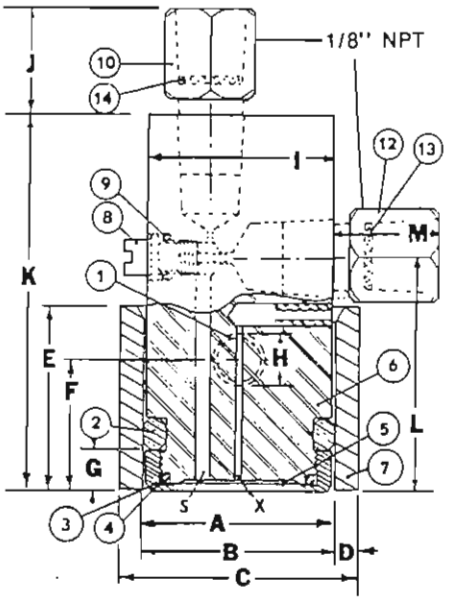
* **RECOMMENDED AIR FILTER:** Where clean instrument air is not available we recommend the following filter:

Adjustable Filter Regulator: (1) Norgren B11-221-M2E-W-5203-01—our part LT-NMFR . This regulator handles 4 transmitters—two ranges 3-50 psi and 5-125 psi—*please specify range desired.*

These filters are available from stock or from any C.A. Norgren distributor.

MINIATURE PRESSURE TRANSMITTER

ENGINEERING DATA



	INCHES	M. M.
A	1.035	26.28
B	1.049	26.64
C	1.315	33.40
D	.133	3.37
E	1.000	25.40
F	.700	17.80
G	.215	5.46
H	.316	8.02
I	1.035	26.28
J	.700	17.80
K	2.050	52.07
L	1.440	36.57
M	.750	19.05

CERTIFIED PRINT

PARTS DESCRIPTION

1 S/S Set Screw & Lock Washer
2 Outer O-Ring
3 Diaphragm Retainer Ring - 316L S/S
4 Inner O-Ring
5 Diaphragm - 3.6 mil thick
6 Transmitter Body - 304 S/S
7 Weld-on Nipple - 316L S/S
8 Needle Flow Control Valve
9 Needle Valve O-Ring
10 Filter Adapter - Gauge Port
11 Dummy Transmitter Plug - not shown
12 Filter Adapter - Air Supply Port
13 Filter Disc - sintered S/S
14 Filter Disc - sintered S/S

PRINCIPLE OF OPERATION

Regulated supply air flows steadily past needle flow control valve 8, lifts diaphragm and exhausts through central port **X**. An increase of pressure against diaphragm outer face blocks exhaust port **X**, until back pressure at S reaches a point of balance. The connected gauge or recorder reads this back pressure. A slight rate of exhaust occurs when balance is reached. The system acts in reverse with decreasing pressure.

PARTS LIST AND PRICES

Number	Description	Price
PT-01	S/S Set Screw & Lock Washer	$ .40
* PT-02-N	Outer O-Ring — Buna N #210 *(35301864 ISO)*	.50
PT-02-Si	Outer O-Ring — Silicone #210 *(35301864 ISO)*	2.00
PT-02-V	Outer O-Ring — Viton #210 *(35301864 ISO)*	2.00
* PT-03-Ha	Diaphragm Retainer Ring Assembly (Parts 3, 4, & 5) Havar diaphragm bonded in place.	19.50
PT-03-Hc	As above — but with Hastelloy-C diaphragm	22.50
PT-03-Ti	As above — but with Titanium diaphragm	25.50
PT-04-Si	Inner O-Ring — Silicone #018 *(17801877 ISO)*	1.00
PT-04-V	Inner O-Ring — Viton #018 *(17801877 ISO)*	1.00
PT-05	Diaphragm - *Available only in bonded assemblies* See part PT-03-Ha above	
PT-06	Transmitter Body — 304 Stainless Steel	70.00
* PT-07	Weld-on nipple — 316 ELC Stainless Steel	8.00
* PT-08	Needle Valve in 303 S/S, complete with O-Ring (Add .50 for Silicone or Viton)	4.00
PT-09-N	Needle Valve O-Ring — Buna N #006 *(17800290 ISO)*	.30
PT-09-Si	Needle Valve O-Ring — Silicone #006 *(17800290 ISO)*	.75
PT-09-V	Needle Valve O-Ring — Viton #006 *(17800290 ISO)*	.75
* PT-10-B	Adapter - Gauge Port, with filter disc — ⅛" NPT female x ⅛" NPT male. Adapter in plated brass.	1.50
PT-10-SS	Adapter — as above in 303 stainless steel	3.00
PT-11	PVC Dummy Transmitter, complete with O-Ring	3.60
* PT-12-B	Adapter — Air Supply Port, (same as PT-10-B)	1.50
PT-12-SS	Adapter — Air Supply Port, (same as PT-10-SS)	3.00
PT-13	Filter Disc - Order assembly PT-12-B	
PT-14	Filter Disc - Order assembly PT-10-B	
PT-15	Silicone Grease Capsule	.40

NOTE:
Parts orders for transmitters made prior to December 1974, Serial No. 18420 require PT-12 Large Air Supply Adapters ¼" NPT female x ⅛" NPT male and PT-13 Large Filter Discs 0.440 O.D.

** Recommended spare parts for every five (5) transmitters.*

MINIMUM ORDER — $10.00 DOMESTIC & $25.00 INTERNATIONAL
Parts orders should include Transmitter Serial Number

PAPER MACHINE COMPONENTS, INC.
Miry Brook Road
Danbury, Connecticut U.S.A. 06810

ROOTS DRESSER

$2.00

Universal RAI BLOWER

INSTRUCTIONS

ROTARY LOBE BLOWERS

CONTENTS

NUMBERS IN ( ) ARE METRIC EQUIVALENTS

DO THESE THINGS To Get The Most From Your Roots Blower

1 Check shipment for damage. If found, file claim with carrier and notify Sales Office.

2 Unpack shipment carefully, and check contents against Packing List. Notify Sales Office if a shortage appears.

3 Store in a clean, dry location until ready for installation, if possible. Lift by methods discussed under INSTALLATION to avoid straining or distorting the equipment. Keep covers on all openings. Protect against weather and corrosion if outdoor storage is necessary.

4 Read LIMITATIONS and INSTALLATION sections in this manual and plan the complete installation.

5 Provide for adequate safeguards against accidents to persons working on or near the equipment during both installation and operation. See SAFETY PRECAUTIONS.

6 Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.

7 Make sure both driving and driven equipment is correctly lubricated before start-up. See LUBRICATION.

8 Read starting check points under OPERATION. Run equipment briefly to check for installation errors and make corrections. Follow with a trial run under normal operating conditions.

9 In event of trouble during installation or operation, do not attempt repairs of Roots furnished equipment. Notify Sales Office or factory, giving all nameplate information plus an outline of operating conditions and a description of the trouble.

10 Unauthorized attempts at equipment repair may void Manufacturer's warranty. Units out of warranty may be repaired or adjusted by the owner. It is recommended that such work be limited to the operation described in this manual, using Factory Parts. Good inspection and maintenance practices should reduce the need for repairs. See Distributor List on last page for parts and service after warranty period.

NOTE — Information in this manual is correct as of the date of publication. The Manufacturer reserves the right to make design or material changes without notice, and without obligation to make similar changes on equipment of prior manufacture.

(5) FIELD TESTS

Transmitters that appear to yield low or false readings can be removed for field test during shut-down or extracted while under pressure and range tested. Part number for the Field Test Panel is (PT-FTP @ $165.00). The test panel uses a 3-way air switch and single gauge to compare process pressure against transmitter output. This arrangement helps eliminate the normal error that exists between a pair of test gauges. (If customers elect to use a pair of test gauges or manometers a preliminary test should be made by connecting a common adjustable supply and a check made over the test range to determine variations between gauges. P.M.C. transmitters cannot be made to track test gauges with gross errors or leaking manometers. Be sure to check first before assuming P.M.C. transmitters are in error.)

(6) FACTORY REBUILDS

All units no matter how old can be returned for rebuild, up-date and recalibration at approximately half the cost of a new unit and carry a new year guarantee.

(7) FACTORY CALIBRATION INFORMATION

All miniature pressure transmitters are factory calibrated, rechecked a week later and then code marked. There is no basic difference between a standard transmitter 100 psi (7 bars) range and one with a range of 0-15 psi (1 bar). During calibration the retainer ring and diaphragm are screwed down further, placing the diaphragm closer to the transmitter face for lower ranges. The needle valve is also opened to achieve correct flow (3 SCFH) for lower ranges. Supply pressure must be 5 psi (0.3 bar) greater than the range.

PAPER MACHINE COMPONENTS, INC.
Miry Brook Road, Danbury, Conn. 06810 U.S.A.
Tel. (203) 792-8686
June 1978

TROUBLE SHOOTING & CALIBRATION INSTRUCTIONS

FOR MINIATURE PRESSURE TRANSMITTERS

FIELD FUNCTION TESTS: The purpose of these tests is to determine whether installed and operating transmitters are yielding correct pressure readings.

(1) CHECK FOR CORRECT SUPPLY PRESSURE TO THE TRANSMITTER

The operating range of the transmitter is code marked above the serial number on the exposed end of the transmitter body. Domestic transmitters are marked PMC-PT-100-N-TI-S. The 100 signifies 0-100 psi and other ranges are marked 0-60, 0-30, 0-20, 0-15 and 0-10. Foreign transmitters are marked in bars, thus 7, 6, 5, 4, 3, 2, 1. The word STD signifies standard and is often used in place of PMC-PT-100# (7 bars) -N-TI-S.

The standard range transmitter works quite well with clean mill air supply pressure ranging from 65 psi to 105 psi or 4 to 7 bars.

If ranges other than STD/standard are installed then transmitters should be supplied with regulated supply 5 psi (0.3 bars) greater than the code marked range.

False readings result from incorrect supply pressure.

Ranges other than STD/standard are furnished to customers who wish to limit the maximum transmitter output pressure in order to prevent over ranging quality pressure gauges (such as installed on pulp cleaner systems) and receiver elements mounted in expensive recorders and controllers.

(2) CHECK FOR CORRECT FLOW OF AIR THROUGH TRANSMITTER

A PMC exhaust Flowmeter (PT-FM @$8.00) may be used to check for correct flow. At low process pressures 0-15 psi (0-1 bar) the flowmeter ball should indicate 3 SCFH. At higher pressures 40-60 psi (3-4 bars) the ball will drop to 2.5 SCFH reading. If the flow is low, adjust the needle valve to achieve correct flow.

NOTE: Low readings often result from partially plugged needle valves and are caused by dirty supply air. Needle valves since 1972 (Serial No. 14000) have been equipped with a groove to pass most of the supply air. This design change helped overcome the dirty air problem, however, all users should equip their service people with PMC exhaust flowmeters if only as field test aids.

(3) CHECK FOR AIR LINE LEAKS BETWEEN TRANSMITTER AND REMOTE GAUGE OR PANEL SYSTEM

If tests (1) and (2) have been made and low readings are still suspected then all tubing connections between transmitter and remote gauge should be soap bubble tested for leaks. An alternate test is to mount a good gauge directly to the transmitter gauge port as an alternate to searching for and leak testing all fittings. Higher readings at the transmitter will confirm a fitting or line leak.

Comment: If tests (1), (2) and (3) fail to give satisfactory readings the following steps can be taken:

(4) INSPECT FOR DIAPHRAGM DAMAGE

Blown or ruptured diaphragms or foreign material trapped under the diaphragm may cause low readings. The suspected transmitter can be removed to inspect for diaphragm rupture or trapped particles during process shut-down.

P.M.C. offers a Field Extractor which permits transmitter inspection and exchange during operation at pressures of up to 100 psi (7 bars) Part No. (PT-FX @ $250.00)

NOTE: Replacement diaphragms are now available only as BONDED ASSEMBLIES and consist of retainer ring, diaphragm bonded in place and inner o-ring. These assemblies provide long term dependable readings, eliminate the possibility of blow-out and errors due to accumulation between the diaphragm and lip of the retainer ring.

Bonded Assembly Installation:

Remove the outer o-ring. Unscrew the diaphragm retainer ring by hand or by fitting a hose clamp over the ring and loosen by hand or with pump pliers. Clean face and threads of body. Remove inner o-ring from new assembly and run ring up by hand until diaphragm contacts face, (avoid force). Magic mark ring opposite arrow on body. Remove ring, install inner o-ring, then thread assembly until ring mark lines up with existing calibration V or mark on body. Transmitter is ready for use. Use PMC field test panel for precise calibration.

OPERATING CHARACTERISTICS

Roots Universal RAI blowers, as covered in this manual, are designated as air blowers, and may be used for handling air in either pressure or vacuum service. They are unsuitable for handling gases because shaft seals are not designed to prevent leakage to atmosphere.

The Roots rotary lobe blower is a positive displacement type unit, whose pumping capacity is determined by size, operating speed and pressure conditions. It employes two double-lobe impellers mounted on parallel shafts and rotating in opposite directions within a cylinder closed at the ends by headplates. As the impellers rotate, air is drawn into one side of the cylinder and forced out the opposite side against the existing pressures. The differential pressure developed, therefore, depends on the resistance of the connected systems.

Effective sealing of the blower inlet area from the discharge area is accomplished by use of very small operating clearances. Resulting absence of moving contacts eliminates the need for any internal lubrication. Clearances between the impellers during rotation are maintained by a pair of accurately machined timing gears, mounted on the two shafts extending outside the air chamber.

Operation of the familiar basic rotary lobe blower is illustrated in FIGURE 1, where air flow is right to left from inlet to discharge with the bottom impeller rotating clockwise. In Position 1 it is delivering a known volume (A) to the discharge, while space (B) between the upper impeller and cylinder wall is being filled. Counterclockwise rotation of this impeller then traps equal volume (B) in Position 2, and further rotation delivers it to the discharge in Position 3. At the same time, another similar volume is forming under the lower impeller, and will be discharged when rotation reaches Position 1 again.

One complete revolution of the driving shaft alternately traps four equal and known volumes of air (two by each impeller) and pushes them through to the discharge. The pumping capacity of a lobe blower operating at a constant speed therefore remains relatively independent of reasonable inlet or discharge pressure variations. To change capacity, it is necessary either to change speed of rotation or vent some of the air.

No attempt should ever be made to control capacity by means of a throttle valve in the intake or discharge piping. This increases the power load on the driver, and may seriously damage the blower. Likewise, if a possibility exists that flow to the blower inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve must be installed near the blower. A pressure type relief valve in the discharge line near the blower is also strongly recommended for protection against cut off or blocking in this line.

When a belt drive is employed, blower speed can usually be adjusted to obtain desired capacity by changing the diameter of one or both sheaves. In a direct coupled arrangement, a variable speed motor or transmission is required, or air may be vented through a manually controlled unloading valve and silencer. If discharge air is returned to the blower inlet, it must be cooled to 100° F (38° C) through a cooling by-pass arrangement.

Before making any change in blower capacity or operating conditions, contact the nearest Distributor for specific information applying to your particular blower. In all cases, operating conditions must be maintained within the approved range of pressures, temperatures and speeds as stated under LIMITATIONS. Also, the blower must not be used to handle air containing liquids or solids, or serious damage to the rotating parts will result.

OPERATING LIMITATIONS

To permit continued satisfactory performance, a Roots Universal RAI blower must be operated within certain approved limiting conditions. The Manufacturer's warranty is, of course, also contingent on such operation.

Maximum limits for pressure, temperature and speed are specified in Table 1 for various sizes of Universal RAI blowers. These limits apply to all blowers of normal construction, having operating clearances as listed in Table 5 when operated under standard atmospheric conditions. **Do not exceed any of these limits.**

Example: The listed maximum allowable temperature rise (increase in air temperature between inlet and discharge) for any particular blower may occur well before its maximum pressure or vacuum rating is reached. This can easily occur at high altitude or at very low speed.

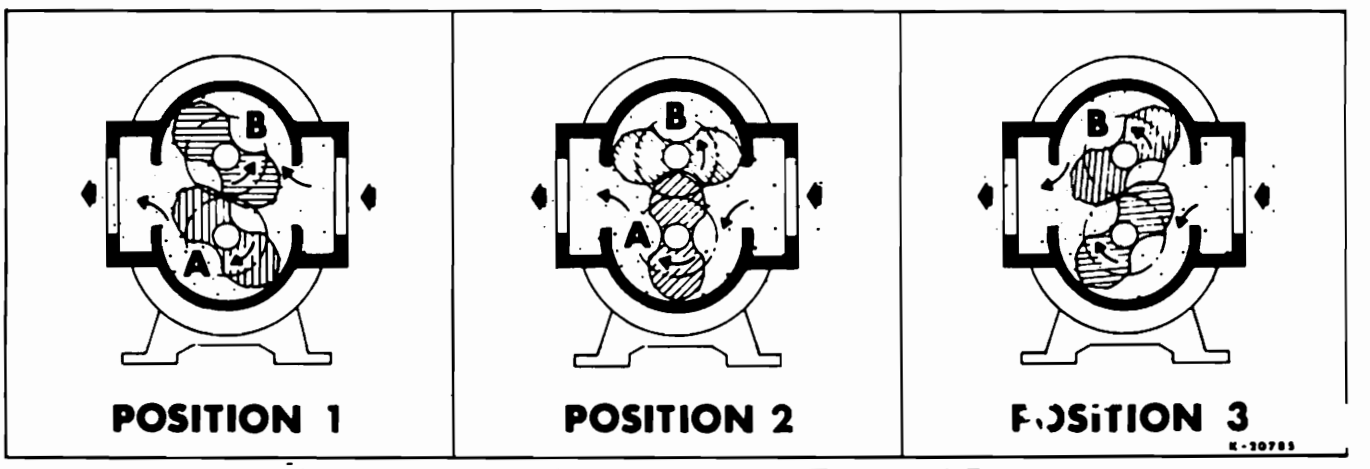


Figure 1 — Flow Through a Basic Type RAI Blower

Temperature rise then is the limiting condition. In other words, the operating limit is always determined by the maximum rating reached first. It can be any one of the three: pressure, temperature or speed.

Be sure to arrange connections or taps for thermometers and mercury type pressure or vacuum gauges at or near the inlet and discharge connections of the blowers. These, along with a good tachometer, will enable periodic checks of operating conditions to be made easily.

PRESSURE — On pressure service, the pressure rise in pounds per square inch (kPa) (between blower inlet and discharge) must not exceed the figure listed for the specific blower frame size concerned. Also, in any system where the blower inlet is at a positive pressure above atmosphere, the discharge pressure must never exceed 25 PSI (172 kPa) gauge regardless of blower size.

On vacuum service, with the discharge going to atmospheric pressure, the inlet suction or vacuum in inches of mercury (Hg.) (kPa) must not be greater than the values listed for the specific frame size.

TEMPERATURE — Various blower frame sizes are approved only for installations where the following temperature limitations can be maintained in service.

A. Measured temperature rise in Fahrenheit degrees (C°) must not exceed listed values when the inlet is at ambient temperature. Ambient is considered as the general temperature of the space around the blower. This is not outdoor temperature unless the blower is installed outdoors.
B. If inlet temperature is higher than ambient, the listed allowable temperature rise values must be reduced by ⅓ of the difference between the actual measured inlet temperature and the ambient temperature.
C. Average of inlet plus discharge temperature must not exceed 220 °F (104 °C).

SPEED RANGE — Universal RAI blowers may be operated at speeds up to the maximums listed for various frame sizes. They may be direct coupled to suitable constant speed drivers if pressure/temperature conditions are also within limits. At low speeds, excessive temperature rise may be the limiting factor as noted in the preceding example.

Table 1 — Maximum Allowable Operating Conditions

Frame Size	Speed RPM	Inlet Vac. Inches Hg. (kPa)	Temp. Rise Fahr. Deg. (C°)	Press. Rise PSI (kPa)
22	4580	12 (40)	225 (125)	10 (68)
24	4580	10 (34)	185 (102)	6 (40)
33	3275	14 (47)	170 (94)	10 (68)
36	3275	10 (34)	115 (64)	6 (40)
42	3050	14 (47)	240 (133)	12 (82)
45	3050	14 (47)	170 (94)	10 (68)
47	3050	12 (40)	130 (72)	7 (47)
53	2440	14 (47)	195 (108)	12 (82)
56	2440	14 (47)	180 (100)	10 (68)
59	2440	12 (40)	115 (63)	7 (47)
65	2100	16 (53)	250 (139)	15 (101)
68	2100	16 (53)	240 (150)	11 (74)
615	2100	12 (40)	130 (72)	6 (40)

BLOWER ORIENTATION

The unique removable feet feature of Roots Universal RAI blowers permit field modification of blower mounting by repositioning blower feet and gear box breather as shown in Fig. 3.

Four blower mounting positions are possible:

1. Horizontal mounting, vertical air flow, drive shaft on left.
2. Same as (1) except drive shaft on right.
3. Vertical mounting, horizontal air flow, drive shaft on bottom.
4. Same as (3) except drive shaft on top.

To change blower mounting:

1. Place blower on its feet.
2. Loosen feet capscrews (32).
3. Place blower on a solid base resting on the gear box end with drive shaft on top.
4. Remove feet. (Note - Feet capscrews (32) are longer than cylinder capscrews (26), only capscrews (32) are to be used for feet, 2½ - 5 use washers (41) between feet and gear head (1)).
5. Remove cylinder capscrews (32) where feet are to be re-installed. Install capscrews (26) in the location previously occupied by feet capscrews (32).
6. Install feet using capscrews (32). Install washers (41) on gear end.
7. Place blower on its feet on flat surface.
8. Loosen feet capscrews (32) and square up blower and re-tighten capscrews (32).
9. Gear box has four threaded holes, one with breather and three with pipe plugs. Remove pipe plug (21) from the top most hole. Remove breather (25) and install it in the top most hole. Install pipe plug that was removed from the top hole into the hole previously occupied by the breather. The breather and the pipe plug should be sealed with a thread sealer.

For convenience, the position of the grease fitting (37) and the relief fitting (38) could be interchanged, however each bearing must have one grease fitting (37) and one relief fitting (38).

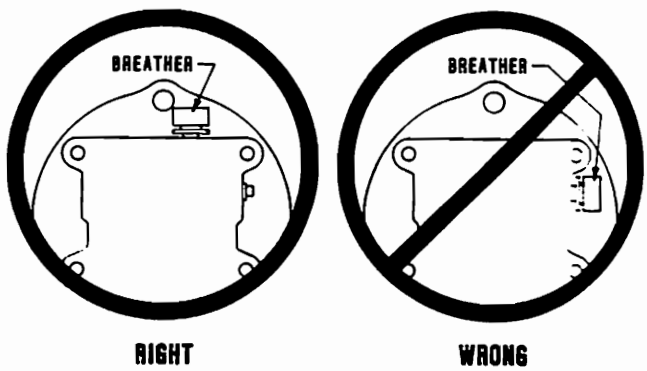


Figure 2 — Breather Installation

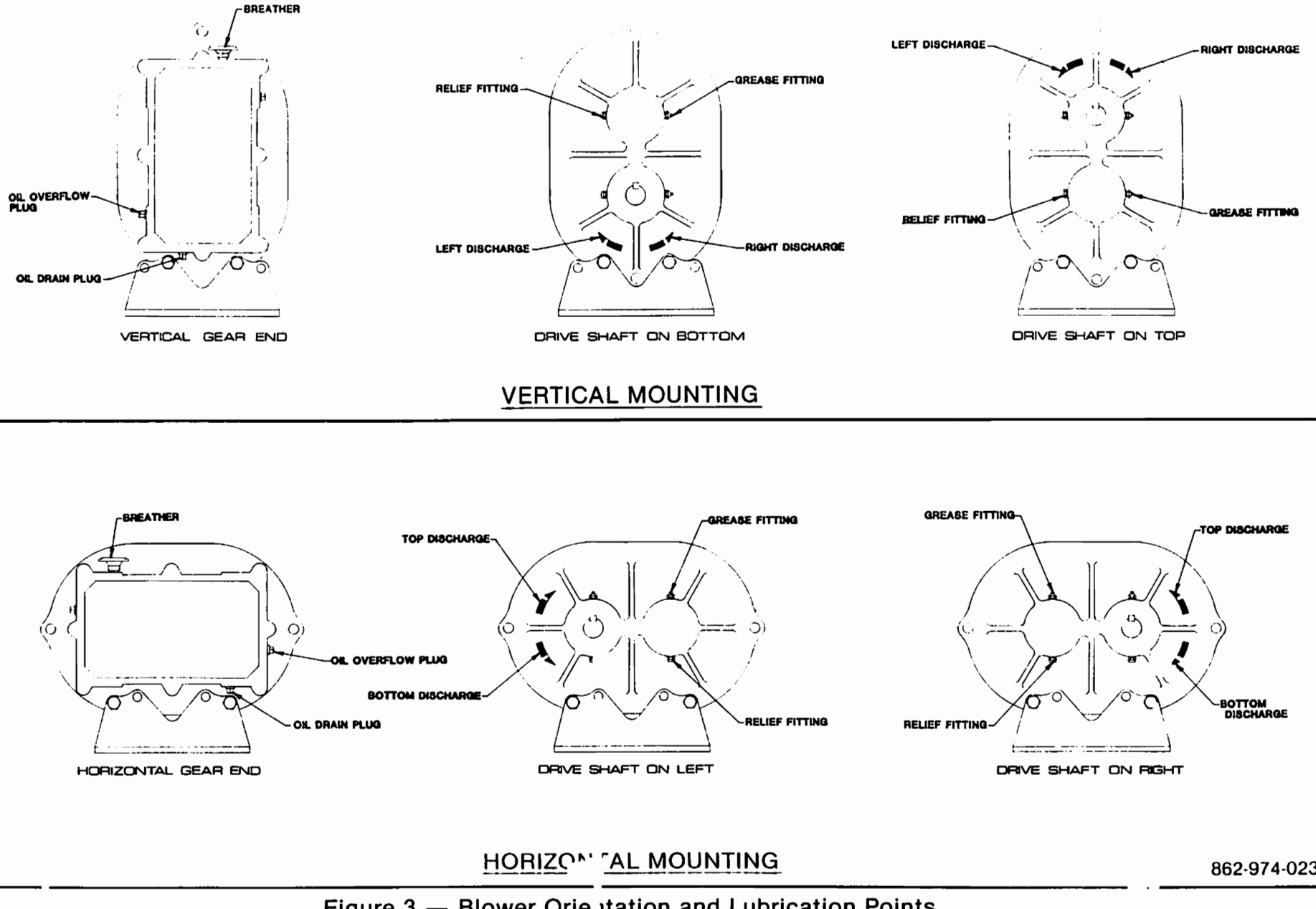


Figure 3 — Blower Orientation and Lubrication Points

INSTALLATION

Roots Universal RAI blowers are internally and externally treated after factory assembly to protect against normal atmospheric corrosion before installation. Maximum period of internal protection is considered to be one year under average conditions, if closing plugs or seals are not removed. **Protection against chemical or salt water atmosphere is not provided.** Avoid opening the blower until ready to start installation, as protection will be lost quickly by evaporation.

NOTE — If there is to be an extended period between installation and startup, the following steps should be taken to insure corrosion protection:

1. Coat internals of cylinder and gearbox with Motorstor or equivalent. Repeat once a year or as conditions may require. Motorstor is oil soluble and does not have to be removed before lubricating. If desired, Motorstor may be removed from within the cylinder shortly before startup by spraying a fine mist of petroleum solvent through the blower while it is running at a slow speed with open inlet and discharge, or it can remain in the blower if it is not harmful to the operation of the connected system. Motorstor is a product of Daubert Chemical Co., Spring Rd., Oak Brook, Ill. 60521.
2. Fill drive end bearing cavities with grease as specified in Lubrication section.
3. Paint shaft extension, inlet and discharge flanges, and all other exposed surfaces with Nox-Rust X-145 or equivalent.
4. Seal inlet, discharge, and all vent openings with tape. It is not recommended that the unit be set in place, piped to the system, and allowed to remain idle for extended periods. If any part is left open to the atmosphere, the Motorstor vapor will escape and lose its effectiveness.
5. Units are not to be subjected to excessive vibration during storage. If stored outdoors, provide coverage such as a tarpaulin or lean-to.
6. Rotate drive shaft three or four revolutions every two weeks.
7. Prior to startup, remove flange covers on both inlet and discharge and inspect internals to insure absence of rust. Check all internal clearances. Also, at this time, remove gearbox and inspect gear teeth for rust.

Because of the completely enclosed blower design, location of the installation is generally not a critical matter. A clean, dry and protected indoor location is to be preferred. However, an outdoor or wet location will normally give satisfactory service. Important requirements are that the correct grade of lubricating oil be provided for expected temperatures, and that the blower be located so that routine checking and servicing can be handled conveniently after installation. Effect of the location on driver and accessory equipment must also be considered.

Supervision of the installation by a Factory Service Engineer is not usually required for these blowers. Workmen with experience in installing light-medium weight machinery should be able to produce satisfactory results. Handling of the equipment needs to be accomplished with care, and in compliance with safe practices. Blower mounting must be solid, without strain or twist, and air piping must be clean, accurately aligned and properly connected.

A bare blower without base should be lifted by a rope sling, with one loop passing under the gearhouse and the other loop under the cylinder.

When a blower is furnished mounted on a baseplate, with or without a driver, use of lifting slings passing under the base flanges is required. Arrange these slings so that no strains are placed on the blower casing or mounting feet, or on any mounted accessory equipment.

Before starting the installation, remove plugs, covers or seals from blower inlet and discharge connections and inspect the interior completely for dirt or foreign material. If cleaning is required, finish by washing the cylinder, headplates and impeller thoroughly with a petroleum solvent such as DuPont Triclene D. After this, turn drive shaft by hand to make sure that the impellers turn freely at all points. Anti-rust compound on the drive shaft extension may also be removed at this time with the same solvent. Then plug the inlet and discharge connections to keep out dirt until ready to connect the air piping. Washing out is not required if the interior is found to be clean. The corrosion inhibitor used will vaporize and disappear during operation.

Care, plus consideration of all possible problems, will pay dividends when arranging the blower mounting. This is especially true when the blower is a "bare" unit furnished without a baseplate. The convenient procedure may be to mount such a unit directly on a floor or small concrete pad, but this generally produces least satisfactory results. It definitely causes the most problems in leveling and alignment.

Direct use of structural framing members is also not a recommended mounting. If unavoidable, the members must be rigidly reinforced when part of a building, and spring type mountings should not be used. Noise transmission can usually be reduced by use of a cork insulating pad 1 to 2 inches (25 to 50 mm) thickness. The pad should be supported by a full steel plate attached to the structure, with a rigid concrete slab laid on top of the cork to carry the blower and driver.

For a blower without base, it is recommended that a well anchored and carefully leveled steel or cast iron mounting plate be provided at the installation point. The plate should be ¾ to 1¼ inches (19 to 32 mm) thick, with its top surface machined flat, and needs to be large enough to provide leveling areas at one side and one end after the blower is mounted. It should have properly sized studs or tapped holes located to match the blower foot drilling. As an alternative, smaller plates at each end of the blower may be used. This is more complicated, usually makes leveling more difficult, and can produce twist or strains in the blower. Use of a high quality machinist's level is important. With the mounting plate in place and leveled, set the blower on it without bolting and check for rocking. If it is not solid, determine the total thickness of shims required under one foot to stop the rocking. Place half of this under each of the two short feet, and tighten the mounting studs or screws. Rotate the drive shaft to make sure the impellers still turn freely. If the blower is to

be direct coupled to a driving motor, consider the height of the motor shaft and the necessity for it to be aligned very accurately with the blower shaft. Best arrangement is for the blower to be bolted directly to the mounting plate while the driver is on shims of at least ⅛ inch (3 mm) thickness. This allows adjustment of motor position in final shaft alignment by varying the shim thickness.

Satisfactory installation can be obtained by setting the baseplate on a concrete slab that is rigid and free of vibration, and leveling the top of the base carefully in two directions so that it is free of twist. The slab must be provided with suitable anchor bolts. The use of grouting under and inside the base, after it has been carefully leveled by shimming, is recommended.

When blower and driver have been factory mounted on a common baseplate, the assembly will have been properly aligned and is to be treated as a unit for leveling purposes. It is possible for a base mounted assembly to become twisted during shipment thus disturbing the original alignment. For this reason, make the following checks after the base has been leveled and bolted down. Disconnect the drive and rotate the blower shaft by hand. It should turn freely at all points. Loosen the blower foot hold-down screws and determine whether all feet are evenly in contact with the base. If not, insert shims as required and again check for free impeller rotation. Finally, if blower is direct coupled to the driver, check shaft and coupling alignment carefully and make any necessary corrections prior to grouting.

In planning the installation, and before setting the blower, consider how piping arrangements are dictated by the blower design and assembly.

When a blower is DIRECT COUPLED to its driver, the driver RPM must be selected or governed so as not to exceed the maximum speed rating of the blower. Refer to LIMITATIONS for allowable speeds for various blower sizes. A flexible type coupling should always be used to connect the driver and blower shafts.

For engine drives, couplings with proper stiffness must be selected to aboid resonant torsional vibrations. Also, safe operating speed must be limited to avoid critical speeds.

Coupling halves must be accurately aligned, and a sufficient gap between shaft ends provided, so that side strains and end thrust on either shaft are avoided or minimized. This will require considerable care in the mounting of the driver. The two shafts must be in as near perfect alignment in all directions as possible, and the gap must be established with the motor armature on its electrical center if end play exists. Coupling halves must be fitted to the two shafts such that they can be worked into place by hand. Maximum deviation in offset alignment of the shafts should not exceed .005" (.13 mm) total indicator reading, taken on the two coupling hubs. Maximum deviation from parallel of the inside coupling faces should not exceed .001" (.03 mm) when checked at six points around the coupling.

CAUTION

Couplings as well as sheave bushings must have a slight slide fit with the blower shaft such that they can be installed in place by hand. Any force used to install them will change blower end clearances resulting in blower damage. If an interference fit is desired for the coupling, the coupling hub should be heated and shrunk on the shaft. For engine drives, use "Locktite" between the coupling hubs and the blower/engine shafts and on the threads of the coupling s screws.

When a blower is BELT DRIVEN, a proper selec- n of sheave diameters can usually be made to adapt any standard driver speed to the required blower speed. This flexibility can sometimes lead to operating temperature problems caused by blower speed being too low. Make sure the drive speed selected is within the allowable range for the specific blower size, as specified under LIMITATIONS.

Belted drive arrangements usually employ two or more V-belts running in grooved sheaves, and a variety of positions are available for the driver. Installation of the driver is less critical than for direct coupling, but its shaft must be level and parallel with the blower shaft. The driver must also be mounted on an adjustable base to permit installing, adjusting and removing the V-belts. To position the driver correctly, both sheaves need to be mounted on their shafts and the nominal shaft center distance known for the belt lengths to be used.

Install the blower sheave (usually the larger one) so that its inner hub face is not more than ¼ inch (7 mm) from the bearing end cover. The shaft fit should be such that the sheave can be worked into place by hand. A tight or driving fit can damage a bearing, and may cause internal blower damage by forcing the impeller out of its normal operating position. A loose fit or wobbly sheave will cause vibration, and may result in shaft breakage

The driver sheave should also be mounted as c to its bearing as possible, and again should fit the shaft correctly. Position the driver on its adjustable base so that ⅔ of the total movement is available in the direction away from the blower, and mount the assembly so that the face of the sheave is accurately in line with the blower sheave. This position minimizes belt wear, and allows sufficient adjustment for both installing and tightening the belts. After belts are installed, adjust their tension in accordance with the manufacturer's instructions. However, only enough tension should be applied to prevent slippage when the blower is operating under load. *Excessive tightening* can lead to early bearing failures.

Failure to properly align the blower and drive sheaves will result in the impeller being forced against one of the headplates during operation causing serious damage to the blower.

In the absence of belt manufacturer's instructions for tensioning, the following procedures may be used.

1. With the belts loose, pull the slack on all of them to the bottom side of the drive.
2. Adjust motor position to tighten belt until they appear to be seating in the sheave grooves.
3. Thump the belts with your fist. If they feel dead, tighten them more un" they vibrate and feel springy when struck.
4. Run-in the drive for a short period, after prepari the blower as instructed in a following paragraph. While running, adjust until only a very slight bow appears in the slack side of the belts.
5. Stop the motor and compare the tensions of the individual belts by pressing down firmly with one hand on the top surface. It should be possible to deflect each

belt only to the point where its top surface is even with the bottoms of the other undeflected belts.

6. A new set of belts should be first tensioned about ⅓ greater than normal to allow for stretch and wear-in. Before putting the drive into normal operation, increase the tension as obtained above by a small amount. Recheck after each 8 hour operating period during the first 50 hours, and adjust as necessary.

Before operating the drive under power to check initial belt tension, first remove covers from the blower connections. Make sure the interior is still clean, then rotate the shaft by hand. Place a screen over the inlet connection to prevent anything being sucked into the blower while it is operating, and avoid standing in line with the discharge opening. Put oil in the gearhouse per instructions under LUBRICATION.

Before cnnecting piping, remove any remaining antirust compound from blower connections. Piping must be clean and should be sized so that the air velocity will not exceed 75 feet per second (23 m per second). Pipe used should be no smaller than blower connections. In addition, make sure it is free of dirt, scale, cuttings, weld beads, or foreign materials of any kind.

To further guard against damage to the blower, especially when an inlet filter is not used, install a substantial screen of 16 mesh backed with hardware cloth at or near the inlet connections. Make provisions to clean this screen of collected debris after a few hours operation. It should be removed when its usefulness has ended, as the wire will eventually deteriorate and small pieces going into the blower may cause serious damage.

Pipe threads or flanges must meet the blower connections accurately and squarely. Do not attempt to correct misalignment by springing or cramping the pipe. In most cases this will distort the blower casing and cause impeller rubbing. In severe cases it can prevent operation or result in a broken drive shaft. For similar reasons, piping should be supported near the blower to eliminate dead weight strains. Also, installation of flexible connectors or expansion joints is recommended.

Figure 4 represents in diagram form a blower installation with all accessory items that might be required under various operating conditions. Inlet piping should be completely free of valves or restrictions. When a shut-off valve (not shown) cannot be avoided, make sure a full size vacuum relief is installed near the blower inlet. This will protect against blower overload caused by accidental closing.

Need for an inlet silencer will depend on blower speed and pressure, as well as sound-level requirements in the general surroundings. An inlet filter is normally recommended, especially in dusty or sandy locations, for blower protection. A discharge silencer is also normally suggested. Specific recommendations on silencing can be obtained from the nearest Distributor. Silencers should be mounted as close to blower as possible.

Discharge piping requires a pressure relief valve, and should include a manual unloading valve to permit starting the blower under no-load conditions. Reliable pressure/vacuum gauges and good thermometers at both inlet and discharge are recommended to allow making the important checks on blower operating conditions. If the demand is constant, but somewhat lower than the blower output, excess may be blown off through the manual unloading valve.

In multiple blower installations when two or more units discharge into a common header, use of check valves is recommended. These should be of a direct acting or free swinging type, with one valve located in each blower

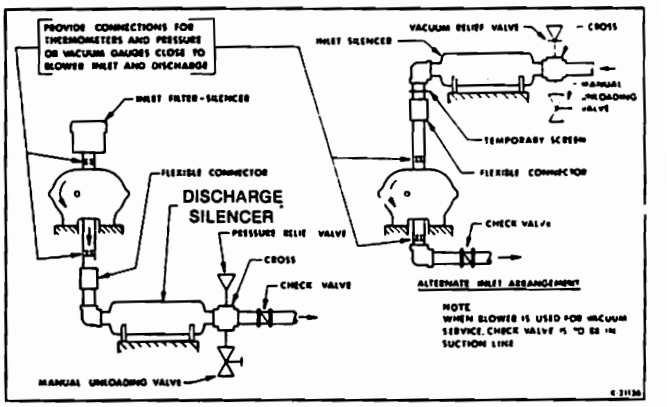


Figure 4 — Installation with Accessories

discharge line. Properly installed, they will protect against damage from reverse rotation caused by air backflow through an idle blower.

After piping is completed, and before applying power, rotate the drive shaft by hand again. If it does not move with uniform freedom, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment. Do not operate the blower more than briefly at this time because of possible inadequate oil supply in the gearhouse. Read LUBRICATION section.

LUBRICATION

A simple but very effective lubrication system is employed on Universal RAI blowers. At the drive shaft end the bearings are grease lubricated using hydraulic pressure relief fittings. These relief fittings vent any excess grease, preventing pressure build-up on the seals. A restriction plug and metering orifice prevent loss of lubricant from initial surges in lubricant pressure but permit venting excess lubricant under steadily rising pressures.

The blind end bearings and timing gears are enclosed by a gearhouse located opposite the drive end of the blower. In a side outlet blower, the lower timing gear functions as an oil slinger, carrying lubricant to the upper timing gear and providing splash lubrication for the bearings. Pressure within the gearbox is vented through the breather vent plug (25).

The above description also applies in general to the top or bottom outlet style blower, the principal difference being that both gears dip into the oil sump.

Before starting blower, be sure oil has been put in gearhouse, as **ALL OIL WAS DRAINED FOLLOWING SHOP TESTS.** For recommended lubricating oil see Table 2. Use a good grade industrial type rust, oxidation. and foam inhibited, non-detergent oil.

Table 2 — Recommended Oil Grades

Ambient Temperature °F	Viscosity Range SSU at 100°F.	Approximate SAE No.
(°C)	(38°C)	
Above 90° (32°)	1000 - 1200	50
32° to 90° (0° to 32°)	700 - 1000	40
0° to 32° (-18° to 0°)	500 - 700	30
Below 0° (-18°)	300 - 500	20

To fill the gearbox, remove the breather plug and the oil overflow plug (Fig. 2). Fill the reservoir up to the overflow hole. Place the breather and the overflow plug back into their respective holes.

Table 3 — Oil Sump Capacities

Frame Size	Capacity, Fl. Oz. (Liters) Vertical	Horizontal
22	3.4 (.1)	6.1 (.18)
24	3.4 (.1)	6.1 (.18)
33	8.5 (.25)	16.0 (.47)
36	8.5 (.25)	16.0 (.47)
42	12.7 (.37)	22.8 (.67)
45	12.7 (.37)	22.8 (.67)
47	12.7 (.37)	22.8 (.67)
53	16.0 (.47)	27.6 (.82)
56	16.0 (.47)	27.6 (.82)
59	16.0 (.47)	27.6 (.82)
65	28.3 (.84)	52.1 (1.54)
68	28.3 (.84)	52.1 (1.54)
615	28.3 (.84)	52.1 (1.54)

Proper lubrication is usually the most important single consideration in obtaining maximum service life and the most satisfactory operation from the unit. Unless operating conditions are quite severe, a weekly check of gearhouse oil level and necessary addition of lubricant should be sufficient. A complete oil change normally is made after 1000 operating hours, or less, depending on the type of oil and oil operating temperature.

Shaft bearings at the drive end of the blower are grease lubricated and each bearing housing is equipped with pressure type grease fittings and pressure type relief fittings. When servicing drive end bearings, use a premium grade, petroleum base grease with high temperature and moisture resistance and good mechanical stability. Using a pressure gun, force new lubricant into each drive end bearing housing until traces of clean grease comes out of the relief fitting.

After a long shutdown, it is recommended that the grease relief fittings be removed, the old grease flushed out with kerosene or #10 lubricating oil, drained thoroughly, and bearings refilled with new grease. Be sure grease relief fittings are reinstalled. Grease should be added using hand operated grease gun to the drive end bearings at varying time intervals depending on duty cycle and RPM. Table 4 has been prepared as a general greasing schedule guide based on average operating conditions. More frequent intervals may be necessary depending on the grease operating temperature and under unusual circumstances.

Table 4 — Suggested Bearing Lubrication Intervals

Speed in RPM	Operating Hours Per Day		
	8	16	24
	Greasing Intervals in Weeks		
750 - 1000	7	4	2
1000 - 1500	5	2	1
1500 - 2000	4	2	1
2000 - 2500	3	1	1
2500 - 3000	2	1	1
3000 and up	1	1	1

OPERATION

Before operating a blower under power for the first time, check the unit and the installation thoroughly to reduce the likelihood of avoidable troubles. Use the following procedure list as a guide, but consider any other special conditions in the installation.

1. **Be certain** that no bolts, tools, rags or dirt have been left in the blower air amb[illegible].
2. **Be certain** that inlet piping is free of debris. If outdoor intake without filter is used, be sure the opening is located so it cannot pick up dirt and is protected by a strong screen or grille. Use of the temporary protective screen at the blower as described under **INSTALLATION** is strongly recommended.
3. **Recheck** blower leveling, drive alignment and tightness of all mounting bolts if installation is not recent. If belt drive is used, adjust belt tension correctly.
4. Turn drive shaft by hand to make sure impellers still rotate without bumping or rubbing at any point.
5. **Make sure** oil level in blower gearbox is correct.
6. Check lubrication of driver. If it is an electric motor, be sure that power is available and that electrical overload devices are installed and workable.
7. Open the manual unloading valve in the discharge air line. If a valve is in the inlet piping, be sure it is open.
8. Bump blower a few revolutions with driver to check that direction of rotation is correct, and that both units coast freely to a stop.

After the preceding points are cleared, blower is ready for trial operation under "no-load" conditions as set up under Item 7. The following procedure is suggested to cover this initial operating test period.

a. Start blower, let it accelerate to full speed, then shut off. Listen for knocking sounds, both with [illegible] and as speed slows down.
b. Repeat above, but let blower run 2 or 3 minutes. Check for noises, and vibrations of 5 mils or greater.
c. Operate blower for about 10 minutes unloaded. Check oil levels. Feel cylinder and headplate surfaces for development of spots too hot to touch, indicating impeller rubs. Be aware of any noticeable increase in vibration.

Assuming that all trials have been satisfactory, or that necessary corrections have been made, the blower should now have a final check run of at least one hour under normal operating conditions. After blower is re-

started, gradually close the discharge unloading valve to apply working pressure. At this point it is recommended that a good pressure gauge or manometer be connected into the discharge line if not already provided, and that thermometers be in both inlet and discharge lines. Readings from these instruments will show whether pressure or temperature ratings of the blower are being exceeded.

During the final run, check operating conditions frequently and observe the oil levels at reasonable intervals. If excessive noise or local heating develops, shut down immediately and determine the cause. If either pressure rise or temperature rise across the blower exceeds the limit specified in this manual shut down and investigate conditions in the piping system or in the process to which air is being supplied. Refer to the **TROUBLE SHOOTING CHECKLIST** for suggestions on various problems that may appear.

The blower should now be ready for continuous duty operation at full speed. During the first few days make periodic checks to determine whether all conditions remain steady, or at least acceptable. This may be particularly important if the blower is supplying air to a process system where conditions can vary. At the first opportunity, stop the blower and clean the temporary inlet protective screen. If no appreciable amount of debris has collected, the screen may be removed. See comments under **INSTALLATION.** At this same time, verify leveling, coupling alignment or belt tension, and mounting bolt tightness.

Should operating experience prove that blower capacity is a little too high for the actual air requirements, a small excess may be blown off continuously through the manual unloading vent valve. **Never rely on the pressure relief valve as an automatic vent.** Such use may cause the discharge pressure to become excessive and can also

TROUBLE SHOOTING CHECKLIST

TROUBLE	ITEM	POSSIBLE CAUSE	REMEDY
No Air Flow	1	Speed too low	Check by tachometer and compare with speed shown on Roots Order Acknowledgement.
	2	Wrong rotation	Compare actual rotation with Figure 2. Change driver if wrong.
	3	Obstruction in piping	Check piping, screen, valves, silencer, to assure an open flow path.
Low capacity	4	Speed too low	See item 1. If belt drive, check for slippage and readjust tension.
	5	Excessive pressure	Check inlet vacuum and discharge pressure, and compare these figures with specified operating conditions on Order.
	6	Obstruction in piping	See item 3.
	7	Excessive slip	Check inside of casing for worn or eroded surfaces causing excessive clearances.
Excessive Power	8	Speed too high	Check speed and compare with Roots Order Acknowledgement.
	9	Pressure too high	See item 5.
	10	Impellers rubbing	Inspect outside of cylinder and headplates for high temperatures areas, then check for peller contacts at these points. Correct blower mounting, drive alignment.
Overheating of Bearings, or Gears	11	Inadequate lubrication	Restore correct oil levels in gearbox and lubricate.
	12	Excessive lubrication	Check gear oil level. If incorrect, drain and refill with clean oil of recommended grade.
	13	Excessive pressure rise	See item 5.
	14	Coupling misalignment	Check carefully. Realign if questionable.
	15	Excessive belt tension	Readjust for correct tension.
	16	Speed too low	Speeds lower than the minimum recommended will overheat the entire blower.
Vibration	17	Misalignment	See item 14.
	18	Impellers rubbing	See item 10.
	19	Worn bearings/gears	Check gear backlash and condition of bearings.
	20	Unbalanced or rubbing impellers	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to retore original clearances and impeller balance.
	21	Driver or blower loose	Tighten mounting bolts securely.
	22	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping. Refer to Distributors.

result in failure of the valve itself. If blower capacity appears to be too low, refer to the TROUBLE SHOOTING CHECKLIST first. If no help is found there it may be possible to increase the blower speed. Before attempting this change, contact the nearest Distributor for recommendations. Be prepared to furnish data on actual air requirements and operating pressure/temperature conditions.

SAFETY PRECAUTIONS

For equipment covered specifically or indirectly in this instruction book, it is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should particularly be noted:

- **Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.**
- **Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Cover external moving parts with adequate guards.**
- **Disconnect power before doing any work and avoid bypassing or rendering inoperative any safety or protective devices.**
- **If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream.**
- **Stay clear of open inlet piping (suction area) of pressure blowers, and the open discharge blast from vacuum blowers.**
- **Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.**
- **Avoid extended exposure in close proximity to machinery which exceeds safe noise levels.**
- **Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.**
- **Casing pressure must not exceed 25 PSI (172 kPa) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents.**
- **Do not use air blowers on explosive or hazardous gases.**
- **Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.**

MAINTENANCE & REPLACEMENTS

A good program of inspection and maintenance servicing, followed consistently, is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are lubrication, checking for hot spots or increase in vibration and noise and the recording of operating pressures and temperatures. Above all, a **blower must be operated within its specified rating limits,** to obtain satisfactory service life.

A newly installed blower should be checked frequently during the first month of full-time operation. Attention thereafter may be less frequent, depending on what the early checks have shown. Lubrication is normally the most important consideration. Unless operating conditions are unusually severe, a weekly check of oil levels in the gearbox, with addition of oil as required, should be sufficient. Complete oil changes should be made at intervals of 1000 operating hours, or more frequently if oil condition becomes poor.

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent it from causing vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts. Refer to tensioning instructions under **INSTALLATION.**

In a new and properly installed blower there are no moving contacts between the two impellers, or between the impeller and cylinder or headplates. Wear is then confined to the bearing which support and locate the shafts, the shaft seals, and the timing gears. All are lubricated, and wear should be nominal if clean oil of the correct grade is always supplied. Seals are subject to deterioration as well as wear, and may require replacement at varying periods.

Shaft bearings have been selected to have optimum life under average conditions with proper lubrication. They are critical in the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and cylinder headplate. This will cause spot heating, which can be detected by feeling these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Shaft seals should be considered expendible items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for any reason. Sealing effectiveness can vary considerably from seal to seal and is also affected by shaft smoothness under the seal lip. Because of these normal variables, minor seal leakage should not be considered an indicator for seal replacement.

Timing gear wear, when correct lubrication is maintained should be negligible over a period of years. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accom-

modate a normal amount of tooth wear without permitting contact between lobes of the two impellers.

However, a high oil level will cause churning and excessive heating, indicated by an unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance or backlash, and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Operating problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch (hundredths of a mm). This makes it possible for impeller interferences or casing rubs to result from shifts in the blower mounting or from changes in piping support. Foreign materials sucked into the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely before reconnecting it.

A wide range of causes for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST.** The remedies suggested there in some cases need to be performed by qualified mechanics with a good background of general experience, using procedures detailed in this manual. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to the nearest Distributor listed on the last page.

Warranty failures should not be repaired at all, unless specific approval has been obtained through a Distributor or a factory before starting work. Unauthorized disassembly within the warranty period may void the warranty.

When a blower is taken out of service it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgment based on existing conditions as well as length of downtime. Under favorable conditions, protection will probably not be needed if shut-down is not longer than a month. Under atmospheric conditions producing rapid corrosion, the blower should be protected immediately. If blower is to be shut down for an extended period of time, see suggestions for corrosion protection under installation.

It is recommended that major repairs, if needed, be performed at a Dresser authorized service facility. However, it is recognized that this may not always be practical, especially when a spare blower is not available. If a blower is out of the warranty period, mechanical adjustments and parts replacement may be undertaken locally at the owner's option and risk. It is recommended that Factory Parts be used to insure fit and suitability. The maintenance of a small stock of on-hand spare parts can eliminate possible delays. When ordering parts give Item Numbers and their word descriptions from Figures 5 & 6. Also specify quantities wanted and the blower size and serial number from the nameplate.

Repairs or adjustments are best performed by personnel with good mechanical experience and the ability to follow the instructions in this manual. Some operations involve extra care and patience, and a degree of precision work. This is especially true in timing impellers and in handling bearings. Experience indicates that a high percentage of bearing failure is caused by dirt contamination before or during assembly. Therefore, the work area should be cleaned before starting disassembly, and new or re-usable parts protected during progress of the work.

In the following outlines of repair procedures, numbers shown in brackets ( ) correspond to the Item Numbers used in assembly drawing, Figure 8 & 9. It is recommended that the procedure be studied carefully and completely, with frequent reference to the drawings, before starting work. This will produce better efficiency through an understanding of what work is to be done, and the order of doing it. Before disassembly, mark all parts so that they may be returned to original locations or relative positions.

A — Replacing Timing Gears

1. Drain all oil from the gearhouse by removing drain plug (21) in the bottom. Remove gearhouse by taking out all cap screws (23) in its flange. It may be necessary to bump the sides with a wood block or mallet to break the flange joint.
2. Reach through one of the blower pipe connections and place a chalk mark on the strip of one impeller and the mating waist of the other, so that they may easily be returned to their original relative positions.

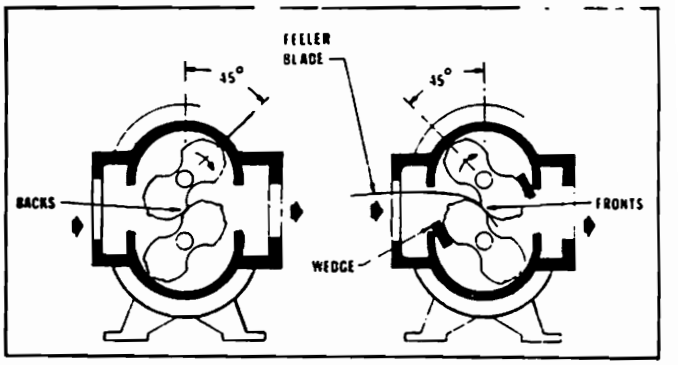


Figure 5 — Impeller Timing Viewed From Gear End

3. GEAR REMOVAL: For this operation, the impellers should be wedged as shown in Figure 5. Back off gear clamping nuts (17) about ¼". Use a puller of the type shown in Figure 10. Position it around the gear per Figure 9. As the puller set screw is torqued, the puller will have a tendency to turn and contact teeth of the other gear. To prevent this contact, hold the puller corner nut with a wrench while torquing the set screw. Once the gear is unseated, remove the puller. Remove gear nuts (17) and the gear. Repeat same procedure for the other gear. NOTE: Do not remove gear nuts (17) completely before the gears are unseated from the taper fits or damage/injury may result.

4. GEAR INSTALLATION: Place impellers in correct position as previously marked. Be sure shafts and gear bores are clean and free of scratches. Clean the shaft tapered fits. Place hardwood wedges as shown in Figure 5. Install drive gear (4) and gear nut (17) so match mark at tooth is at the line of engagement. Tighten the drive gear nut to the torque given in Table 5. Blower assembly must be fastened down for torquing operation.

TABLE 5 — GEAR NUT TORQUE

Gear Size (in.)	Torque	
	lb.-ft.	(kg-m)
2.5	45	(6.5)
3.5	65	(9.0)
4.0	125	(17.5)
5.0	210	(29.0)
6.0	350	(48.0)

5. Installing driven gear (4) - Insert a long, metal feeler gauge between the impellers' lobes at the fronts or backs as shown in Figure 5. Feeler gauge thickness to be a middle value from Table 6 for fronts and backs. Align the gear so the tooth match marks agree with the drive gear, then install nut (17). Tighten lightly with a small wrench, then check front and back clearances against Table 6 for each 45° position. Both fronts and backs should be about the same and within the specified range in Table 6. Adjust gear position, if necessary, then insert the corrected feeler gauge and wedges and use a torque wrench to tighten the gear nut to the torque specified in Table 5. Remove wedges and rotate the drive shaft by hand to make sure there are no gear tight spots or impeller contacts.

   Caution! Keep fingers away from impellers and gears.

6. Check the end clearances between impellers and headplates. Adjust clearances per B-15 below.

7. When clearances are correct, clean and re-install the gearhouse. Check condition of flange gasket (7) and replace if questionable. Fill gearhouse to correct level with proper grade of oil.

B — Replacing Shaft Bearings, and Impellers

Remove coupling or sheave from the drive shaft. Drain and remove gearhouse, and pull the timing gears. If gears are to be re-used, mark them so they may be returned to the same shafts.

1. Break corners and deburr the keyway. Remove bearing end cover at the drive end. Remove bearing clamp plates (34).

2. Make single and double identifying punch marks on the mating edges of headplate and cylinder flanges at the two ends of the blower.

3. At the drive end, drive out the two dowel pins and remove all capscrews holding headplate to cylinder. By inserting jacking screws into the two threaded flange holes, and turning them in evenly, the headplate will be separated from the cylinder. As the headplate comes off the shafts it will bring bearings with it. 2½" and 3½" gear diameter units do not have tapped holes for jack screws in the drive end headplates. Remove dowel pins and all capscrews holding headplate to cylinder and foot on the drive end. Support unit under gear end cylinder flange with the shafts vertical. Using soft metal block against gear end shafts, push them out of gear end headplate.

4. For 2½" and 3½" gear diameter units, support the drive end headplate on the underside, and use soft metal block against drive end, shafts, push them out of drive end headplate.

   For 4", 5" and 6" gear diameter units, from the gear end, using a wood or soft metal block against the ends of the shafts, drive them out of the headplate. If they are to be reused, protect them from damage in this operation.

5. If blower interior surfaces need cleaning, it may be advisable to separate the gear end headplate from the cylinder. Use the same general procedure as employed at the drive end.

6. Working from the back (flat) face of each headplate, push or tap out the bearings and seals. Use a round bar or tube that will pass through the shaft clearance holes in the headplates. All lip seals will be damaged during removal and must be replaced.

7. Clean bearing and seal pockets in headplates and remove burrs or rough edges. (Apply a thin coating of sealant on seal O.D.) Press new seals (27) into gear end headplate using a round tube or bar with recessed end that will bear on the outer metal edge of seal enclosure. Seal lip should point toward driving tool. Seals to be flush with outboard bore face. Apply a light coat of oil or grease to the seal lips. In a similar fashion, install lip seals into the drive end headplate.

8. Place cylinder on a flat surface. Assemble gear end headplate to cylinder after checking flange punch marks. Drive in the two locating dowel pins before tightening flange screws. Also install gear end foot using the same longer cap screws (32) and washers (41). (On 6" RAI install both gear and feet.)

9. Place the assembly horizontally on steel blocks with gear end headplate on bottom. The height of the blocks should be sufficient to clear gear end shaft extensions. Assemble impellers into the cylinder with the drive shaft (longer shaft) in same

location as in original assembly. Before starting the shafts through the headplate holes, make sure shaft ends have no sharp or rough edges to damage seal lips. Position impellers at 90° to each other in the cylinder, using lobe-and-waist match marks if original impellers are being re-installed. Install drive end headplate and feet in same manner as gear end.

10. It is recommended that new bearings be used for rebuild. Apply thin film of machine oil on the shaft bearing fit, bearing I.D., and headplate bearing bore. Install drive end bearings into headplate. Use a tube with flanged end that will contact both bearing faces simultaneously. Refer to Fig. 11 for proper bearing depths.

    NOTE: Cylindrical drive bearing should be installed with inner race large shoulder facing outboard.

11. Place blower on its feet on a flat surface. Loosen feet capscrews (32) and square up unit. Re-tighten capscrews (32). Clamp unit down to a solid base for further assembly.

12. Oil the gear end bearing fits as described previously. Install 2½-5" RAI gear end bearings flush with the headplate bearing shoulders using proper drivers. On 6" RAI. install thrust washer (29) in bearing bores then install gear end bearings so that they protrude 1/16" (1.6mm) above headplate surface.

13. Install bearing clamp plates (34). On 6" RAI, impeller end clearances are also to be set during this step. Install clamp plates (34) with capscrews (31) making sure that the gap between the clamp plates and the headplate is even all around, at the same time, set end clearances per Table 5.

14. Install gears and time impellers as in (A).

15. For setting end clearances on 2½-5" gear diameter units, special tools, thrust adjuster fork Fig. 7 and thrust adjuster saddle Figure 8 are required. Refer to Fig. 6 for installation of tools. The flat side of the saddle rests against the bearing inner race and the flat side of the fork rests against the back side of the gear. Install a shim, with thickness equal to gear end clearance (Table 6), between the impeller and the gear end headplates. Tap on top of the fork until the shim becomes snug. Remove the shim and check end clearances. To increase gear end clearance, tap on the end of the gear end shaft with a soft metal mallet. On 6" units set end clearances by turning capscrews (31) evenly in or out.

16. Install drive end cover (5) after packing bearing cavities with suitable grease. Replace drive shaft seal. Lip must point toward (33) the bearing. Exercise care not to damage the lip as it passes over shaft keyway.

17. Install gasket item (7). Install the gear house after cleaning out the inside. Tighten gear box cap screws (23) evenly. Fill with correct grade of oil until oil flows out through oil level hole. Grease drive and bearings. (See Lubrication.)

18. Reinstall coupling or belt sheave making sure that they have a slight slide fit with the shaft and could be installed by hand.

INTERNAL CLEARANCES

References to operating clearances in this manual include only one mention of the specific amount of clearance to be used or expected. For units in good condition this information is not essential in field service work. Situations may arise, however, when it is desirable to compare existing clearances with the correct Engineering values or to re-establish clearances.

Listed in Table 6 are the ranges of impeller clearances used in factory assembly of normal RAI blowers. It should be kept in mind that clearances may change slightly in service, but should never be less than the minimum values listed. Only well qualified personnel should attempt to measure clearances for direct comparison with this data.

Table 6 — Normal Clearances for Universal RAI Blowers — Inches (MM)

SIZE	IMPELLER ENDS		CYLINDER	IMPELLER
	TOTAL	GEAR END	STRIP ALL AROUND	FRONTS & BACKS
22	.005/.009 (.13-.23)	.002 (.05)	.004/.0055 (.1-.14)	.007/.01 (.18-.25)
24	.005/.009 (.08-.18)	.002 (.05)	.004/.0055 (.1-.14)	.007/.01 (.18-.25)
33	.005/.01 (.13-.25)	.002 (.05)	.0045/.0065 (.11-.17)	.01/.012 (.25-.30)
36	.005/.01 (.13-.25)	.002 (.05)	.0045/.0065 (.11-.17)	.01/.012 (.25-.30)
42	.0055/.01 (.14-.25)	.003 (.08)	.005/.007 (.13-.18)	.011/.014 (.28-.36)
45	.007/.012 (.18-.30)	.003 (.08)	.005/.007 (.13-.18)	.012/.015 (.3-.38)
47	.007/.012 (.18-.3)	.003 (.08)	.005/.007 (.13-.18)	.012/.015 (.3-.38)
53	.006/.01 (.15-.25)	.003 (.08)	.0055/.0075 (.14-.19)	.013/.015 (.33-.38)
56	.007/.012 (.18-.3)	.003 (.08)	.0055/.0075 (.14-.19)	.015/.017 (.38-.43)
59	.007/.012 (.18-.3)	.003 (.08)	.0055/.0075 (.14-.19)	.015/.017 (.38-.43)
65	.011/.015 (.28-.38)	.003 (.08)	.006/.008 (.15-.2)	.010/.014 (.25-.36)
68	.011/.015 (.28-.38)	.003 (.08)	.006/.008 (.15-.2)	.010/.014 (.25-.36)
615	.011/.015 (.28-.38)	.003 (.08)	.006/.008 (.15-.2)	.010/.014 (.25-.36)

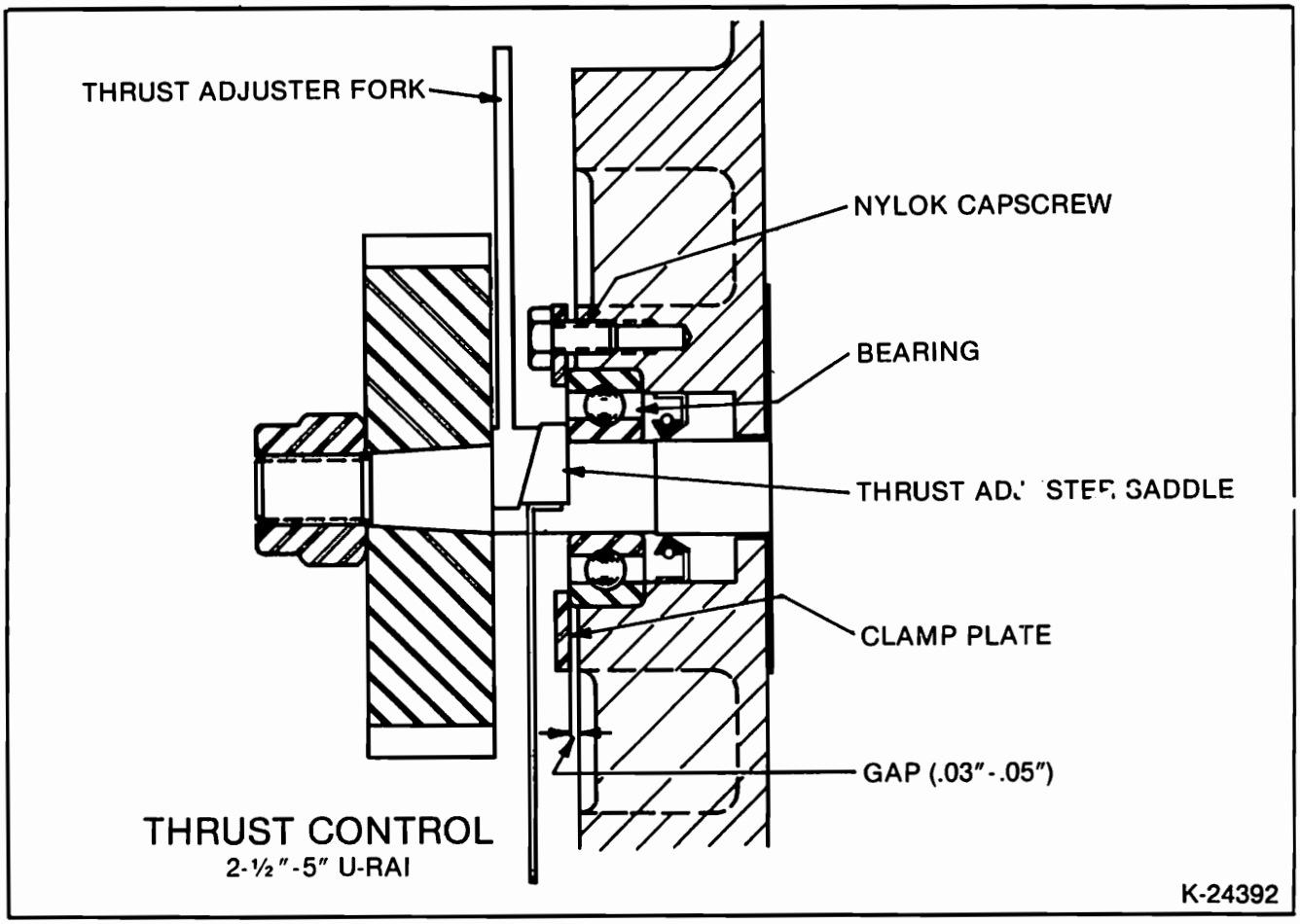
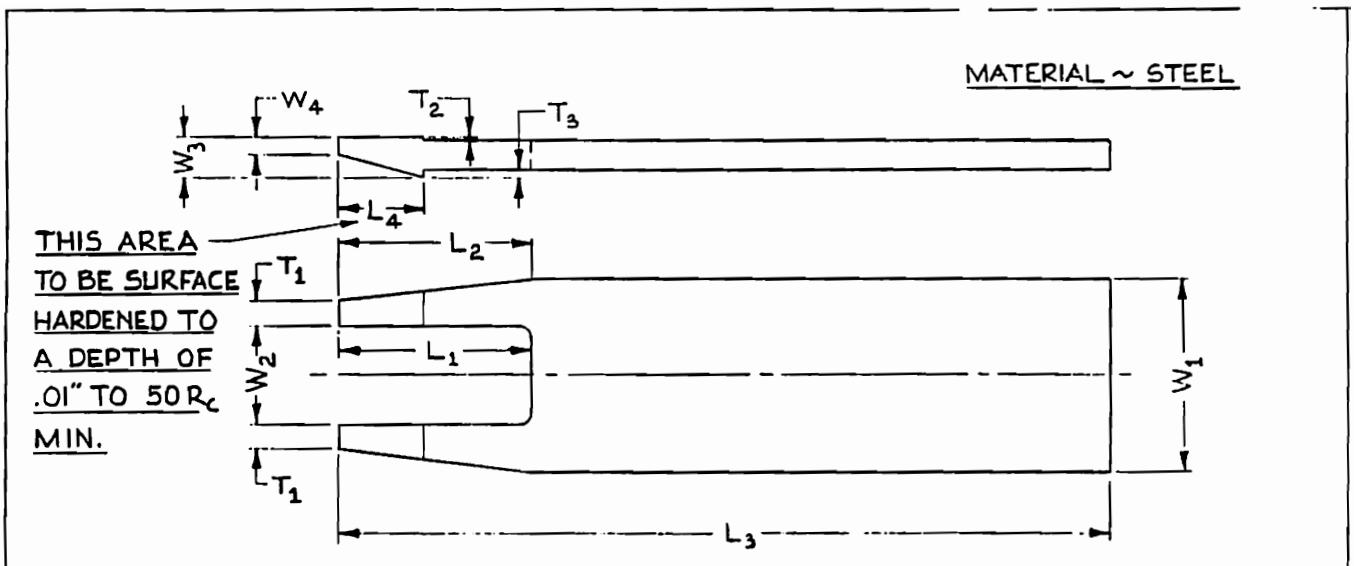
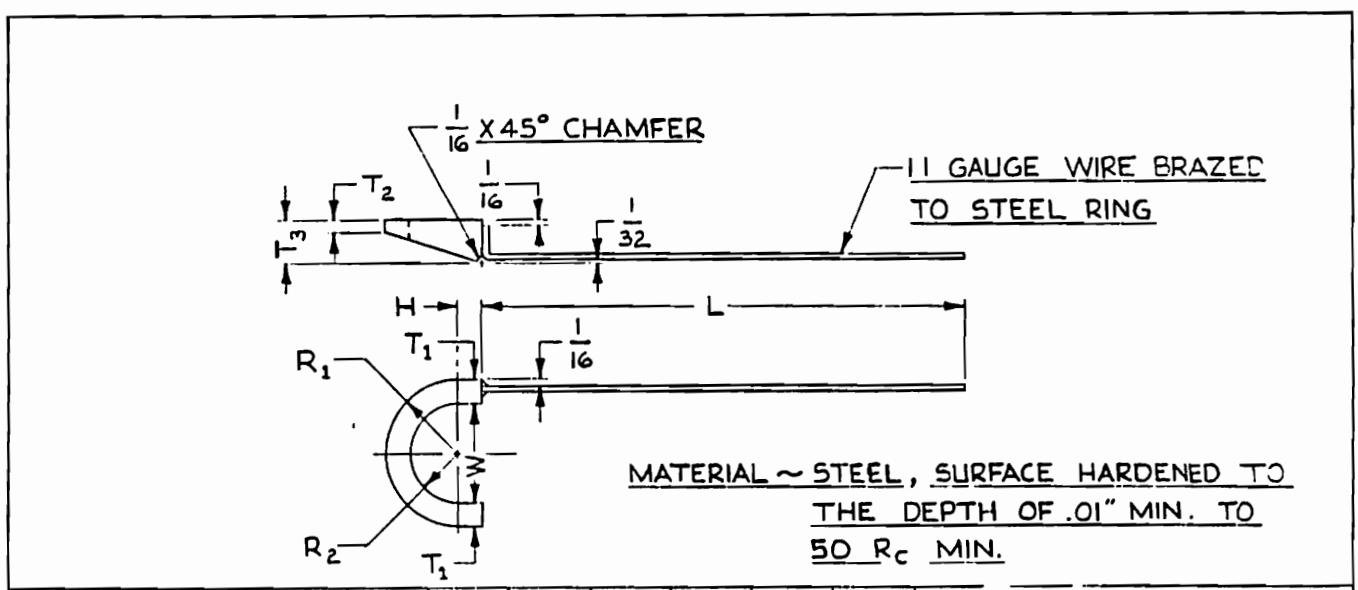


Figure 6 — Thrust Setting, 2½"-5" Universal RAI



PART Nº	BLW. SIZE	L_1	L_2	L_3	L_4	W_1	W_2	W_3	W_4	T_1	T_2	T_3	NOTES
812-973-001	2 1/2" U-RAI	1 3/4	1 3/4	6 1/2	9/16	1 3/8	11/16	1/4	1/8	7/32	1/32	1/32	
812-973-002	3 1/2" U-RAI	2	2	7	7/8	1 1/2	13/16	5/16	1/16	7/32	1/32	1/16	
812-973-003	4" U-RAI	2	2	7 1/2	1	1 3/4	1 1/32	3/8	1/16	1/4	1/32	1/32	
812-973-004	5" U-RAI	2 1/4	2 1/4	8	7/8	2	1 1/4	13/32	3/16	1/4	1/32	1/16	

Figure 7 — Thrust Adjuster Fork 812-973



PART Nº	BLW. SIZE	R_1	R_2	W	T_1	T_2	T_3	H	L	NOTES
812-974-001	2 1/2" U-RAI	15/32	11/32	11/16	1/8	1/16	1/4	3/16	3	
812-974-002	3 1/2" U-RAI	5/8	13/32	13/16	7/32	1/16	5/16	3/16	3 1/2	
812-974-003	4" U-RAI	49/64	33/64	1 1/32	1/4	1/8	7/16	1/4	4	
812-974-004	5" U-RAI	7/8	5/8	1 1/4	1/4	1/8	7/16	1/4	5	

Figure 8 — Thrust Adjuster Saddle 812-974

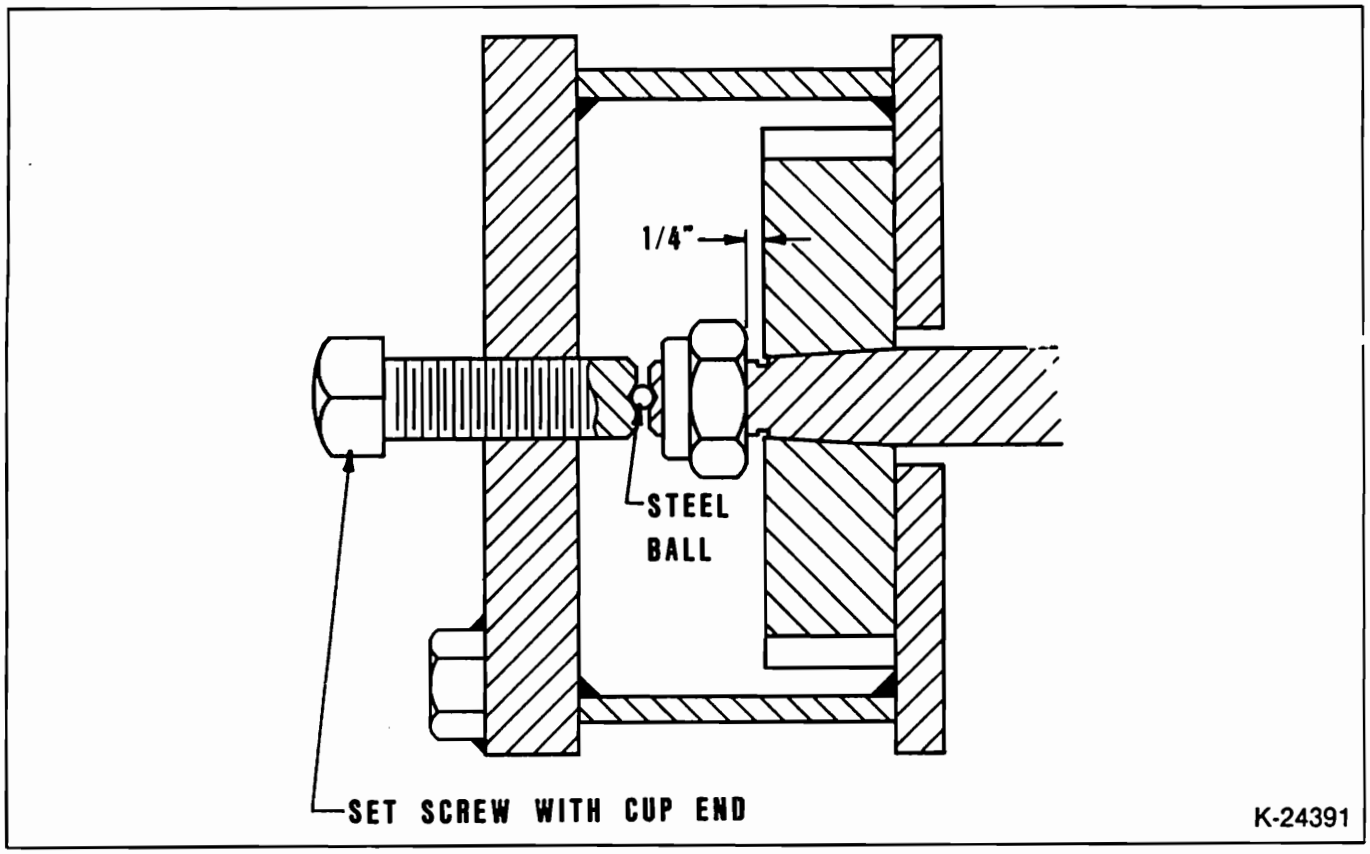
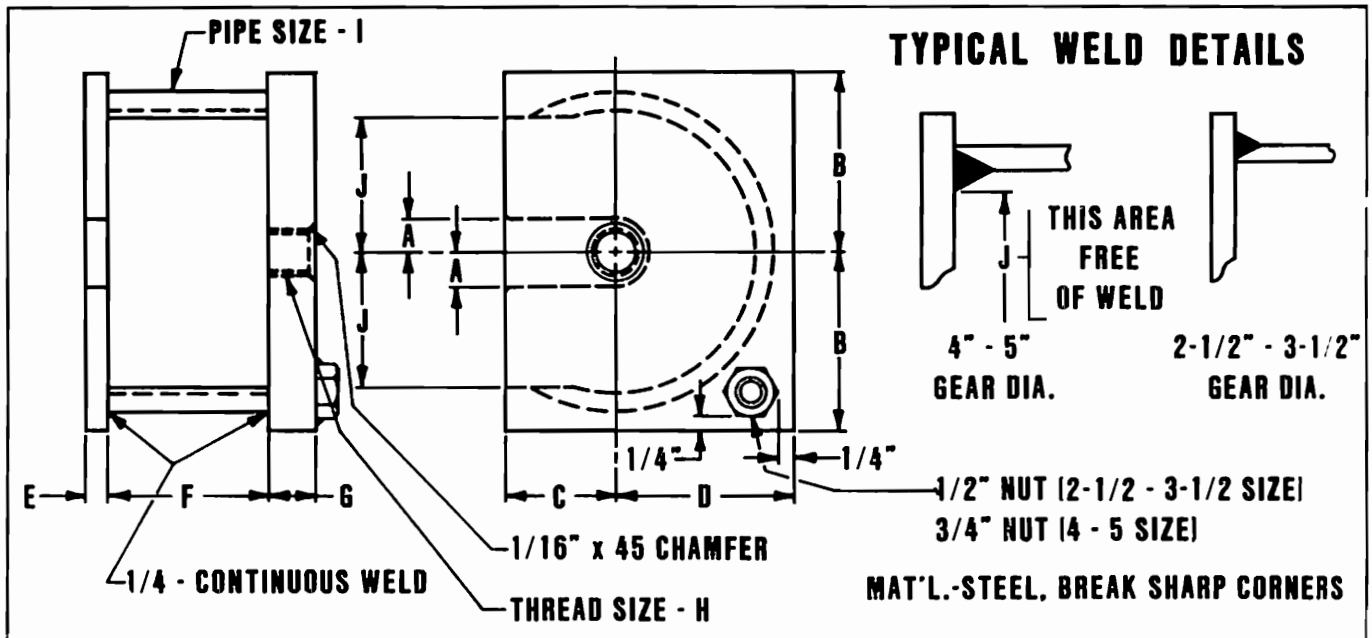
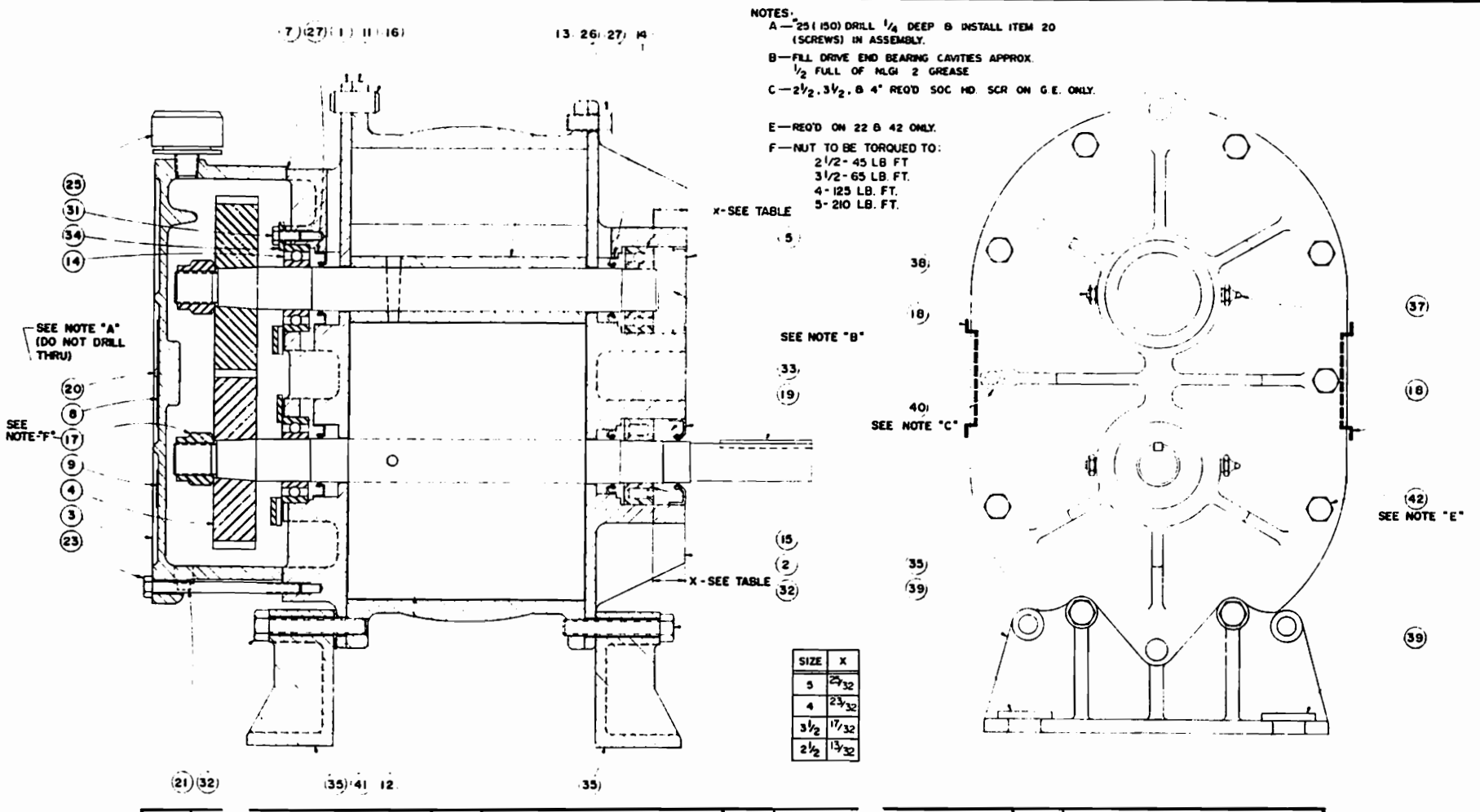


Figure 9 — Gear Removal



BLOWER SIZE	PART NO.	A	B	C	D	E	F	G	H	I	J
2-1/2	812-977-001	3/8	2	1-1/16	2	1/4	2	5/8	7/16-14	3" SCH. - 40	1-3/8
3-1/2	812-977-002	7/16	2-1/2	1-1/4	2-1/2	5/16	2-3/8	3/4	1/2-13	4" SCH. - 40	1-7/8
4	812-977-003	17/32	2-13/16	1-3/4	2-13/16	3/8	2-1/2	3/4	5/8-11	5" SCH. - 40	2-1/8
5	812-977-004	5/8	3-3/8	2	3-3/8	7/16	3	1	3/4-10	6" SCH. - 40	2-11/16

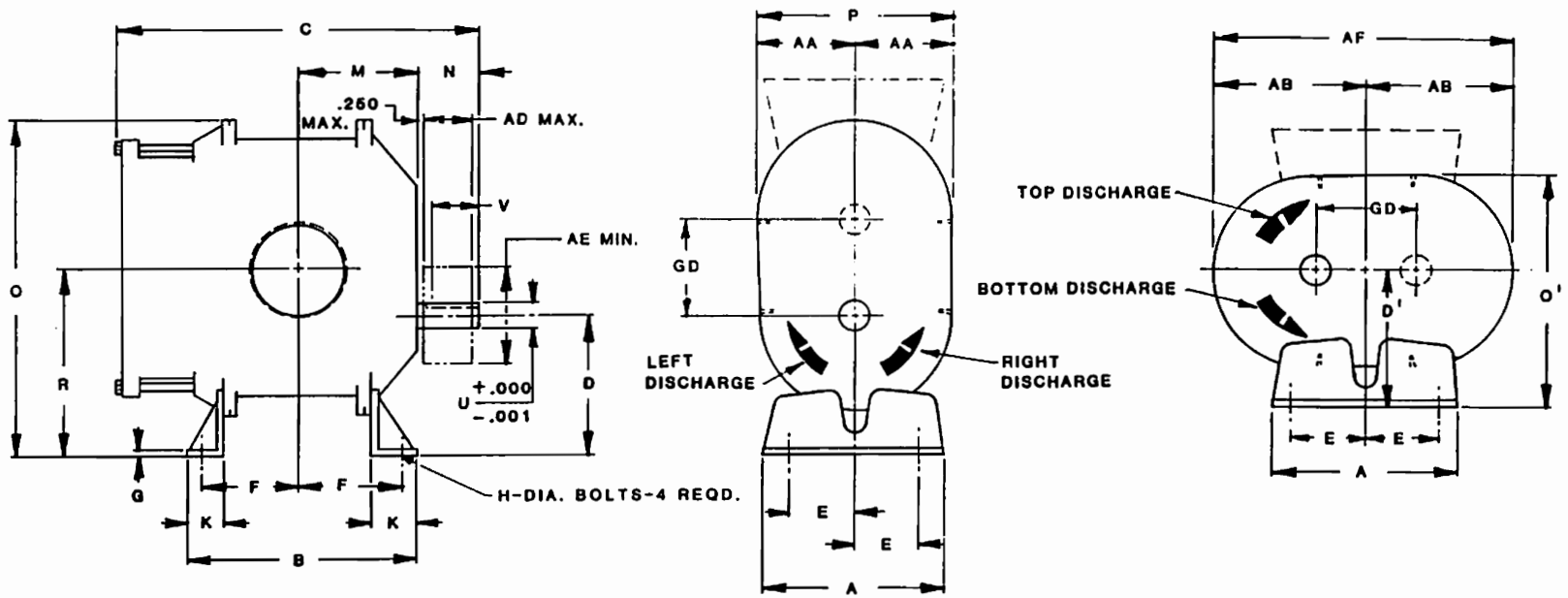
Figure 10 — Gear Pullers for U-RAI with Tapered Gear Bores 812- 7-



ITEM	PART NAME	ITEM	PART NAME	ITEM	PART NAME	ITEM	PART NAME
1	Headplate Gear End	12	Impeller & Shaft-Drive	21	Plug, Pipe	35	Foot
2	Headplate Drive End	13	Impeller & Shaft-Driven	23	Screw, Hex	37	Fitting, Grease
3	Gearbox	14	Bearing G.E.,-Driven	25	Breather	38	Fitting, Relief
4	Gears	15	Bearing D.E.-Drive	26	Screw, Hex	7	Gasket
5	Cover-Blind	16	Pin, Dowel	27	Seal, Lip	39	Washer Flat
8	Nameplate-Serial Number	17	Gear Nut	31	Screw, Hex	40	Screw Socket
9	Nameplate-Lub	18	Plug Tin	32	Screw, Hex	41	Washer
		19	Key	33	Seal Lip-Drive	42	Screw Hex
11	nder	20	Screw, Self Tap	34	Clam, te		

864-720-02

Figure 11 — Assembly of RAI Blowers, 2½"-5" Gear Diameter



FRAME SIZE	APPROX. OIL CAPACITY VERT.	APPROX. OIL CAPACITY HORIZ.	GD
2-1/2	3.4 FL. OZ.	6.1 FL. OZ.	2.50
3-1/2	8.6 FL. OZ.	16 FL. OZ.	3.50
4	12.7 FL. OZ.	22.8 FL. OZ.	4.00
5	18 FL. OZ.	27.6 FL. OZ.	5.00

UNIVERSAL RAI BLOWER

W - INLET & DISCHARGE
AD - SHEAVE WIDTH
AE - SHEAVE DIAMETER

ALL DIMENSIONS IN INCHES

FRAME SIZE	A	B	C	D	D'	E MIN	E MAX	F MIN	F MAX	G	H	K	M	N	O	O'	P	R	U	KEYWAY	W NPT	V	AA	AB	AD	AE	AF	APPROX. WT. LBS.
22	5.13	5.00	9.75	3.75	3.75	1.50	2.00	2.00	2.00	.25	.38	1.25	2.63	2.50	9.63	6.88	6.25	5.00	.625	.188x.094	1"	1.81	3.13	4.63		4.00	9.25	32
24	5.13	7.00	11.75	3.75	3.75	1.50	2.00	3.00	3.00	.25	.38	1.25	3.63	2.50	9.63	6.88	6.25	5.00	.625	.188x.094	2"	1.81	3.13	4.63		4.00	9.25	43
33	7.25	7.63	12.13	5.00	5.00	2.50	2.88	3.00	3.25	.25	.44	1.75	3.81	2.44	12.81	8.86	7.75	6.75	.750	.188x.094	2"	1.63	3.88	6.06	1.91	5.00	12.13	74
34	7.25	10.00	14.63	5.00	5.00	2.50	2.88	4.18	4.44	.25	.44	1.75	5.00	2.56	12.81	8.86	7.75	6.75	.750	.188x.094	2-1/2"	1.75	3.88	6.06	1.91	5.00	12.13	102
42	8.00	7.25	13.00	6.25	6.25	3.00	3.13	2.50	3.13	.31	.44	2.00	3.68	3.18	15.06	10.63	8.75	8.25	.875	.188x.094	1-1/2"	2.31	4.38	6.81	2.31	5.00	13.63	88
45	8.00	10.00	15.50	6.25	6.25	3.00	3.13	3.56	4.25	.31	.44	2.00	5.06	2.94	15.06	10.63	8.75	8.25	.875	.188x.094	2-1/2"	2.13	4.38	6.81	2.31	5.00	13.63	109
47	8.00	11.75	17.63	6.25	6.25	3.00	3.13	4.63	5.38	.31	.44	00	5.94	3.31	15.06	10.50	8.50	8.25	.875	.188x.094	3"	2.50	4.25	6.	2.31	5.00	13.63	128
53	10.50	8.38	15.38	6.25	6.75	3.50	3.50	3.18	3.68	.36	.50	1.88	4.50	3.68	17.38	11.98	10.25	8.75	1.125	.25 x.125	2-1/2"	2.75	5.13	8.63	3.06	6.00	17.25	143
56	10.50	11.00	18.00	6.25	6.75	3.50	3.50	4.25	5.00	.36	.50	1.88	5.81	3.38	17.38	12.25	11.00	8.75	1.125	.25 x.125	4"	2.50	5.50	8.63	3.06	6.00	17.25	171
59	10.50	14.00	21.18	6.25	6.75	3.50	3.50	6.00	6.50	.36	.50	.88	7.31	3.38	17.38	12.25	11.00	8.75	1.125	.25 x.125	4"	3.00	5.50	8.63	3.06	6.00	17.25	204

862-795-021

Figure 12 — Dimensional Assembly of RAI Blower (2½"-5")

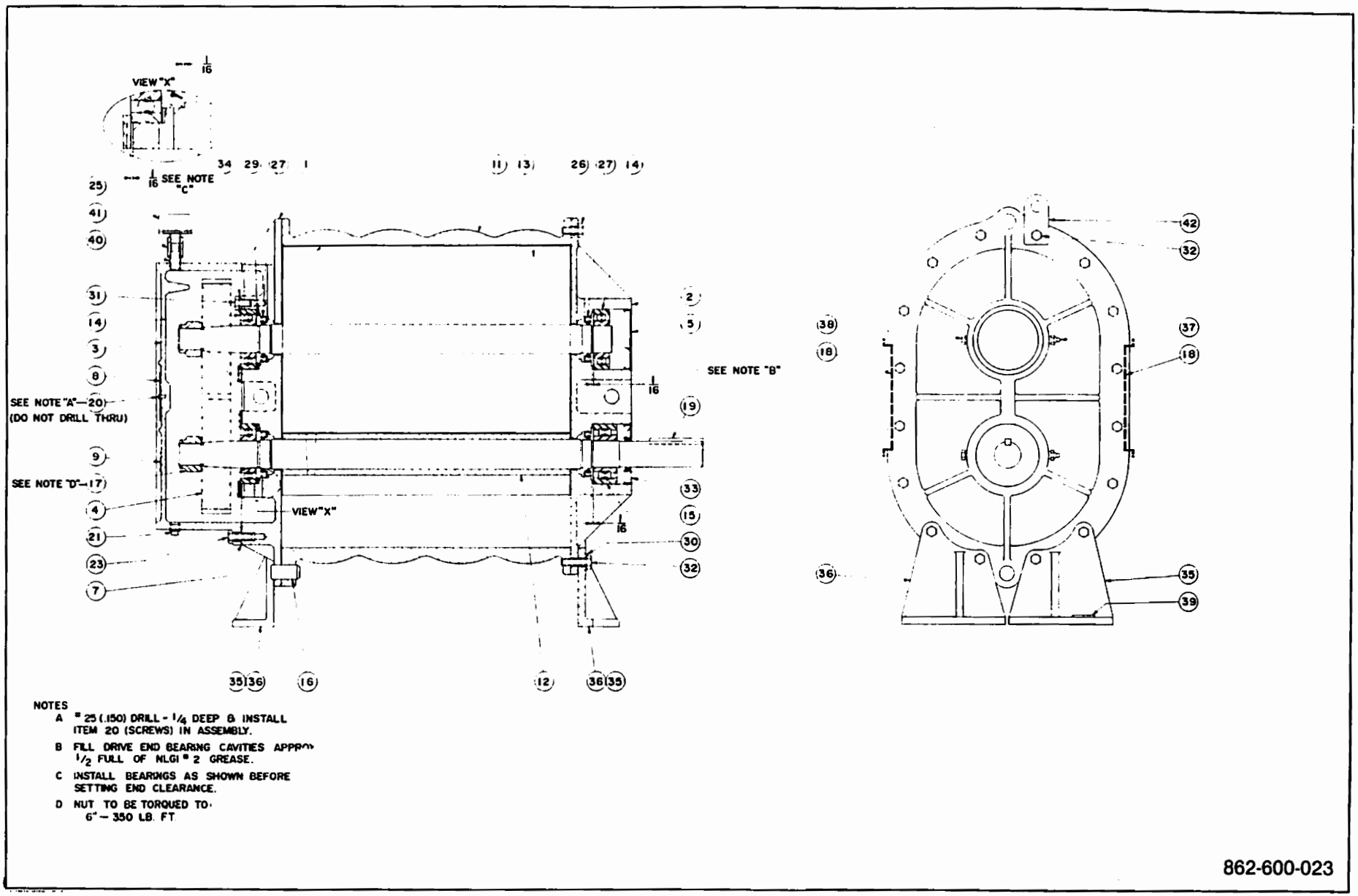
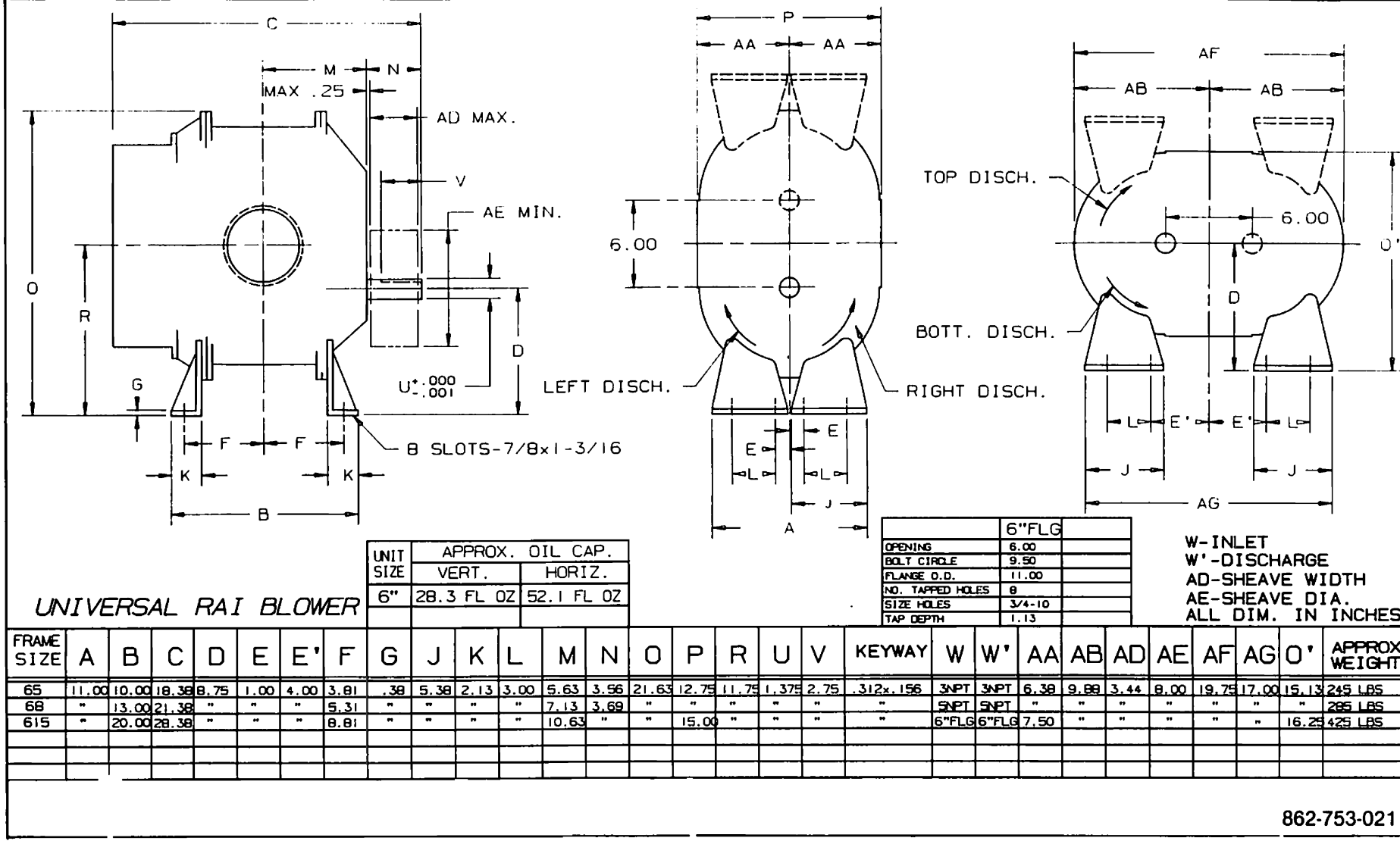


Figure 13 — Assembly of RAI Blowers, 6" Gear Diameter



UNIT SIZE	APPROX. OIL CAP. VERT.	APPROX. OIL CAP. HORIZ.
6"	28.3 FL OZ	52.1 FL OZ

	6"FLG
OPENING	6.00
BOLT CIRCLE	9.50
FLANGE O.D.	11.00
NO. TAPPED HOLES	8
SIZE HOLES	3/4-10
TAP DEPTH	1.13

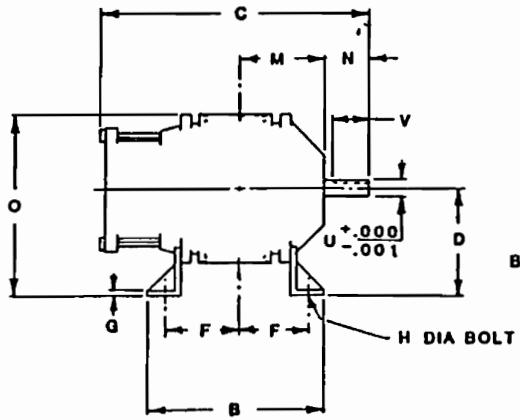
W-INLET
W'-DISCHARGE
AD-SHEAVE WIDTH
AE-SHEAVE DIA.
ALL DIM. IN INCHES

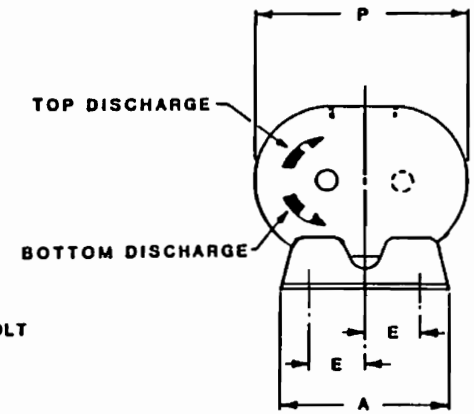
UNIVERSAL RAI BLOWER

FRAME SIZE	A	B	C	D	E	E'	F	G	J	K	L	M	N	O	P	R	U	V	KEYWAY	W	W'	AA	AB	AD	AE	AF	AG	O'	APPROX WEIGHT
65	11.00	10.00	18.38	8.75	1.00	4.00	3.81	.38	5.38	2.13	3.00	5.63	3.56	21.63	12.75	11.75	1.375	2.75	.312x.156	3NPT	3NPT	6.38	9.88	3.44	8.00	19.75	17.00	15.13	245 LBS
68	"	13.00	21.38	"	"	"	5.31	"	"	"	"	7.13	3.69	"	"	"	"	"	"	5NPT	5NPT	"	"	"	"	"	"	"	285 LBS
615	"	20.00	28.38	"	"	"	8.81	"	"	"	"	10.63	"	"	15.00	"	"	"	"	6"FLG	6"FLG	7.50	"	"	"	"	"	16.25	425 LBS

862-753-021

Figure 14 — Dimensional Assembly of RAI Blower (6")





W-INLET & DISCHARGE

ALL DIMENSIONS IN INCHES

DIMENSIONS NOT CERTIFIED FOR CONSTRUCTION

NOTE:
UNIVERSAL RAI

1. 45 & 56 U-RAI WILL HAVE TO RUN AT REDUCED SPEED TO DUPLICATE AF PERFORMANCE.
2. LARGER STANDARD SHAFT THAN AF. SEE DIMENSION "U".
3. U-RAI INLET & OUTLET CONNECTIONS ARE LARGER THAN AF ON THE FOLLOWING SIZES: 24, 45, 47, 56 & 59. SEE DIMENSION "W".
4. 45 U-RAI REPLACES 44 AF. 56 U-RAI REPLACES 55 AF.
5. FOR ADDITIONAL INFORMATION CONTACT YOUR SALES REPRESENTATIVE OR THE FACTORY.

FRAME SIZE	A	B	C	D	E	F	H	M	N	O	P	U	V	KEYWAY	W
22 U-RAI	5.13	5.00	9.75	3.75	2.00	2.00	3/8	2.63	2.50	6.88	9.25	.625	1.81	3/16 x 3/32	1" NPT
22 AF	5.50	5.06	9.13	3.75	2.00	2.00	3/8	2.63	1.94	6.86	9.25	.5875	1.31	3/16 x 3/32	1" NPT
24 U-RAI	5.13	7.00	11.75	3.75	2.00	3.00	3/8	3.63	2.50	6.88	9.25	.625	1.81	3/16 x 3/32	2" NPT
24 AF	5.50	7.06	11.13	3.75	2.00	3.00	3/8	3.63	1.94	6.88	9.25	.5875	1.31	3/16 x 3/32	1-1/2" NPT
33 U-RAI	7.25	7.63	12.13	5.00	2.88	3.00	3/8	3.81	2.44	8.88	12.13	.750	1.63	3/16 x 3/32	2" NPT
33 AF	7.25	7.44	12.56	5.00	2.88	3.00	3/8	3.81	2.63	8.88	12.13	.6562	1.66	3/16 x 3/32	2" NPT
36 U-RAI	7.25	10.00	14.63	5.00	2.88	4.18	3/8	5.00	2.56	8.88	12.13	.750	1.75	3/16 x 3/32	2-1/2" NPT
36 AF	7.25	9.81	14.94	5.00	2.88	4.18	3/8	5.00	2.63	8.88	12.13	.6562	1.88	3/16 x 3/32	2-1/2" NPT
42 U-RAI	8.00	7.25	13.00	6.25	3.13	2.94	3/8	3.68	3.18	10.63	13.63	.875	2.31	3/16 x 3/32	1-1/2" NPT
42 AF	8.25	7.13	12.88	6.25	3.13	2.94	3/8	3.68	3.00	10.63	13.63	.7812	2.38	3/16 x 3/32	1-1/2" NPT
45 U-RAI	8.00	10.00	15.50	6.25	3.13	3.56	3/8	5.06	2.94	10.63	13.63	.875	2.13	3/16 x 3/32	2-1/2" NPT
44 AF	8.25	8.83	14.13	6.25	3.13	3.56	3/8	4.31	3.00	10.63	13.63	.7812	2.38	3/16 x 3/32	2" NPT
47 U-RAI	8.00	11.75	17.63	6.25	3.13	5.18	3/8	5.94	3.31	10.50	13.63	.875	2.50	3/16 x 3/32	3" NPT
47 AF	8.25	11.63	17.38	6.25	3.13	5.18	3/8	5.94	3.00	10.63	13.63	.7812	2.30	3/16 x 3/32	2-1/2" NPT
53 U-RAI	10.50	8.38	15.38	6.75	4.25	3.69	3/8	4.50	3.66	11.88	17.25	1.125	2.75	1/4 x 1/8	2-1/2" NPT
53 AF	10.75	8.81	15.44	6.75	4.25	3.69	3/8	4.50	3.63	12.00	17.25	.9687	2.86	1/4 x 1/8	2-1/2" NPT
56 U-RAI	10.50	11.00	18.00	6.75	4.25	4.25	3/8	5.81	3.38	12.25	17.25	1.125	2.50	1/4 x 1/8	4" NPT
55 AF	10.75	9.81	16.56	6.75	4.25	4.25	3/8	5.06	3.63	12.00	17.25	.9687	2.88	1/4 x 1/8	2-1/2" NPT
59 U-RAI	10.50	14.00	21.18	6.75	4.25	6.50	3/8	7.31	3.38	12.25	17.25	1.125	3.00	1/4 x 1/8	4" NPT
59 AF	10.75	14.31	21.06	6.75	4.25	6.50	3/8	7.31	3.63	12.00	17.25	.9687	2.88	1/4 x 1/8	3" NPT

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ROOTS DRESSER

DRESSER INDUSTRIES, INC
ROOTS OPERATIONS
900 WEST MOUNT STREET
CONNERSVILLE, INDIANA 47331

COMPARING ROOTS UNIVERSAL RAI TO ROOTS AF

DB 1-7-85

863-813-021

Figure 15

Major Changes when Replacing AF with Universal RAI Blower

Size & Type	Sheave Bushing Dia.	Inlet Size	Disch. Size	Mounting Feet
22 U-RAI	.625"	1"	1"	Interchangeable
22 AF	.5875"	1"	1"	
24 U-RAI	.625"	2"	2"	Interchangeable
24 AF	.5875"	1½"	1½"	
33 U-RAI	.750"	2"	2"	Interchangeable
33 AF	.6562"	2"	2"	
36 U-RAI	.750"	2½"	2½"	Interchangeable
36 AF	.6562"	2½"	2½"	
42 U-RAI	.875"	1½"	1½"	Interchangeable
42 AF	.7812"	1½"	1½"	
45 U-RAI	.875"	2½"	2½"	Reverse Feet
44 AF	.7812"	2"	2"	
47 U-RAI	.875"	3"	3"	Interchangeable
47 AF	.7812"	2½"	2½"	
53 U-RAI	1.250"	2½"	2½"	Special Feet
53 AF	.9687"	2½"	2½"	
56 U-RAI	1.250"	4"	4"	Special Feet
55 AF	.9687"	2½"	2½"	
59 U-RAI	1.250"	4"	4"	Special Feet
59 AF	.9687"	3"	3"	

*To maintain AF performance with U-RAI, the blower speed will have to be reduced by sheave change.

See enclosed dimension drawing for your specific blower.

CAUTION CAUTION CAUTION

MAKE CERTAIN THAT THE BREATHER IS LOCATED ON TOP AND THE DRAIN PLUG IN THE BOTTOM OF THE GEAR BOX.

CORRECTIVE MAINTENANCE - CONTINUOUS SCAVENGER

DISASSEMBLY

GENERAL

The disassembly procedures are divided according to specific tasks rather than being arranged in complete disassembly sequence. Although there should rarely be a need to completely disassemble a Scavenger, the complete disassembly can be accomplished by following the individual procedures.

ROTOR CUTTER REPLACEMENT

The rotor cutters should be replaced when they are damaged, become dull, or are worn excessively. They can be checked and replaced through the inspection hatch.

1. Review and follow procedures under "Preparing for Disassembly", page 32-33.
2. Remove a cutter by removing the screws that secures it to rotor. Install new cutter. Turn rotor until next cutter is accessible. Replace as described. Repeat same steps for third cutter.

ROTOR REMOVAL

The rotor can be removed from the Scavenger without disturbing the other parts of the rotor assembly. Remove the rotor as follows:

1. Prepare Scavenger for disassembly as described above.

ROTOR REMOVAL (CONTINUED)

2. Remove two belt guards by removing screws that hold them together and that secure them to rotor assembly.

3. Decrease tension on belts (See **Preventive Maintenance** chapter), and remove belts.

4. Remove screws that secure rotor housing to Scavenger body.

5. Disconnect piping from stock discharge of rotor housing.

6. Slide rotor assembly away from Scavenger body on tube support.

7. Remove and discard O-ring.

8. Remove end cap by removing screws that secure it to shaft.

9. Attach puller supplied with Scavenger to rotor (There are two tapped holes in rotor for mounting puller).

10. Pull rotor off of shaft leaving key in place on shaft.

ROTOR SHROUD REMOVAL

1. Remove rotor as described under ROTOR REMOVAL.
2. Remove retaining ring by removing the screws that secure it to rotor housing.
3. Remove rotor shroud.

ROTATING MECHANISM DISASSEMBLY

NOTE: In order to avoid removing tube support, which is secured to motor mount with a roll pin, rotor housing is reattached to Scavenger body after rotor has been removed. Then assembly, with guide bracket attached, can be removed without disturbing tube support.

1. Remove rotor and rotor shroud as described above.
2. Slide rotor assembly (less rotor) back against Scavenger body, and secure rotor housing to body with screws removed in step 4 of ROTOR REMOVAL.
3. Remove screws that secure stuffing box to rotor housing.
4. Remove screws that secure guide bracket to motor mount.
5. While supporting assembly, slide it out until guide bracket is clear of tube support; remove assembly to work bench for further disassembly.
6. Remove key by removing screws that secure it, and then slide shims and seal sleeve spacer off shaft.

ROTATING MECHANISM DISASSEMBLY (continued)

7. Remove driven pulley by removing screws and bushing that secure pulley to shaft; retain key for use at reassembly.
8. Loosen nuts on gland adjusting studs enough to release compression of shaft packing rings.
9. Support bearing support housing and stuffing box housing on wooden blocks or other suitable supports, and remove nuts, lockwashers, and screws that hold two housings together.
10. Carefully pull bearing support housing with shaft straight out until shaft clears packing gland; remove flinger, seal cap, O-ring, and seal; discard O-ring and seal.
11. Remove seal sleeve from shaft.
12. Remove screws that secure bearing cap then remove bearing cap, seal, bearing locknut, and bearing lockwasher.
13. Using a press on pulley end of shaft, press it out of bearing support housing. Be careful to support rotor end of shaft while removing it from housing. Single row bearing will come out with shaft, while double row bearing will remain in housing.

ROTATING MECHANISM DISASSEMBLY (CONTINUED)

14. Use a suitable puller to remove bearing from shaft; remove both bearing spacers.
15. Remove bearing retaining ring from housing, and with a press remove bearing from housing.
16. Remove valve and piping to stuffing box.
17. Remove stuffing box housing from stuffing box by removing screws that secure them together.
18. Remove packing gland by removing nuts from studs.
19. Remove stuffing box cap by removing screws that secure it to stuffing box.
20. Remove packing ring retainer, packing rings, and lantern ring.

REASSEMBLY

The Scavenger can be reassembled by reversing the order and sense of the procedures used for disassembly. The following points should be noted during reassembly.

1. Wipe bearing mounting surfaces on shaft and in housings with a thin coat of light oil or micronized graphite to ease assembly and to prevent galling of machined surfaces.

2. Use a press to install bearings on shaft, and use a press to install shaft and bearings in bearing support housing.

3. If a bearing must be heated to fit on shaft, place bearing in clean oil heated to 200 °F (93.3 °C) for about 15 minutes. Be sure to place supports under bearing to keep it away from bottom of container. If it touches container, it may overheat and distort.

4. Assure that bearings are properly lubricated after installation and prior to turning on power to Scavenger.

5. Always install new grease seals, O-rings, and gaskets during reassembly.

CORRECTIVE MAINTENANCE - CONTINUOUS SCAVENGER

POST MAINTENANCE CHECKOUT

After any maintenance procedure that requires opening or disassembling any part of the Scavenger, make the following simple checks before restoring the Scavenger to service.

CAUTION: DO NOT START OR APPLY POWER TO THE DRIVE MOTOR UNTIL STEPS 1 THROUGH 5, HAVE BEEN COMPLETED.

1. Check to assure that water supply to stuffing box has been reconnected and that bearings have been properly lubricated.

2. Check tension of drive belts.

3. Check that nuts on motor threaded rods have been tightened.

4. Turn on clear water supply to stuffing box and check tightness of packing gland. There must be some leakage from gland to assure proper lubrication of packing.

5. Turn driven pulley slowly by hand to assure that there is no binding, scraping, wobble, or unusual noise.

POST MAINTENANCE CHECKOUT (CONTINUED)

6. Correct any abnormal conditions found before starting drive motor.

7. Restore power to drive motor and start Scavenger.

# # # #

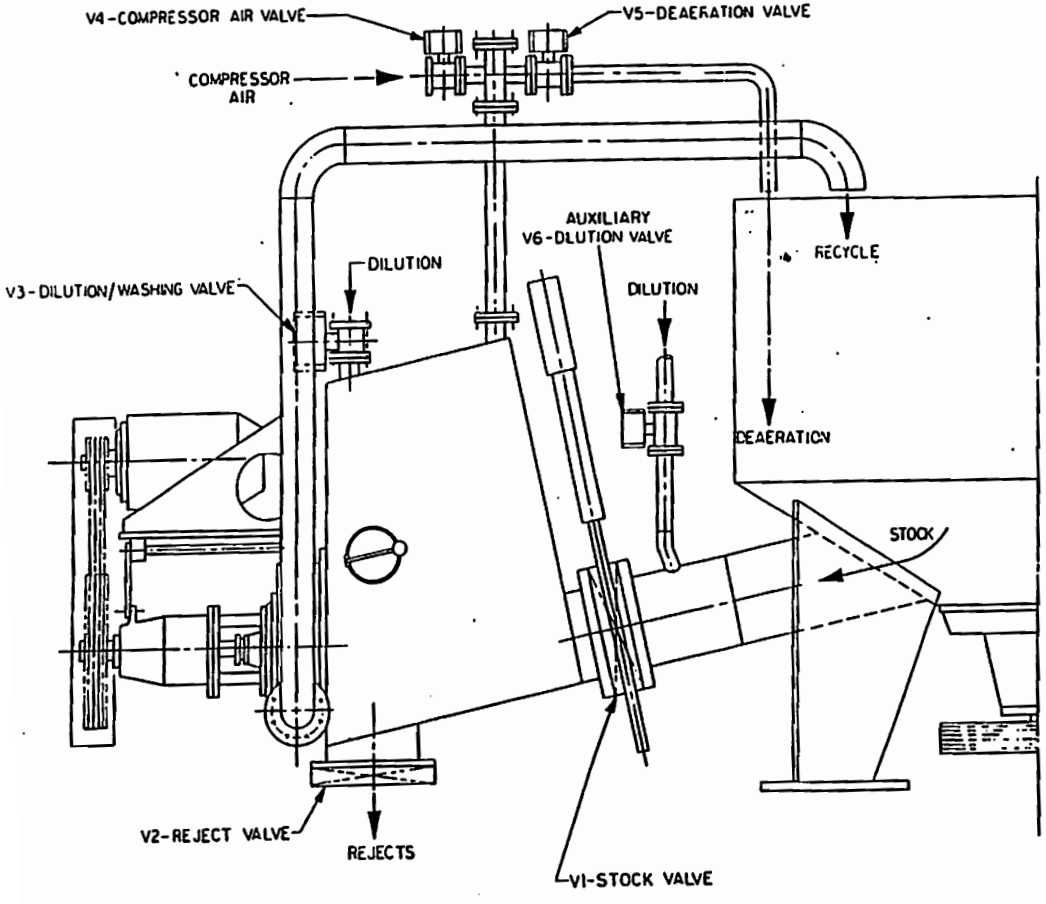

TABLE OF OPERATION

TIMER PHASE	FUNCTION	STOCK VALVE V1	REJECT VALVE V2	DILUT WASH VALVE V3	COMPR AIR VALVE V4	DEAER VALVE V5	AUX DILUT VALVE V6	DRIVE MOTOR M1	COMPR MOTOR M2
I	FILL WITH WATER	C	C	O	C	O	C	SP	SP
II	STOCK FLOW	O	C	C	C	O	C	ST	SP
III	DILUTION & WASHING	C	C	O	C	O	O C	ST	SP
IV	STOCK DISCHARGE	C	C	C	O	C	C	ST	ST
V	REJECT	C	O	C	C	O	C	ST	SP
VI	CYCLE INTERVAL	C	O	C	C	O	C	SP	SP

LEGEND
C - CLOSED
O — OPEN
ST — START/RUN
SP — STOP

Figure 11