

# Centravac General Service Literature

---

## Centravac General Service Literature CTVH-GCO-01-EN

### CVHE/CVHG Compressor Disassembly (Including):

- w Economizer Removal
- w Suction Elbow Removal
- w Compressor Disassembly
- w Unit Mounted Starter Removal
- w Motor Removal
- w Discharge Volute Removal

### CVHE (E-Design And Later), CVHG And CDHG Duplex Unit Compressor Sizes 013-140 and 350-1280 Ton

This section describes disassembly (including economizer, suction elbow, unit mounted starter, motor, and discharge volute removal) procedures for the model CVHE AND CVHG CenTraVac compressor assemblies. The same information applies to the compressors for the CDHG duplex units. For disassembly and re-assembly procedures for the motor, see Centravac Service Literature Section *CTVH-GMO-01*. The procedures covered in this section may be used for the CVHE (E design sequence and later) and all CVHG compressor sizes (013 through 140) and (130 through 1250) tons. For information on the CVHF compressors, see Centravac Literature Sections *CTVH-GCO-03, 04* for compressor sizes (350 through 1280) and *CTVH-GCO-05 & 06* for the extended capacity compressor sizes 1470 and 1720.

The CVHE AND CVHG compressors are similar in construction. Always check the appropriate table to obtain weights and tolerances for a particular type or size compressor.

#### Warning and Cautions

WARNINGS and CAUTIONS appear at appropriate sections throughout this manual. Read these carefully.

**⚠ WARNING:** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

**⚠ CAUTION:** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

**CAUTION:** may also be used to alert the reader to a situation that could result in equipment or property-only damage.



# Centravac General Service Literature

---

## Disassembly.

Refer to CenTraVac General Literature Section CTVH-GMS-01 for details on the special lifting fixtures for removing the first stage inlet vane assembly and handling the compressor suction cover and casing components. The tools shown can be fabricated locally using the drawings found in the special tools section. The Trane Company assumes no responsibility for the use of materials that do not meet the required specifications, or for improper or faulty manufacturing, assembly or use of these lifting fixtures. Never exceed the maximum safe lifting capacity of the fixture.

*IMPORTANT: Some of the lifting tools built for the CVHE compressor components have a maximum lifting capacity of 1300 lb. The tool maximum weight capacity is stamped on the tool. Some CVHG castings exceed this rating and the lifting tool given in Literature Section CTVH-GMS-01 must be used.*

### **⚠ WARNING HEAVY OBJECTS!**

**Use lifting and rigging equipment that is rated to handle the maximum weights. Improper use of lifting fixtures may result in death or serious injury.**

Follow all proper procedures when handling large compressor components. Use lifting and rigging equipment that is rated to handle the maximum weights of the pieces found in Table 2 in the back of this literature section. It is recommended that all lifting devices have a capacity rating no less than 100% of the weights shown. Carefully inspect lifting equipment to ensure it is in good condition and has been certified for continued use at proper intervals.

*1* It may be advisable to obtain vibration readings for reference purposes prior to disassembly. See General Service Bulletin *CVHE-SB-18* (latest revision) for information on allowable vibration limits.

### **⚠ WARNING HAZARDOUS VOLTAGE!**

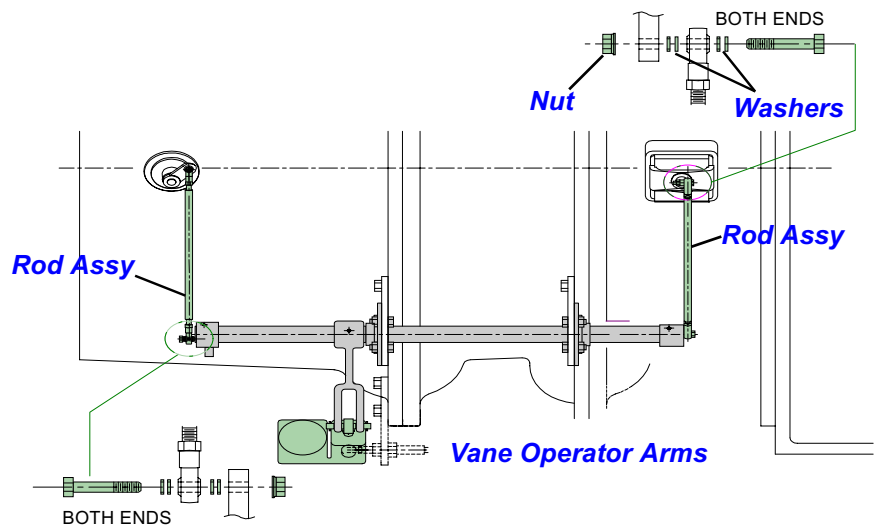
**Disconnect all electrical power, including remote disconnects, before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

*IMPORTANT: Be sure to properly lock out ALL potentially hazardous energy sources before servicing is done on the equipment. Follow all proper refrigerant handling procedures. Before disassembly, evacuate the unit to 2.5 mm vacuum and bring the unit back up to atmospheric pressure using dry nitrogen.*

# Centravac General Service Literature

- 2 Mark and disconnect all power leads to the inlet vane actuator motor. Remove the conduit assembly from the actuator motor.
- 3 Remove the inlet vane actuator linkages.
  - (a) Disconnect the universal joints at the inlet vane operator levers.
  - (b) Remove the 5/8" - 11 x 2" hex head bolts securing the vane drive support assemblies to the compressor castings. Before removing them, mark the compressor castings by scribing a line around the brackets so they may be reassembled in the same relative positions. This will help ensure that the inlet vane linkages maintain their proper coordination between the stages. See Figure 1

Figure 1



- (c) Remove the cotter pin securing the vane operator stud.
- (d) Slide the vane motor off the stud and remove the entire vane linkage assembly and vane motor from the unit.
- (e) Remove the linkage assembly from the vane motor by removing the cotter pin or bolt and nut. The vane motor is now free and can be removed.

## CAUTION

### COMPONENT ALIGNMENT!

Before disassembling the compressor, scribe lines across the flanges on the exterior edges of all compressor castings in two locations, 180 degrees apart. This must be done so that all components can be re-aligned during re-assembly. Failure to complete this step may result in misalignment of the suction elbow upon re-assembly and possible distortion of the compressor. This can cause vibration problems or seal-to-impeller interference



# Centravac General Service Literature

---

and possible damage to the impellers and compressor.

## CAUTION

### COMPONENT ALIGNMENT!

**The following two paragraphs provide instructions to maintain proper component alignment and fit. Make sure the compressor casings are dowelled or scribed and the discharge volute is dowelled. Failure to maintain proper alignment may result in compressor damage. Failure to maintain proper suction elbow fit up can cause vibration problems or seal-to-impeller interference and possible damage to the impellers and compressor.**

- 4 Before proceeding further, check to make sure the discharge volute has dowel pins in the flange at the condenser and the compressor foot where it mounts on the evaporator support bracket. These pins are standard on all newer units and will be required if the discharge volute or entire compressor will be removed from the shells. The alignment of the compressor/motor assembly is determined by the position of the discharge volute. A shift in volute position at either the discharge flange or the compressor foot can change the suction elbow to compressor alignment. **Failure to maintain proper suction elbow fit up can cause vibration problems or seal-to-impeller interference and possible damage to the impellers and compressor.** Some early vintage CVHE units were built without these two dowel pins. When necessary, dowel pins should be added to the discharge flange and compressor foot. Units ordered for field disassembly (compressor removal) may have the motor, interstage casings and suction cover doweled as well as the discharge flange and foot.

For additional information on compressor doweling see General Service Bulletin CVHE-SB-10 (latest revision).

- 5 If the entire compressor or the volute will need to be removed from the shells, the dowel pins at the discharge flange and foot will have to be removed. First remove the threaded nut on the exposed end of the dowel pin. Then slip washers or a bushing over the pin. Reinstall the nut. As the nut is tightened, the pin will be pulled out of place. The dowel pins allow for precise assembly of the compressor components in their original position.

*Note: It is not necessary to dowel all compressor casings for overhauls when properly scribed as detailed above.*

*IMPORTANT: Make sure the evaporator and condenser inlet and outlet water valves have been closed (**no water flow!**) and the evaporator and condenser water boxes have been completely drained. Failure to prevent water flow through the unit during repairs could cause severe rusting inside the shells. In humid environments it may be advisable to place a portable light or trouble light (100 -300 Watt) in the evaporator and condenser if necessary to provide enough heat to prevent moisture from condensing in the unit during repairs. In excessively humid environments, consider the use of a nitrogen purge to help prevent corrosion.*

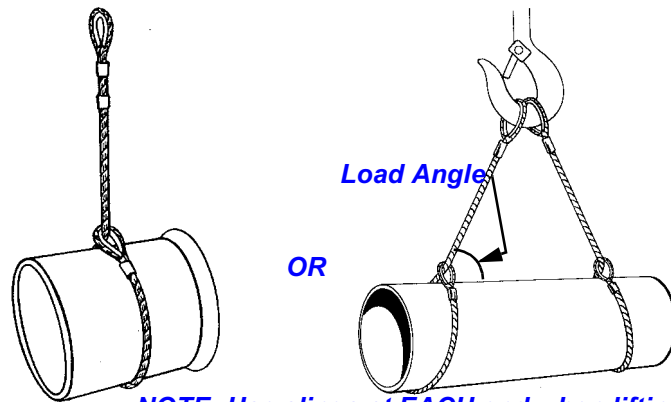
- 6 Remove the economizer to allow for compressor volute clearance.

# Centravac General Service Literature

- (a) Some CVHE and CVHG units will require cutting the drain line that returns motor cooling liquid to the economizer. Sand the line to remove paint then cut with a tubing cutter. Do not use a hacksaw to cut the line. *Always use a tubing cutter to avoid introducing copper chips (debris) into the unit.*
- (b) On smaller units, a floor jack may be placed under the economizer sump.
- (c) For larger units it may be advisable to block the economizer and piping when the bolts are removed and then use slings (in the choke configuration) at each end to lift the economizer. See Table 2 for weights of economizers. Make sure the proper balance point of the economizer is found, to prevent it from rotating as it is lifted. See Figure 2 for proper sling use.

*Note: The lifting capacity of a sling is reduced when the load angle is less than 90°. See Table 1 for load factor values. For angles less than 90°, multiply the load factor by the nominal sling lifting capacity to determine the allowed lift weight.*

**Figure 2**  
**Typical Choke Sling Cable Arrangement**



**NOTE: Use slings at EACH end when lifting.**

**Table 1**

Load Angle (°)	Factor	Load Angle (°)	Factor
90	1.000	50	0.7660
85	0.9962	45	0.7071
80	0.9848	40	0.6428
75	0.9659	35	0.5736
70	0.9397	30	0.5000
65	0.9063	25	0.4226
60	0.8660	20	0.3420
55	0.8192	15	0.2589

- (d) Carefully slide the economizer away from the shells.

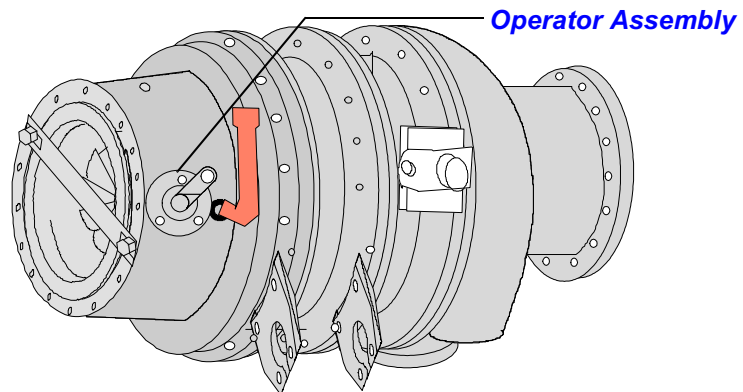
## Centravac General Service Literature

- (e) Lightly oil all flanges with compressor oil. Cover all openings with plastic and seal with duct tape to prevent debris from entering the economizer.
  - (f) Remove the orifice assemblies and mark them properly. Oil the flanges on the condenser liquid line and the evaporator liquid inlet to prevent rusting. Cover the openings with plastic and duct tape to prevent entry of debris.
- 7 Remove the Suction Elbow.
- (a) Remove the bolts from the suction elbow flanges at the evaporator and compressor.
  - (b) Place a sling in the choke configuration around the suction elbow. Position the sling so the elbow balances properly as it is lifted. *Do NOT use the weld nut on the suction elbow for lifting.* See Table 2 for the weight of the suction elbow.
  - (c) Clean and lightly oil the suction elbow flanges to prevent rusting and place the elbow on wooden blocks to protect the face of flange. Remove the o-ring, then thoroughly clean the groove in the flange on the evaporator. Lightly oil the flange on the evaporator. Cover the opening with plywood to protect the flange and prevent debris from entering the evaporator during repairs.

*IMPORTANT: Mark all components before removing them. Mark the face of components with a description or location (e.g. 1<sup>st</sup> stage impeller seal) and the top (12 o'clock) mounting position of all seals, impellers, spacers, casings, plates etc. so they may be re-installed in the same position. This will be important in maintaining the proper balance and alignment of the rotating components during re-assembly.*

- 8 Remove the first stage inlet vane assembly.
- (a) Loosen and remove the 5/16" - 18 x 1" hex head bolts and lockwashers securing the first stage vane operator assembly to the suction cover. See Figure 3. Mark the operator lever and the suction cover casing with the vanes in the closed position. Remove the vane operator assembly.

**Figure 3**

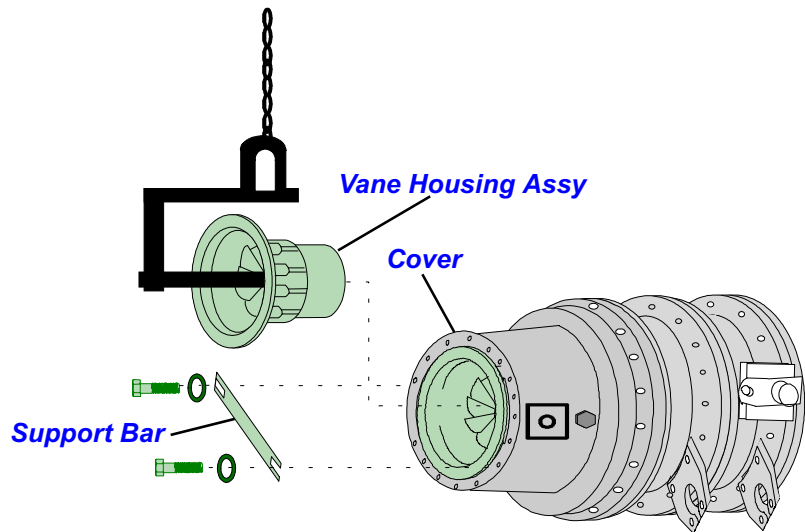


- (b) Use a length of L-channel extending across the width of the inlet vanes and two bolts with washers in the suction cover flange to hold the inlet vane assembly in the cover.

## Centravac General Service Literature

Remove the three 5/16" - 18 x 3/8" countersunk set screws in the suction cover holding the inlet vane assembly in place. See Figure 3.

**Figure 4**



- (c) Using the vane lifting tool shown in Figure 4, lift up slightly on the vane assembly. Remove the L-channel holding it in place and pull the vane assembly away from the suction cover. The weight of the vane assembly is given in Table 2.

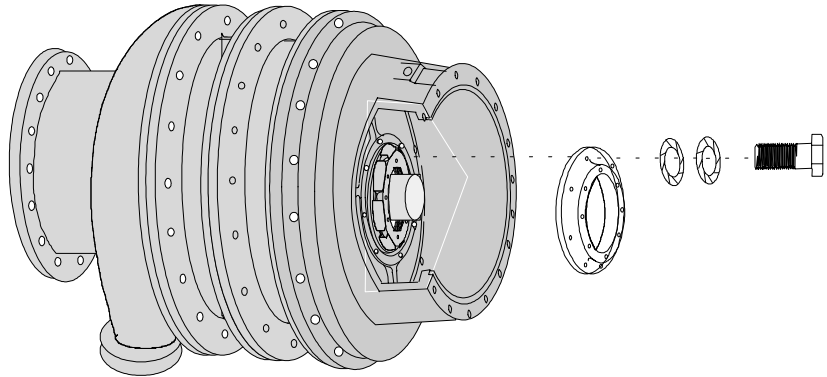
**IMPORTANT:** Immediately spray a rust-preventive penetrating oil into the needle bearings in the inlet vane housing, while manually opening and closing the vanes. Thoroughly oil the bearings to minimize the risk of rust forming in the bearings, which could lead to vane binding. **Anytime a unit will be open for major repairs, it is recommended the needle bearings in the vane assembly be replaced.**

- 9 When applicable, sand the paint from the oil sump vent line to the suction cover and cut the pipe using a tubing cutter. Do not use a hacksaw to cut the line. Always use a tubing cutter to avoid introducing copper chips (debris) into the unit.
- 10 Remove the 1/4" oil drain line at the bottom of the suction cover.
- 11 Measure and record the clearance between the 1<sup>st</sup> stage seal impeller labyrinth and impeller nose using a feeler gauge. If so equipped, bend the tabwasher tab back allowing the hex head bolts that secure the seal to be removed. The tabwashers are no longer used in production and should be replaced by ramp washers during re-assembly. Remove the seal and store properly along with the retaining bolts. See Figure 5.

## Centravac General Service Literature

---

Figure 5



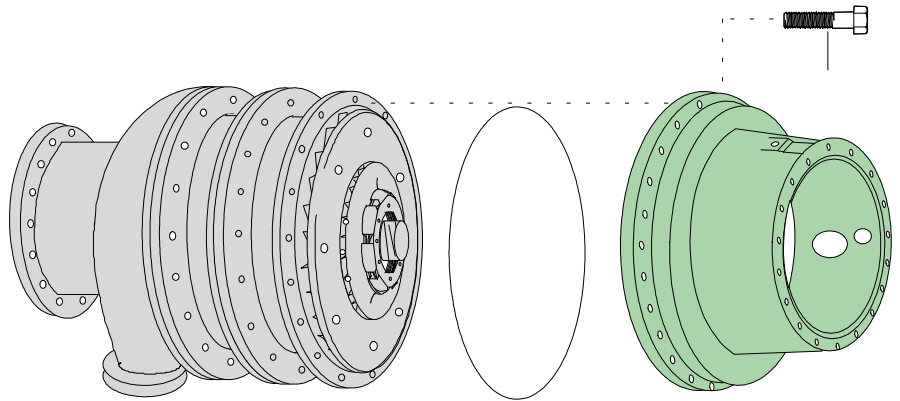
*IMPORTANT: Mark this seal carefully. On some size units this seal is mounted in a reverse position. Installing it incorrectly could result in improper venting of the suction cover and may lead to oil loss. Do not mix the bolts with those of other seals, as the bolt lengths may vary.*

**12** Remove the suction cover and suction cover o-ring.

- (a) Remove two of the 5/8" bolts from the suction cover, 180 degrees apart on the horizontal centerline (3 and 9 o'clock position) and insert 6" long guide pins.
- (b) Attach a casting lifting fixture to the face of the suction cover flange.
- (c) Remove a bolt near the bottom of the suction cover and one to the side of the lifting fixture and insert 6" long 5/8" stop bolts with heads to limit movement of the cover until a proper balance point is obtained. Attach an overhead hoist of sufficient lifting capacity to the lifting plate. See Table 2 for the weight of the suction cover. Remove the remaining bolts (leaving in place the 6" long guide pins and 6" long stop bolts) and pick up slightly on cover. It may be necessary to use jacking bolts to push the cover away from the casing. If necessary, move the pick-up point on the lifting tool until the cover is balanced. Once the cover is balanced properly with the lifting tool, remove the stop bolts at the top and bottom of the cover and remove the suction cover. Oil the cover flanges lightly and store it properly to prevent rust or damage to the sealing surfaces. See Figure 6. Remove the guide pins.

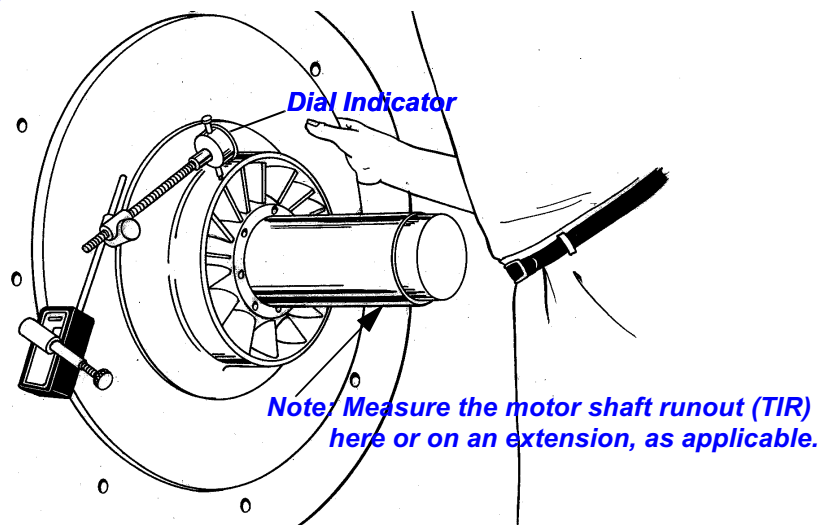
## Centravac General Service Literature

**Figure 6**



- 13** Measure and record the total indicated runout (TIR) on the nose of the 1<sup>st</sup> stage impeller. Use a dial indicator with a magnetic base for measuring runout. See Figure 7.

**Figure 7**



- 14** Measure and record the total indicated runout (TIR) at the end of the shaft. Some motor sizes have an extension on the end of the shaft where the runout can be measured without having to remove the impeller locknut. Many motors will require removal of the locknut and 1<sup>st</sup> stage impeller to provide a surface for measuring runout. The allowable TIR is .0012". See note in Figure 7.

- 15** If it is anticipated that the present compressor seals along with other components will be used during re-assembly, it is advisable to record clearances and runout measurements. The form at the back of this section can be used to record the tolerances. The recommended tolerances can be found in Table 3.



## Centravac General Service Literature

---

16 Remove the impeller locknut.

*Note: Some units are equipped with a standard locknut, while some units have a balance style locknut. The balance style locknut has small tapped holes in the face for the purpose of installing balancing screws and weights.*

*IMPORTANT: When the unit has a balance style locknut with weights attached, and the motor and all rotating compressor components will be re-used, it is necessary to mark all rotating components such as the locknut, spacers, impellers and motor shaft. This is required to ensure the components can be re-assembled in the exact position as they were removed. Failure to mark all components and reassemble properly could lead to an out of balance condition and require the assembly to be trim balanced. If the motor/rotor or other rotating components located on the shaft will be replaced, it is not necessary to mark all components. Whenever replacing individual rotating components with new ones, the balance weights from the locknut should be removed.*

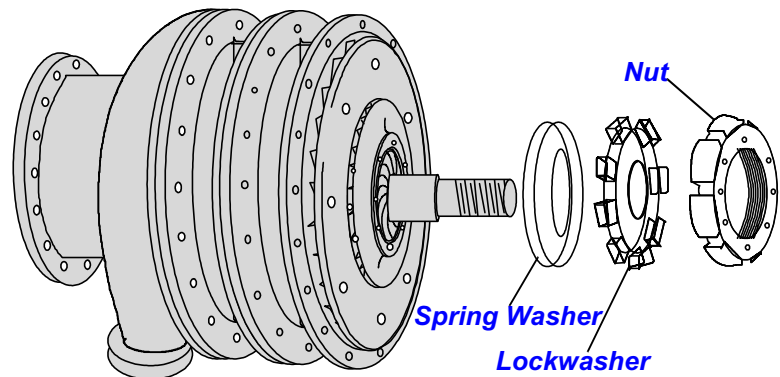
All major rotating components are individually balanced to specification before the compressor is assembled. Even though each major rotating component in the compressor is individually balanced, a small percentage of the compressors assembled in the factory and in the field may be beyond the allowable limit for unbalance. When this occurs, the compressor will need to be trim balanced in the field after re-assembly, using a balance style locknut and weights. Refer to Service Bulletin *CVHE-SB-18* (latest revision) for information on allowable vibration limits.

*IMPORTANT: When all components will be re-used during re-assembly, mark the position of the locknut relative to the end of the motor shaft. It is best to mark these at the location of the keyway for the 1<sup>st</sup> stage impeller. A small center punch can be used to place a mark on the locknut and the end of the shaft. **Do not remove the balance screws or weights from the balance locknut when all components will be re-used!***

- (a) Bend the lockwasher tab back from the slot on the impeller locknut.
- (b) Remove the impeller locknut, lockwasher, spring washer, and steel spacer as applicable. Use a spanner wrench to remove the locknut. See Figure 8. The locknut has right hand threads. To loosen impeller locknut, turn it counter clockwise. Use a wire cable tie or tape to keep the items together. Tape the end of the shaft to prevent damage to the threads. Note: It is recommended that the lockwasher be discarded and replaced with a new lockwasher during re-assembly.

## Centravac General Service Literature

Figure 8



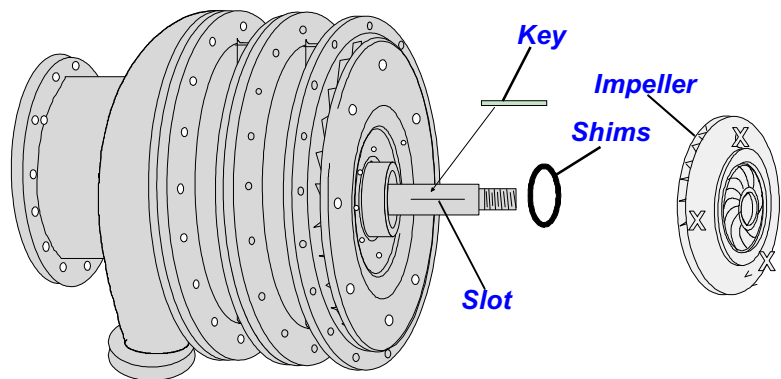
### CAUTION

#### POSSIBLE COMPRESSOR FAILURE!

Use undamaged or new lockwashers for re-assembly. Once a locking tab has been bent over on a lockwasher it may become weak and break off if re-used. This could cause the impeller locknut to loosen and come off during operation, causing major damage to the compressor and motor.

(c) Note: Discard old or damaged lockwashers. Save the conical spring washer for re-use.

Figure 9

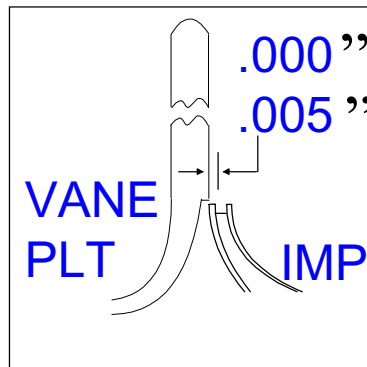


17 Remove the impeller. (See Figure 9.)

(a) Before removing the impeller, check the alignment of the impeller inside back discharge surface to the diffuser plate. The impeller surface should be aligned as shown in Figure 10. When reusing all rotating components and the alignment is not as specified above, measure and record the amount of shim(s) that may need to be added or removed during re-assembly.

## Centravac General Service Literature

Figure 10



(b) It may be necessary to use a puller to remove the impeller. When using a puller, make sure the face of the puller is parallel to the face of the impeller hub to ensure a straight pull. Take care not to damage the machining center in the end of the shaft. If necessary, a small amount of heat may be required to loosen the impeller on the shaft. When heating impeller, use a large (Rosebud) tip with a soft gentle flame. Do not overheat the impeller. The impeller should be heated so that it is warm to the touch. Do not exceed 120° F.

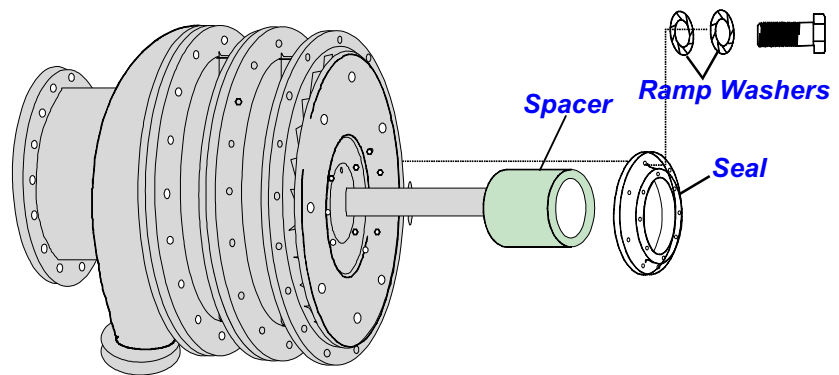
(c) Mark the impeller 1<sup>st</sup> STAGE.

18 Remove the impeller key and shims from behind the impeller. Tape the shims together and secure them to the impeller along with the key. Keep the parts for each stage separate.

19 Measure and record the clearance between the 1<sup>st</sup> stage shaft seal and spacer. If the shaft seal has the lockwashers with bent over tab, bend them over using a screw driver. It is recommended the tab type lock washers be discarded and replaced by the ramp type washers shown in Figure 11. Remove the hex head bolts and ramp washers and remove the seal and mark it properly.

20 Remove the 1<sup>st</sup> stage spacer and spacer tube (some CVHG compressors).

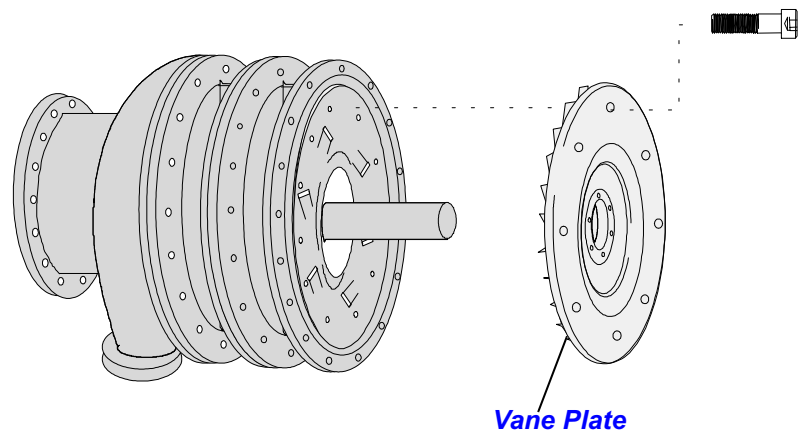
Figure 11



## Centravac General Service Literature

- (a) Mark the spacer and spacer tube with its position on the shaft with the first stage impeller keyway at the 12 o'clock position. The shaft spacer has tapped pull-off holes that can be used to pull the spacer if needed. Using the pull-off holes may be required on units where corrosion has occurred due to leaks and moisture or other causes.
  - (b) Mark the spacer and spacer tube for TOP and 1<sup>st</sup> STAGE.
- 21 Remove the 1<sup>st</sup> stage vane plate. See Figure 12. Refer to Table 2 for the weight of the vane plate.

**Figure 12**

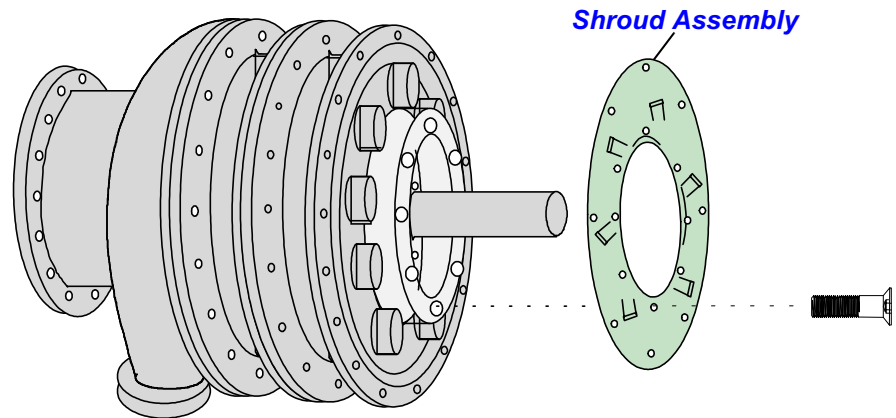


- (a) Remove four 3/8"- 16 socket head cap screws.
  - (b) Mark the vane plate for TOP and 1<sup>st</sup> STAGE.
  - (c) Install two 3/8"- 16 x 6" stop bolts with heads in two of the bolt holes. Install two 3/8"- 16 x 6" guide pins (may be threaded rod, no heads) in the remaining two bolt holes.
  - (d) Remove the remaining socket head screws holding the vane plate to the interstage casing.
  - (e) Back the vane plate away from the interstage casing on the guide and stop bolts as far as the bolt heads will allow (approximately 6").
  - (f) Place a nylon sling through the center of the vane plate in the choke configuration.
  - (g) Lift the plate slightly with the nylon sling and remove the two remaining stop bolts with heads.
  - (h) Remove the vane plate, being careful not to damage the rotor shaft.
- 22 Remove the 2<sup>nd</sup> stage steel shroud assembly. See Figure 13.
- (a) Leave the guide pins in place as installed in Step 21 above.
  - (b) Mark the TOP of the shroud assembly.
  - (c) Remove the 1/4"-20 x 3/4" flathead screws that secure the shroud assembly. These screws use a thread locking compound and may be difficult to remove. Use an allen

## Centravac General Service Literature

head socket for removal. Make sure the allen head socket does not have rounded edges. A hand impact driver may be helpful in removing screws. See Figure 13.

**Figure 13**



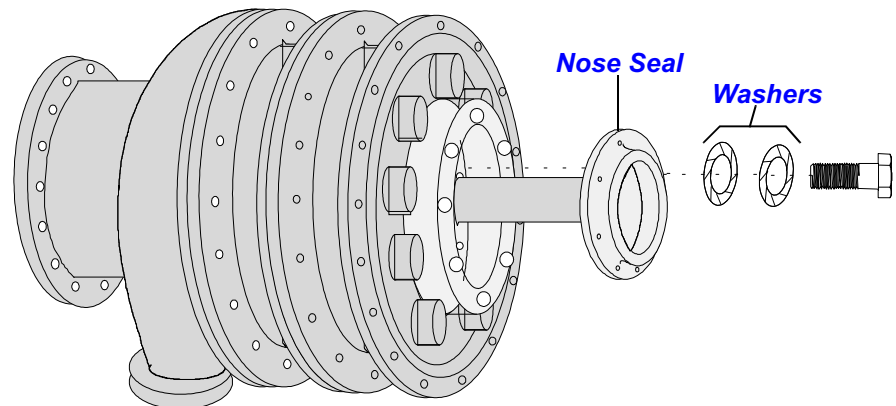
(d) Slide the vane shroud assembly out on the guide pins and attach a lifting sling.

(e) Remove the shroud, guiding it clear with the guide pins. Lightly coat the shroud with compressor oil and store properly.

**23** Remove the shims from in front of the 2<sup>nd</sup> stage impeller. Tape them together and secure them to the back of the spacer removed in Step 20.

**24** Remove the 2<sup>nd</sup> stage impeller nose seal. Refer to Figure 14.

**Figure 14**



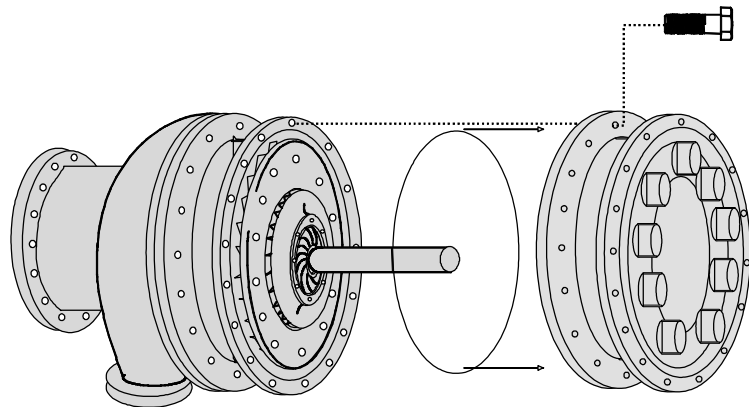
(a) Measure and record the seal clearance. Table 3 provides proper clearances.

(b) Mark the seal for TOP and 2<sup>nd</sup> STAGE. **IMPORTANT:** Mark this seal carefully. On some size units this seal is mounted in a reverse position.

## Centravac General Service Literature

- (c) Remove the 3/8" - 16 x 1" hex head screws and tab or ramp washers.
  - (d) Remove the seal. See Figure 14.
- 25 Measure and record the total indicated runout (TIR) on the nose of the 2<sup>nd</sup> stage impeller.
- 26 Remove the 2<sup>nd</sup> stage suction cover and o-ring. See Table 2 for the weight of the intermediate stage suction cover.
- (a) Remove two bolts from the suction cover, 180 degrees apart on the horizontal centerline (3 and 9 o'clock positions) and insert 6" long guide pins.
  - (b) Remove a bolt near the bottom of the suction cover and one to the side of the lifting fixture and insert 6" long stop bolts (with heads) to limit movement of the cover until a proper balance point with the lifting fixture is obtained. Attach the lifting plate. Remove the remaining bolts (leaving in place the guide pins and stop bolts) and pick up slightly on the cover. It may be necessary to use jacking bolts to push the cover away from the casing. If necessary, move the pick up point on the lifting tool until the cover is balanced.
  - (c) Once the cover is balanced properly with the lifting tool, remove the stop bolts at the top and bottom of the cover and remove the suction cover. Lightly oil the cover flanges and store it properly to prevent rust or damage to the flange sealing surfaces. See Figure 15.

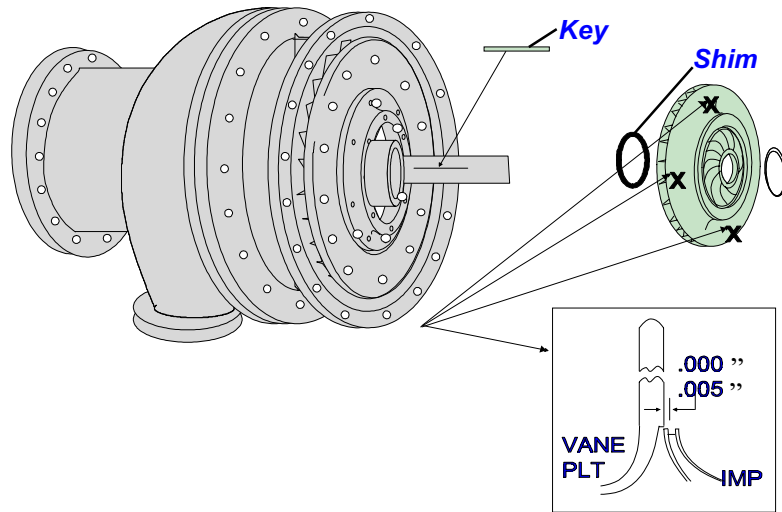
Figure 15



- 27 Remove the 2<sup>nd</sup> stage impeller.
- (a) Before removing the impeller, check the alignment of the impeller inside the back discharge surface to the diffuser plate. The impeller surface should be aligned as shown in Figure 16. When re-using all rotating components and the alignment is not as specified above, measure and record the amount of shims that may need to be added or removed during re-assembly.

## Centravac General Service Literature

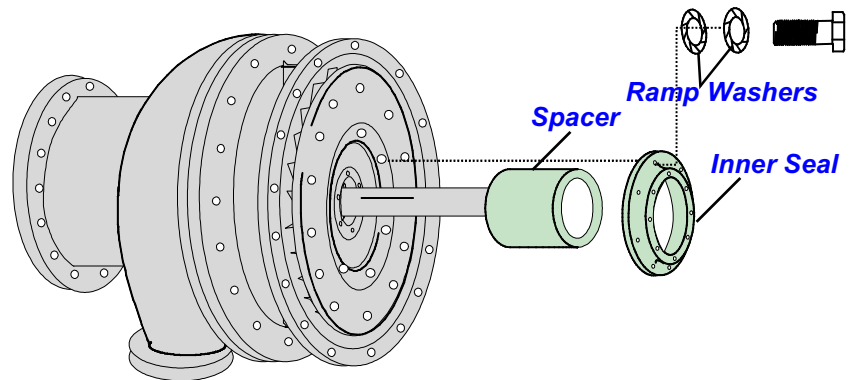
Figure 16



- (b) It may be necessary to use a puller to remove the impeller. When using a puller, make sure the face of the puller is parallel to the face of the impeller hub to ensure a straight pull. Take care not to damage the machining center in the end of the shaft. If necessary, a small amount of heat may be required to loosen the impeller on the shaft. When heating impeller, use a large (Rosebud) tip with a soft gentle flame. Do not overheat the impeller. The impeller should be heated so that it is warm to the touch. Do not exceed 120° F.
- (c) Mark the impeller 2<sup>nd</sup> STAGE.
- 28 Remove the impeller key and shims from behind the impeller. Tape the shims together and secure them to the impeller along with the key. Keep the parts for each stage together. See Figure 16.
- 29 Mark and remove the 2<sup>nd</sup> stage shaft seal.
- (a) Measure and record the seal clearance. Proper clearances are given in Table 3.
- (b) Mark the seal for TOP and second stage.
- (c) Remove the 3/8" - 16 x 1" bolts and tab or ramp washers that secure the seal to the vane plate.
- (d) Remove the seal. See Figure 17.

## Centravac General Service Literature

**Figure 17**

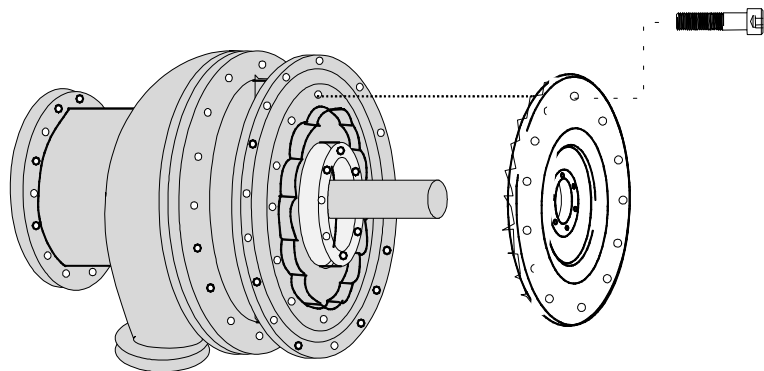


**30** Remove the 2<sup>nd</sup> stage shaft spacer.

- (a) Mark spacer position on the shaft with the 1<sup>st</sup> stage impeller keyway at the 12 o'clock position.
- (b) Mark the seal for TOP and 2<sup>nd</sup> STAGE.

**31** Remove the aluminum vane plate. See Figure 18. Refer to Table 2 for the weight of the vane plate.

**Figure 18**



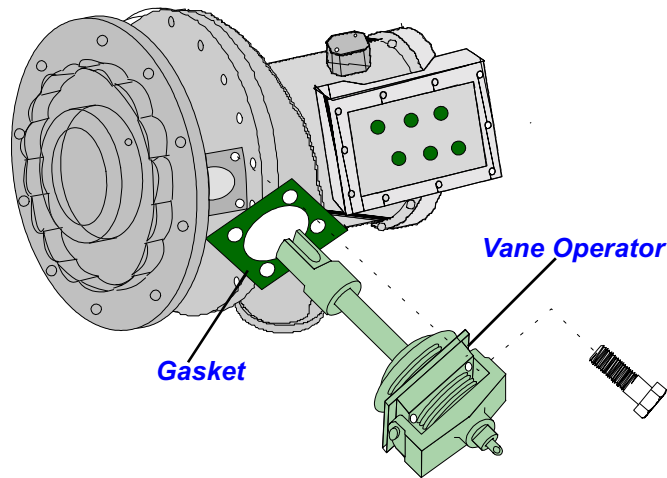
- (a) Remove four 3/8"-16 socket head screws.
- (b) Mark the vane plate for TOP and 2<sup>nd</sup> STAGE.
- (c) Install two 3/8"-16 x 6" stop bolts with heads in two of the bolt holes. See Figure 12. Install two 3/8"-16 x 6" guide pins (can be threaded rod, no heads) in the remaining two bolt holes.
- (d) Remove the remaining socket head screws holding the vane plate to the interstage casing.

## Centravac General Service Literature

- (e) Back the vane plate away from the interstage casing on the bolts as far as the bolt heads will allow.
- (f) Place a nylon sling through the center of the vane plate in the choke configuration.
- (g) Lift the plate slightly with the nylon sling until the two stop bolts (with heads) can be removed.
- (h) Remove the vane plate, being careful not to damage the rotor shaft.

32 Remove the 3<sup>rd</sup> stage vane operator assembly. See Figure 19.

**Figure 19**



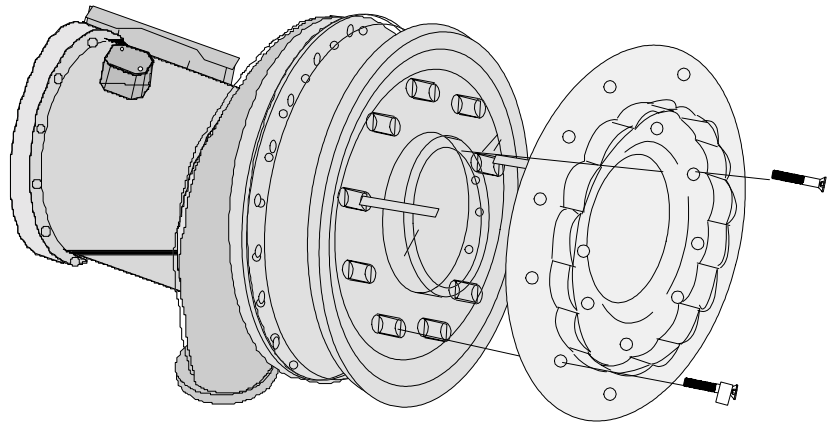
- (a) Remove the 1/2" - 13 x 1-3/4" hex head screws that secure the vane operator assembly.
- (b) Remove the vane operator and gasket. Lightly coat all bare metal surfaces with compressor oil.

33 Remove the shroud and 3<sup>rd</sup> stage inlet vane assembly.

- (a) Mark the assembly for TOP.
- (b) Leave the guide pins installed in Step 32 in place. See Figure 20.
- (c) Remove the 1/4" - 20 x 3/4" flathead screws that secure the shroud. These screws use a thread locking compound and may be difficult to remove. Use an allen head socket for removal. Make sure the allen head socket does not have rounded edges. A hand impact driver may be helpful in removing screws.
- (d) Attach a sling or cable to the shroud and remove the shroud and vane assembly. See Figure 20. For weights, see Table 2. Immediately coat the vane assembly shroud, pins, levers etc. with compressor oil or rust preventive oil to stop corrosion or rust.

## Centravac General Service Literature

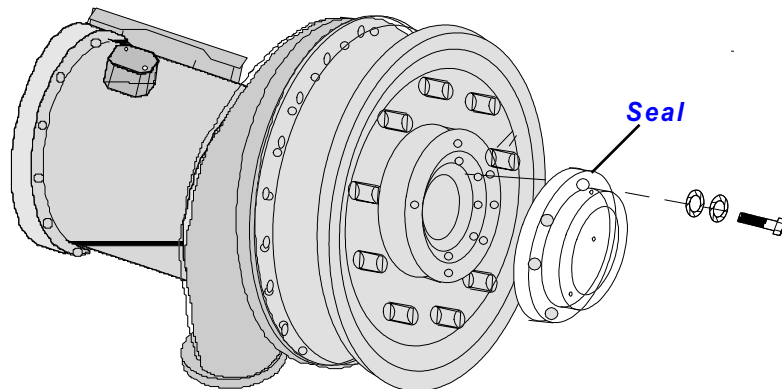
**Figure 20**



**34** Remove the 3<sup>rd</sup> stage impeller nose seal. Refer to Figure 21.

- (a) Measure and record the seal clearance. Table 3 provides proper clearances.
- (b) Mark the seal for TOP and 3<sup>rd</sup> STAGE.
- (c) Remove the 3/8" - 16 x 1" hex head screws and tab or ramp washers.
- (d) Remove the seal.

**Figure 21**



**35** Measure and record the total indicated runout (TIR) on the nose of the 3<sup>rd</sup> stage impeller.

**36** Remove the 3<sup>rd</sup> stage suction cover and o-ring. See Table 2 for the weight of the intermediate stage suction cover.

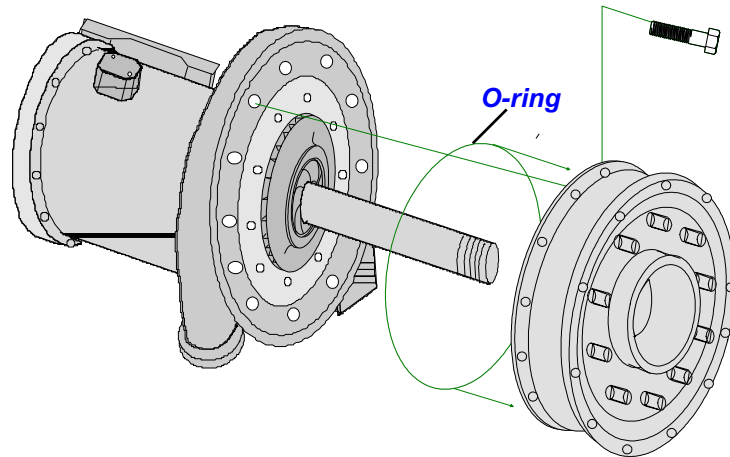
- (a) Remove two bolts from the suction cover, 180 degrees apart on the horizontal centerline (3 and 9 o'clock positions) and insert 6" long guide pins.

## Centravac General Service Literature

- (b) Remove a bolt near the bottom of the suction cover and one to the side of the lifting fixture and insert 6" long stop bolts (with heads) to limit movement of the cover until a proper balance point with the lifting fixture is obtained. Attach the lifting plate. Remove the remaining bolts (leaving in place the guide pins and stop bolts) and pick up slightly on the cover. It may be necessary to use jacking bolts to push the cover away from the casing. If necessary, move the pick-up point on the lifting tool until the cover is balanced.
- (c) Once the cover is balanced properly with the lifting tool, remove the stop bolts at the top and bottom of the cover and remove the suction cover. Lightly oil the cover flanges and store it properly to prevent rust or damage to the flange sealing surfaces. See Figure 22.

37 Remove the 3<sup>rd</sup> stage impeller and the shim(s) in front of impeller. Tape the shims to the spacer removed earlier.

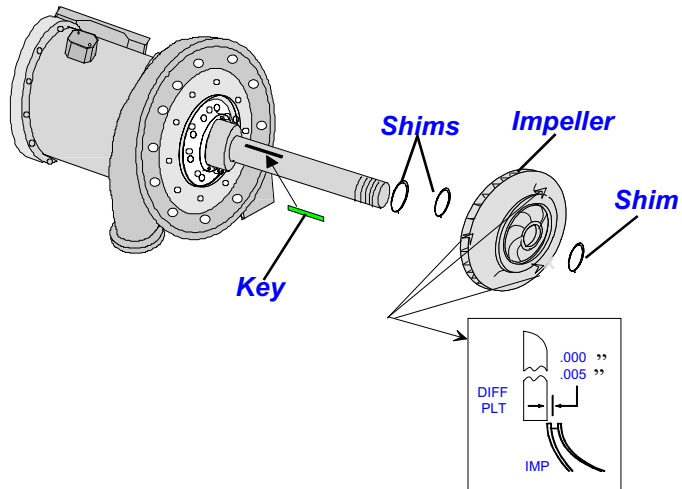
Figure 22



- (a) Before removing the impeller, check the alignment of the impeller inside the back discharge surface to the diffuser plate. The impeller surface should be aligned as shown in Figure 23. When re-using all rotating components and the alignment is not as specified, measure and record the amount of shims that may need to be added or removed during re-assembly.
- (b) A puller may be necessary to remove the impeller. When using a puller, make sure the face of the puller is parallel to the face of the impeller hub to ensure a straight pull. Take care not to damage the machining center in the end of the shaft. If necessary, a small amount of heat may be required to loosen the impeller on the shaft. When applying heat, use a torch with a large (Rosebud) tip and a soft gentle flame. Do not overheat the impeller. The impeller should be heated so that it is warm to the touch. Do not exceed 120° F. See Figure 23.

# Centravac General Service Literature

Figure 23



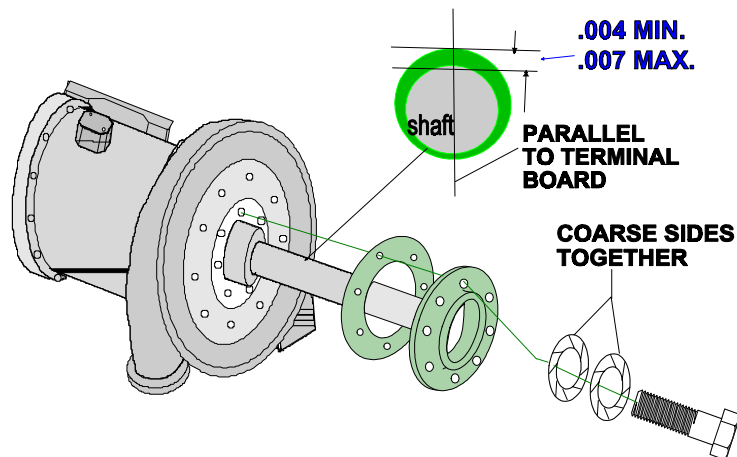
(c) Mark the impeller 3<sup>rd</sup> STAGE.

38 Remove the impeller key and shims from behind the impeller. Tape the shims together and secure them to the impeller along with the key. *Note: It is important that the thicker steel spacer be installed against the shaft shoulder with the chamfer facing the shaft shoulder.*

39 Remove the bearing oil seal and gasket.

(a) Measure and record the seal clearance. **IMPORTANT:** Excessive clearance of this seal will cause oil loss. Measure the seal clearance all the way around as shown. The total clearance between the shaft OD and seal ID will be 0.0040" to 0.0070". This seal is set in the factory with the bottom of the seal brought up to the bottom of the shaft and all the clearance (.004"-.007" total) at the top. The clearance between shaft and seal at the sides (3 and 9 o'clock positions) should be equal. See Figure 24.

Figure 24



## Centravac General Service Literature

(b) Mark the seal for TOP. *IMPORTANT: The seal has a small oil drain hole in the back which must be correctly aligned during re-assembly. The drain hole must be at the 6 o'clock position.*

(c) Remove the hex head screws and tab or ramp washers securing the seal and gasket.

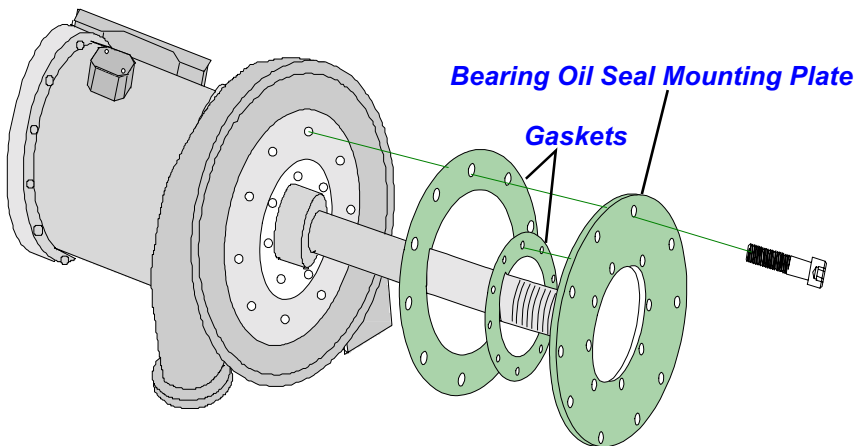
#### 40 Remove the bearing oil seal mounting plate and gasket.

(a) Mark the plate for TOP.

(b) Remove two 3/8" - 16 x 1" socket head screws and insert two stop bolts approximately 6" in length and two 6" long guide pins.

(c) Remove the remaining screws and then remove the plate and gasket. See Figure 25. Use a nylon sling or rope to lift the plate. See Table 2 for the weight of the plate. Place a container under the plate since some oil will drain out when the plate is removed. Lightly coat the plate with compressor oil to prevent rust.

**Figure 25**



#### 41 Unit mounted starter removal (when applicable).

(a) Attach a small chain to the lifting eye bolts on top of the starter. Pick up slightly on the chain to take up slack.

(b) Remove the motor leads from the motor terminal studs. Mark each lead carefully with the corresponding motor terminal number stamped on the motor terminal board. Remove other electrical connections as necessary to allow enough room to remove the starter and mark them carefully.

(c) Remove the bolts holding the starter to the motor housing and the bolts (when applicable) on the lower support bracket and move the starter away from the motor, being careful not to damage the motor terminals.

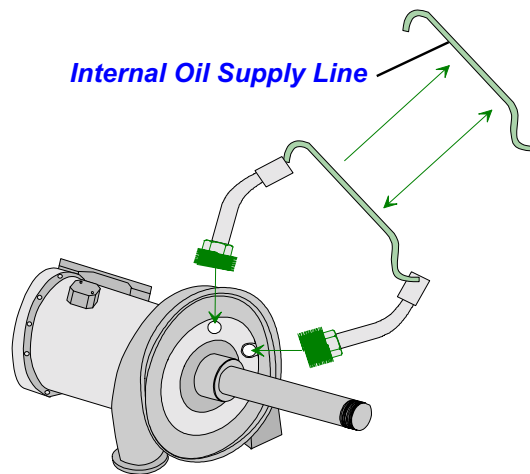
#### 42 Motor removal.

(a) Sand the external oil supply and drain lines to remove paint, then cut them with a tubing cutter. Do not use a hacksaw to cut the lines. Always use a tubing cutter to avoid introducing copper chips (debris) into the unit.

## Centravac General Service Literature

- (b) Heat the internal oil supply line to loosen and remove line. Bleed nitrogen through the line when heating to prevent build up of copper oxides inside the line. Use a wet rag to protect the threaded connections from excessive heat. See Figure 26.

**Figure 26**



- (c) If the motor is to be replaced or remanufactured, remove the bearing oil supply orifice on the thrust (ball) bearing end of the motor. The orifice threads into the motor bearing housing.

**IMPORTANT:** Save the orifice for re-use.

**IMPORTANT:** Failure to use a properly sized orifice on the ball bearing supply line could result in excessive oil flow and possible oil loss problems.

- (d) Remove the flange bolts for the motor cooling refrigerant supply line and drain lines. In some instances, the drain lines may need to be cut to provide enough clearance for motor removal. Sand the drain line to remove paint then cut it with a tubing cutter. Do not use a hacksaw to cut the line. Always use a tubing cutter to avoid introducing copper chips (debris) into the unit.

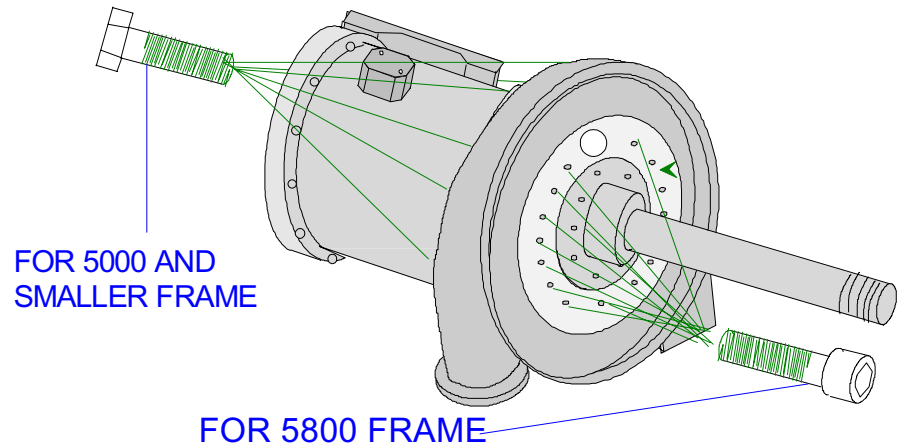
**IMPORTANT:** Remove the motor cooling orifice located between the motor housing and the motor cooling supply line flange. Save the orifice for re-use.

- (e) Using two slings in the choke configuration, position them at each end of the motor housing. Refer to Table 4 for motor weights.
- (f) Remove two of the bolts holding the motor assembly in the volute and install 5/8" guide pins (2-3" in length) so they are 180 degrees across from each other.

**Note:** On some units with large frame motors (>5000 frame), the bolts securing the motor to the discharge volute must be accessed from the compressor side. See Figure 27. This will require removing the volute diffuser plate as detailed in step 43.

## Centravac General Service Literature

Figure 27



(g) Pick up on the slings to take up slack and remove the remaining bolts that secure the motor to the volute. Lift the motor slightly and move away from the volute being careful not to damage the motor shaft.

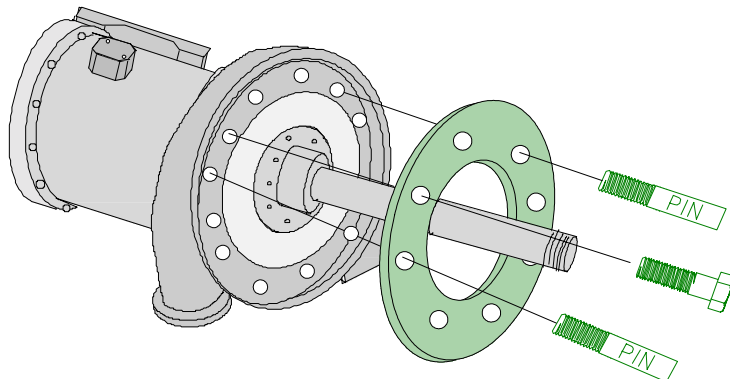
(h) Oil the shaft and cover all openings to prevent debris from entering the motor.

### 43 Volute diffuser plate removal.

(a) Remove four 1/2" allen head cap screws and insert two 6" long guide pins and two 4" long stop bolts.

(b) Remove the remaining allen head cap screws and slide the diffuser plate away from the volute. See Figure 28.

Figure 28



(c) Place a sling or cable in the choke configuration through to the center of the diffuser plate. See Table 2 for the weight of the diffuser plate.

(d) Lift the diffuser plate and remove the stop bolts.

## Centravac General Service Literature

---

(e) Slide the diffuser plate away from the volute. Oil the diffuser to prevent rusting.

### 44 Discharge volute removal.

- (a) Remove the dowel pins on the discharge flange at the condenser and on the foot of the volute. First remove the threaded nut on the exposed end of the dowel pin. Then slip washers or a bushing over the pin and reinstall the nut. As the nut is tightened, the pin will be pulled out of place. The dowel pins allow for precise assembly of the compressor components in their original position.
- (b) Place a sling in the choke configuration through the center of the volute. Take up the slack in the sling.
- (c) Remove the bolts at the discharge flange and the compressor foot and then lift the volute. See Table 2 for volute weights.
- (d) Clean and oil the discharge flange on the condenser and cover the opening to prevent entry of debris

Inspect all components for damage or excessive wear. Do not re-assemble the compressor using faulty components. Clean each component and apply a light coat of compressor oil to protect it from moisture and corrosion (especially o-ring and gasket surfaces).

*Note: Refer to Centravac Literature Section CTVH-GCO-02 for the compressor re-assembly procedures.*

**Table 2**  
**Compressor Component Weights (lb.)**

Unit Type	Unit/ Comp Size 60HZ	Unit/Comp Size 50HZ	Economizer (Std. Less free cooling)	Suction Elbow	1 <sup>st</sup> Stage Inlet Vane	1 <sup>st</sup> Stage Suction Cover	Impellers All Stages	2 <sup>nd</sup> Stage Alum. Vane Plate	2 <sup>nd</sup> Stage Casing	3 <sup>rd</sup> Stage Alum. Vane Plate	2 <sup>nd</sup> or 3 <sup>rd</sup> Stage Inlet Vanes & Plate	3 <sup>rd</sup> Stage Casing	Steel Volute Diffuser Plate	Discharge Volute	Complete Compressor Including Motor
CVHE	016-020	016-020	300	203	200	715	37	90	820	90	70	768	162	800	5665
CVHE	023-032 230-320	023-320 190-270	385	266	240	1008	42	115	719	115	76	742	162	793	6880
CVHE	036-050 360-500	036-050 300-420	700	310	270	1050	42	130	875	130	82	775	162	910	7300
CVHE	056-080 560-800	056-080 470-660	840	494	300	1145	47	140	1132	140	88	880	232	1110	9175
CVHE	089-125 890-1250	089-125 740-1040	1230 lbs	706	350	1285	47	150	1257	150	93	1200	346	1608	11125
CVHG	N/A	480-565			311	1740		190	1840	190		1840	356	1418	
CVHG	N/A	670-780			408	1690		190	1990	190		1920	309	1430	
CVHG	N/A	920-1067			425	1718		190	2010	190		1920	309	1820	
CDHG*	N/A	1250			See Compressor Size CVHG 670										
CDHG*	N/A	1750			See Compressor Size CVHG 920										
CDHG*	N/A	2150			See Compressor Size CVHG 1067										

\* Duplex Units. Suction elbow weight for each compressor.

**Table 3**  
**CVHE/CVHG Compressor Clearances**

Model			1 <sup>st</sup> Stage Impeller Nose Seal (in.)	2 <sup>nd</sup> Stage Impeller Nose Seal (in.)	3 <sup>rd</sup> Stage Impeller Nose Seal (in.)	Shaft Runout Max. TIR (in.)	Impeller Nose Runout Max. TIR (in.)		Interstage Seal to Shaft Spacer	Bearing Oil Seal to Shaft+ (in.)
CVHE			Radial Clearance	Radial Clearance	Radial Clearance		Cast*	Fab.*	Radial Clearance	See Note +
50-60 Hz.	60 Hz.	50 Hz.								
013	130	N/A	.0195-.0295	.0165-.0240	.0165-.0240	.0012	.0035	.0050	.0180-.0240	.0040-.0070
014	140	N/A	.0195-.0295	.0165-.0240	.0165-.0240	.0012	.0035	.0050	.0180-.0240	.0040-.0070
015&016	160	N/A	.0195-.0295	.0195-.0295	.0165-.0240	.0012	.0035	.0050	.0180-.0240	.0040-.0070
018	180	N/A	.0195-.0295	.0195-.0295	.0165-.0240	.0012	.0035	.0050	.0180-.0240	.0040-.0070
020	200	N/A	.0195-.0295	.0195-.0295	.0165-.0240	.0012	.0035	.0050	.0180-.0240	.0040-.0070
022	N/A	N/A	.0195-.0295	.0195-.0295	.0195-.0295	.0012	.0035	.0050	.0180-.0240	.0040-.0070
023	230	190	.0220-.0330	.0195-.0295	.0195-.0295	.0012	.0035	.0050	.0180-.0240	.0040-.0070
025	250	210	.0220-.0330	.0195-.0295	.0195-.0295	.0012	.0035	.0050	.0180-.0240	.0040-.0070
028	280	240	.0220-.0330	.0195-.0295	.0195-.0295	.0012	.0035	.0050	.0180-.0240	.0040-.0070
032	320	270	.0220-.0330	.0195-.0295	.0195-.0295	.0012	.0035	.0050	.0180-.0240	.0040-.0070
035&036	360	300	.0245-.0365	.0220-.0330	.0195-.0295	.0012	.0035	.0050	.0180-.0240	.0040-.0070
040	400	330	.0245-.0365	.0220-.0330	.0195-.0295	.0012	.0035	.0050	.0180-.0240	.0040-.0070
045	450	370	.0245-.0365	.0220-.0330	.0195-.0295	.0012	.0035	.0050	.0180-.0240	.0040-.0070
049	N/A	N/A	.0245-.0365	.0220-.0330	.0220-.0330	.0012	.0035	.0050	.0180-.0240	.0040-.0070
050	500	420	.0245-.0365	.0220-.0330	.0220-.0330	.0012	.0035	.0050	.0180-.0240	.0040-.0070
056	560	470	.0285-.0430	.0245-.0365	.0220-.0330	.0012	.0035	.0050	.0180-.0240	.0040-.0070
063	630	530	.0285-.0430	.0245-.0365	.0220-.0330	.0012	.0035	.0050	.0180-.0240	.0040-.0070
071	710	590	.0285-.0430	.0245-.0365	.0220-.0330	.0012	.0035	.0050	.0180-.0240	.0040-.0070
079	N/A	N/A	.0285-.0430	.0245-.0365	.0245-.0365	.0012	.0035	.0050	.0180-.0240	.0040-.0070
080	800	660	.0285-.0430	.0245-.0365	.0245-.0365	.0012	.0035	.0050	.0180-.0240	.0040-.0070
089	890	740	.0310-.0460	.0285-.0430	.0245-.0365	.0012	.0035	.0050	.0180-.0240	.0040-.0070
090	900	N/A	.0310-.0460	.0285-.0430	.0245-.0365	.0012	.0035	.0050	.0180-.0240	.0040-.0070
100&101	1000	830	.0310-.0460	.0285-.0430	.0245-.0365	.0012	.0035	.0050	.0180-.0240	.0040-.0070
112&113	1120	930	.0310-.0460	.0285-.0430	.0245-.0365	.0012	.0035	.0050	.0180-.0240	.0040-.0070
125	1250	1040	.0310-.0460	.0285-.0430	.0285-.0430	.0012	.0035	.0050	.0180-.0240	.0040-.0070
140	N/A	N/A	.0310-.0460	.0285-.0430	.0285-.0430	.0012	.0035	.0050	.0180-.0240	.0040-.0070
<b>CVHG: 50 Hz.</b>										
<b>All Sizes</b>			.0160-.0210	.0160-.0210	.0160-.0210	.0012	.0035	.0050	.0100-.0160	.0040-.0070

\* Clearances shown for cast impellers and welded/fabricated impellers.

+ Seal should be lightly touching bottom of shaft and maximum clearance at top.



# Centravac General Service Literature

## Compressor/Motor Record Sheet

<b>Job Name:</b>	<b>Disassembly:</b>	<b>CVHE:</b>
<b>Technician:</b>	<b>Assembly:</b>	<b>CVHF:</b>
<b>Date:</b>	<b>City:</b>	<b>CVHG:</b>
<b>Unit Model:</b>	<b>Serial #:</b>	

	(in.)	<b>1<sup>st</sup> Stage Impeller Seal Clearance</b>
	(in.)	<b>1<sup>st</sup> Stage Impeller Nose Runout</b>
	(in.)	<b>1<sup>st</sup> Stage Impeller OD. to Diffuser Clearance</b>
	(in.)	<b>Shaft Runout (TIR)</b>
	(in.)	<b>1<sup>st</sup> Stage Spacer Seal Clearance</b>
	(in.)	<b>2<sup>nd</sup> Stage Impeller Seal Clearance</b>
	(in.)	<b>2<sup>nd</sup> Stage Impeller Nose Runout</b>
	(in.)	<b>2<sup>nd</sup> Stage Impeller OD. To Diffuser Clearance</b>
	(in.)	<b>2<sup>nd</sup> Stage Spacer Seal Clearance</b>
	(in.)	<b>3<sup>rd</sup> Stage Impeller Seal Clearance</b>
	(in.)	<b>3<sup>rd</sup> Stage Impeller Nose Runout</b>
	(in.)	<b>3<sup>rd</sup> Stage Impeller OD. to Diffuser Clearance</b>
	(in.) 12:00	<b>Oil Seal Clearance (Record 4 Places)</b>
	(in.) 6:00	
	(in.) 3:00	
	(in.) 9:00	

<b>Air-Run (Elbow Off)</b>	(in./sec. H)	(in./sec. V)	(in./sec. A)
<b>Air-Run (Elbow On)</b>	(in./sec. H)	(in./sec. V)	(in./sec. A)
<b>Freon-Run</b>	(in./sec. H)	(in./sec. V)	(in./sec. A)

**Comments:**

## Centravac General Service Literature

**Table 4**  
**Centravac Motor Weights**

<i>Unit Type</i>	<i>Unit/Compressor Size (60 Hz.)</i>	<i>Unit/Compressor Size (50 Hz.)</i>	<i>Low Voltage (208-600 Volts)</i>	<i>High Voltage (2300-6600 Volts)</i>
CVHE	016-020 N/A	016-020 N/A	1568 lb. 711 kg.	N/A N/A
CVHE	023-032 230-320	023-032 190-270	1861 lb. 844 kg.	2641 lb. 1198 kg.
CVHE	036-050 360-500	036-050 300-420	2730 lb. 1238 kg.	2898 lb. 1315 kg.
CVHE	056-080 560-800	056-080 470-660	3554 lb. 1612 kg.	3991 lb. 1810 kg.
CVHE	089-125 890-1250	089-125 740-1040	4464 lb. 2025 kg.	4598 lb. 2086 kg.
CVHG	N/A	480-565	3560 lb. 1615 kg.	3968 lb. 1800 kg.
CVHG	N/A	670-780	3845 lb. 1744 kg.	4359 lb. 1977 kg.
CVHG	N/A	920-1067	4562 lb. 2069 kg.	4696 lb. 2130 kg.
CDHG	N/A	1250	3677 lb. 1668 kg.	3952 lb. 1793 kg.
CDHG	N/A	1750	3845 lb. 1744 kg.	4359 lb. 1977 kg.
CDHG	N/A	2150	4562 lb. 2069 kg.	4696 lb. 2130 kg.

# Centravac General Service Literature

*Figure 29  
Compressor Cross-Section View*

