SERVICE BULLETIN

Title: 17FA R–22 Type Seal (Rev. 1A)
Models Affected: 17FA R–22 (single shaft) version

Number: C9506
Date: 4/20/95
Supersedes: C9302
Date: 1/11/93

Purpose:

To provide the field with installation and service information on the "Hydropad"-style seal that is standard in the 17FA R-22 compressor.

File: Compressor

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Approved By: Alan Johnson

This revision adds information on troubleshooting the seal based on accumulated experience since the issue of the original bulletin. Answers to some common questions about contact seals in general have been added to the end of the bulletin. Lastly, a method to reposition the shaft with respect to the seal when replacing the thrust assembly.

Background:

The input shaft to the R-22 17FA compressor turns much faster than the shafts in the original 17FA compressor because of the necessity of using an external speed increaser rather than a gear set inside of the compressor. The input and impeller shafts are now one and the same. There is no "low-speed" shaft. The greater rpm required a different seal design. Because this seal is considerably different in construction from any seal previously used in Carrier Centrifugals, this bulletin is being issued to provide the field with the information required to service this seal.

Please note that the 17FA R-22 model compressor can also be applied with HFC-134a. You can be sure you have this model compressor by examining the shaft-end of the compressor. The compressor end will be flat instead of dished and the shaft will be offset instead of centered on the back of the compressor.

Machines Affected:

All 17FA R-22 style (single-shaft) compressors. This includes those used with refrigerants other than R-22.

Replacement Procedure:

Note: In the procedure we instruct you to coat the carbons with oil when assembling the seal. Although it has been fairly common practice to assemble seals dry so they will "lap in", the high speed of this seal will produce destructive temperatures if started with dry faces. Make sure the faces are lubricated during assembly.

1. Examine the seal casings (see fig. 1). When replacing the seal carbons it is NOT necessary and it is NOT recommended to replace the stainless steel seal casing unless it is damaged (see “Troubleshooting”). The spring and pressure plate which are contained in the casing can easily be replaced without replacing the casing itself. New casings are included with the complete seal package in case they are needed. However they are difficult to replace and there is nothing to be gained by it unless they have been damaged, and any damage is usually done while they are being handled, not during machine operation.

To install a new seal casing, first replace the o-ring between the outboard seal holder and the OD of the outboard seal casing. Early machines will not have this o-ring.

Heat the seal holder to 212F (no higher or you will damage the o-ring) and then after coating the OD of the seal casing with Loctite Retaining Compound 75 or equivalent, carefully press the seal casing into the holder until the edge of the casing is exactly flush with the surface of the seal holder. DO NOT push the casing in until it bottoms in the holder.

2. If the thrust bearing has been adjusted, perform the steps in the section "ADJUSTING THE CARBON WORKING HEIGHT" (see fig. 2). Then proceed to the next step.
3. An Omniseal must be installed in each seal casing with the open edge facing the pressure plate (see fig. 1). The rounded edges at the tips (it is U shaped in cross section) are the sealing surfaces. Be careful not to damage these edges with hard objects. Denting the edge with your fingernail can compromise its sealing ability.

   Do not try to install the Omniseal and carbon simultaneously. Install the Omniseal first.
4. Insert the carbon (primary ring) in each seal casing, being careful to line up the 4 indentations in the O.D. with the anti-rotation "dents" in the seal casing.

   Using the mating ring, press the carbon in until the carbon and springs bottom in the casing. Inspect the ID of the assembly. If a gap can be seen between the Omniseal and the carbon shoulder, the lip of the Omniseal is not on the carbon ID. Properly assembled, the carbon shoulder will be out of sight in the seal casing.
5. Using guide rods fastened into the 1/4-20 threaded holes in the inner seal mounting flange, insert the inner seal shims and the inner seal holder and bolt into place.
6. Coat the inner carbon surface with oil then install the Mating Ring on the shaft. (Don't forget the o-ring behind the Mating Ring in the shaft shoulder)

   Lock the Mating Ring in place with the threaded shaft sleeve.

7. Coat the outer carbon face with oil. Then using guide rods threaded into the 3/8-16 holes in the outer seal mounting flange install the outer seal holder and outer seal shims. Bolt into place. Torque the outer seal mounting bolts to 46-50 ft-lbs.

Adjusting Carbon Working Height:

(refer to fig. 2) The shims that position the inner and outer seal housings must be adjusted to provide the correct working height for the carbons. The working height is defined as the gap between the seal casing/holder and the face of the Mating ring.

Required Measurements:

(shaft should be in the thrust position)

A = Inner seal housing bolt ring thickness

B = Outer seal flange to inner seal flange distance. Use depth micrometer.

C = Outer seal flange to outer surface of the Mating Ring. The Mating Ring must be locked against the shaft shoulder with the spacer sleeve and locknut. Use depth micrometer. Be careful to not scratch the face of the Mating Ring with the micrometer.

D = Outer seal housing face to open end of seal casing, which is flush with the outer seal holder shoulder.

E = Outer seal housing bolt ring thickness.

F = Mating Ring thickness (for reference it should 0.625 +-0.008)

Inner Shim Thk. = B - (A + C + F + 0.040) tolerance ±0.002

Outer Shim Thk. = D + 0.050 - (C + E) tolerance ±0.002

Service Parts Packages:

17FA522-1507 is a complete seal as furnished by John Crane. It contains two primary rings (carbons), two Omniseals, one Mating Ring (rotating ring). The carbons and Omniseals are assembled into seal casings containing the seal springs. This replaces Kit 17FA522-1057 which has been discontinued.

Again, it is not recommended that the seal casings be replaced unless there is damage to the casing or the seal problem can be traced to the casing. Remove the carbons and Omniseals and install them in the existing seal casings.

17FA522-327 contains two carbons and two Omniseals. It replaces Kit 17FA522-158-1 which has been discontinued.

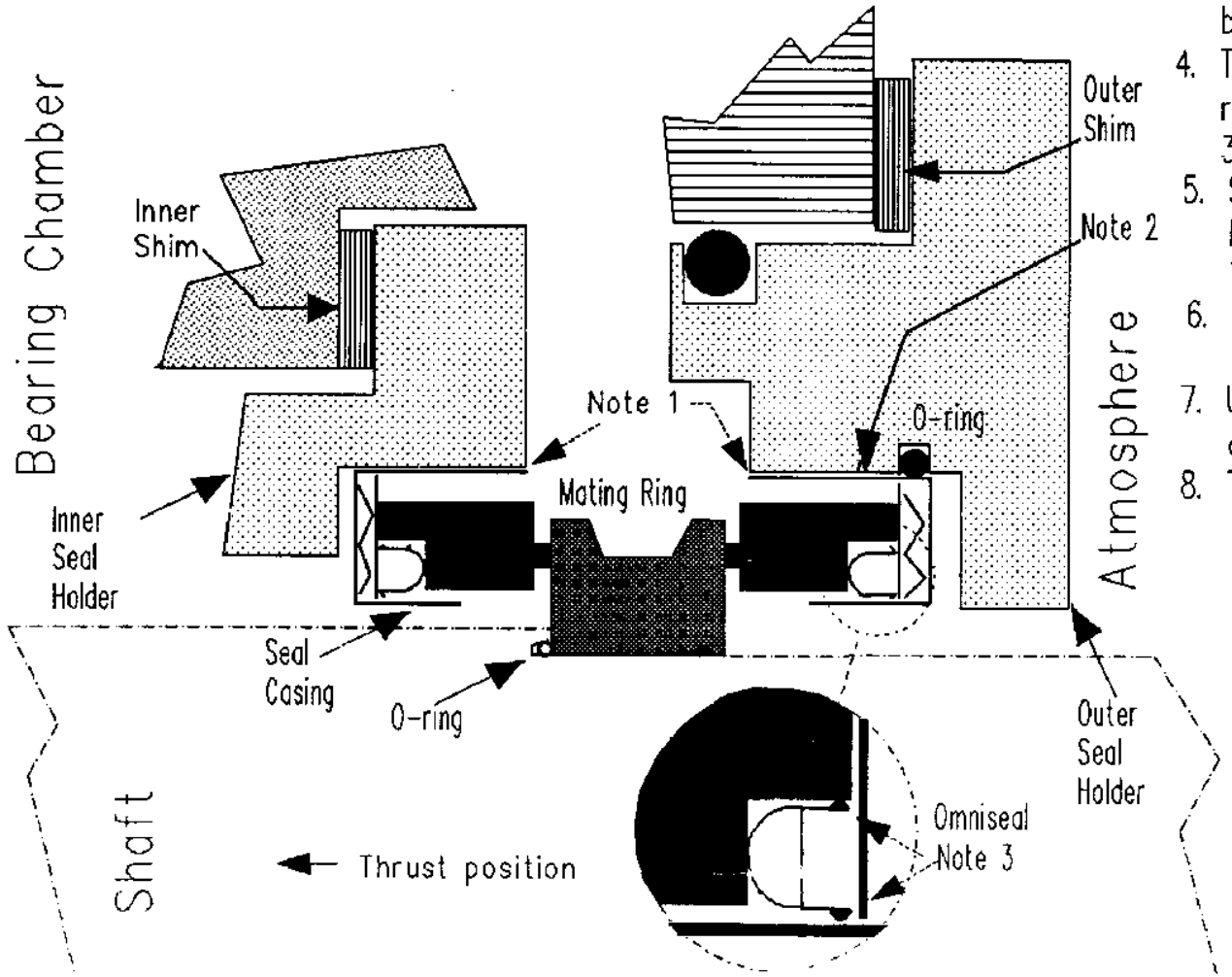
17FA522-1327-1 Individual Omniseal

Additional parts needed when changing a seal: (one each except as noted)

Gasket, Seal Cover	17FA522-1226
Gasket, Labyrinth	17M421-1811
O-ring, Outer seal holder	KK71EW431
O-ring, Shaft shoulder	KK71EW038
O-ring, Inner seal holder	KK71GW048
O-ring, Seal casing	KK71GW047 (Qty 1)**
Shim pkg., Inner seal holder	17FA522-1486
Shim pkg., Outer seal holder	17FA522-1477

**This o-ring was added to the seal assembly in December 1992.

17FA Seal (R-22 type)



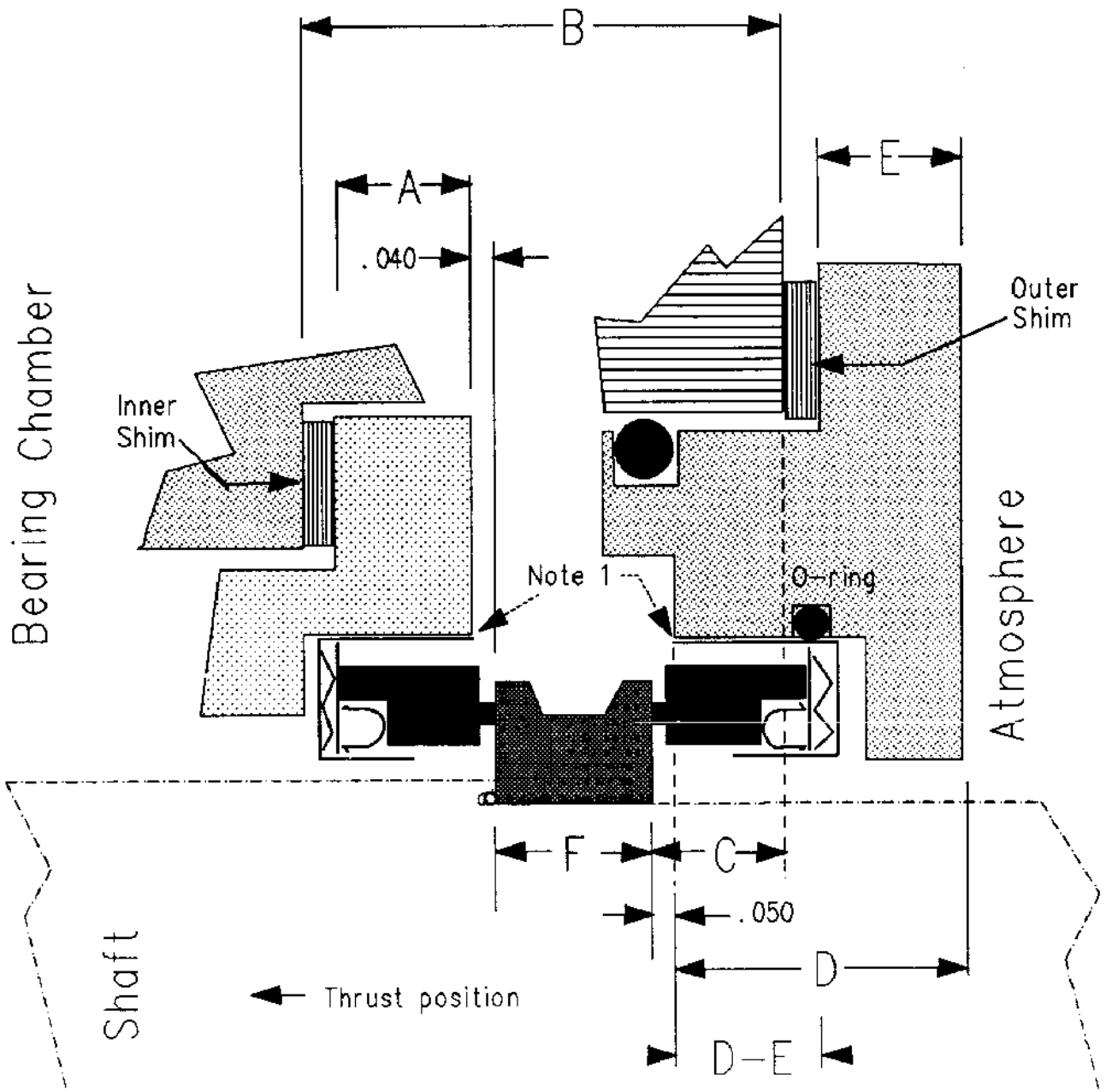
NOTES:

1. Seal Casing must be flush with seal holder
2. Loctite must be applied between holder and casing before pressing the casing into the seal holder.
3. Omniseal sealing points are the rounded edges at the tip. These must not be damaged.
4. The diameter of the correct mating ring for the Hydropad seal is 3.718 +.02 -.01
5. Seal Holder must be heated to 220 degrees F before attempting to press seal casing into place
6. See "Adjusting Carbon Working Height" to determine proper shim thickness.
7. Use 2 guide rods to guide shims and inner and outer seal holders during assembly.
8. Take care that carbon rings are correctly aligned with the anti-rotation bumps in the seal casings before assembling the seal.

Figure 1

Graphic: TPL
10/27/92

Adjusting Carbon Working Height



MEASUREMENTS:

A=Inner seal hsg. bolt ring thick.
B=Outer seal flange to inner seal flange
NOTE: Use depth micrometer
C=Outer seal flange to outer surface of Mating ring. Ring must be locked t the shaft. Use depth micrometer.
D=Outer seal hsg. face to open end of seal casing.
E=Outer seal hsg. bolt ring thick.
F=Mating ring thickness

CALCULATIONS:

INNER SHIM = B−(A + C + F + .040)

OUTER SHIM = .050−C+D−E

Tolerance: + − .002

MEASUREMENTS TO MATING RING SHOULD BE TAKEN WITH THE SHAFT IN THE THRUST POSITION

NOTE 1:
Seal retainer must be flush with face of seal holder.

Figure 2

Method: L. Damarin
Graphic: TPL
10/27/92

Troubleshooting The 17FA R-22 Style Compressor Seal:

Symptom - Seal starts leaking refrigerant gas shortly after the oil pump is stopped. No apparent external oil leakage is noticed prior to the gas leakage.

Cause - The oil is draining from the seal internally. This can be caused by a bad inner carbon, axial hang-up of the inner carbon (see below) or a leaking check valve in the seal supply line. This valve can be reached through the inspection cover.

Symptom - Intermittent increases in seal oil drip rate and, or external oil dripping at shutdown followed by gas discharge.

Cause - Axial hang-up of the OUTER seal carbon.

Axial carbon hang-up can be caused by foreign matter collecting around the Omniseal and also by poor fit between the carbon and the stainless steel seal casing. If poor fit is the cause you will find the carbon anti-rotation slot worn right at the corner where the curve of the slot meets the OD of the carbon. If the fit is proper the wear or contact area will extend over the arc defined by the arrows in figure 4.

Proper distance from the tip of a bump to the opposite bump is 3.845 +- .005 in. with the casing installed in the seal housing. The casing is a shrink fit in the housing so measurement of the bump-to-bump distance is not valid if the casing is not installed in the housing.

The carbon to casing clearance can be checked with the carbon and Omniseal installed in the casing which, in turn, has been installed in the seal housing. The clearance between the carbon

anti-rotation groove and the tip of the casing bump should be .0095/.0145 in.

If you find evidence of axial carbon hang-up replace the stainless steel. New casings come with the “complete” seal kit 17FA502-1507.

The original casing was of two piece construction with an insert piece used to form the anti-rotation “dents”. The current casing design is one solid piece of metal. See fig. 3 for a comparison of the anti rotation dents.

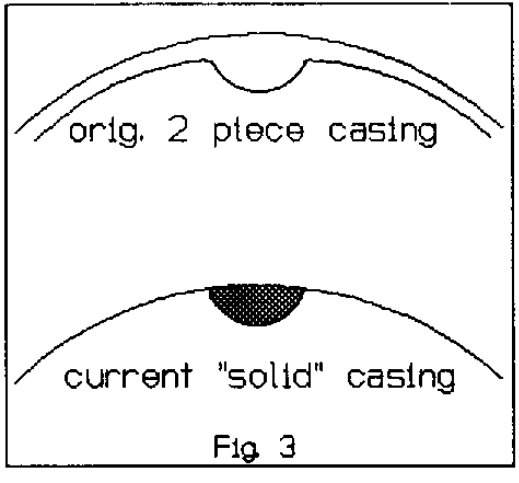


Fig. 3

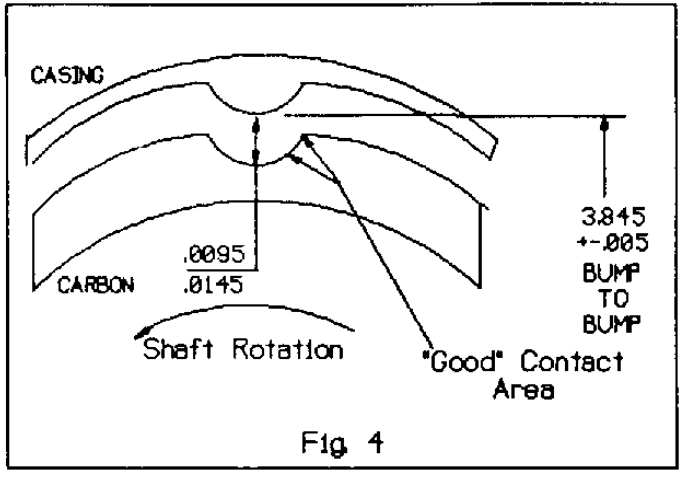


Fig. 4

Symptom - Seal performance deteriorates over time.

Possible cause - Teflon Omniseal wears on the stainless steel casing producing a flat ID on the Omniseal and a brownish paste which is a mixture of oil and Teflon powder coating the ID of the Omniseal. If this is found replace the casing. See figure 5.

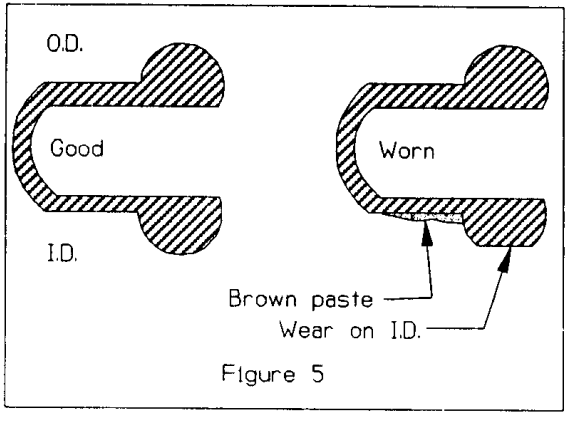


Figure 5

Commonly Asked Questions About Contact Seals In General:

The following is not specific to the 17FA.

If a seal starts to blow refrigerant during downtime, how do I prevent the loss of the refrigerant charge?

Start the oil pump and allow the seal to fill with oil. If the seal starts to blow again after a short time, leave the oil pump running until the charge can be removed and the seal repaired. If oil should gush from the seal during this time, spread absorbent and get to work pumping out the charge. Cleaning the floor costs much less that replacing the charge.

If a technician cannot get to the job immediately and the oil sump is getting low, have the customer add oil to the sump through the seal oil return pump. Any centrifugal oil will do. You can drain the sump later.

How long can the charge be left in the machine without any attention?

No more than a day. Here's why:

A contact seal consists of two EXTREMELY flat polished surfaces that are pressed against one another. Since one has to move with respect to the other they are actually separated by a film of oil. You can look at the seal surface as a very small hole that is filled with oil. Oil being thick, cannot flow through the hole more than a drip at a time. Refrigerant is an extremely small molecule and refrigerant gas could flow rapidly through the seal it oil was not in the way. Thus, oil will slowly leave the seal and as soon as part of the seal surface is uncovered, refrigerant will escape.

The length of time it will take for this to happen can vary greatly. A low pressure machine with a small surface can sit for weeks. With high pressure refrigerant the force trying to push the oil reserve through the seal is much greater. Larger shaft diameters resulting in larger seal circumferences will also reduce the amount of time that a seal will hold after the oil supply is stopped. Although the seal could hold for several days, it is foolish to risk leaving the charge unattended. Run the oil pump daily and visually monitor the seal. Better yet, pump the machine down to zero psig (zero kPa) if it will be idle for several weeks.

How do I know if a seal must be repaired?

Ask yourself these questions:

Does the seal drip oil during shutdown periods at a rate greater than one drop every 10-15 minutes?

Whatever the shutdown drip rate, will the seal prevent refrigerant from escaping for at least 24 hours?

Does oil escape from the seal during operation at a rate great enough that some oil leaks out of the seal labyrinth instead of flowing to the seal oil return chamber?

Is the seal drip rate increasing daily or weekly or is it holding steady?

Now that you have asked those questions consider these statements.

During run-in at the factory a seal must hold to a spec. of 50-75 drops/min. depending on the

seal and when the specs were written. The oil sump is at atmospheric pressure and the parts are all new and (we hope) perfect. You certainly don't have these conditions when a seal is running.

An FA 57-59 heat exchanger combination contains roughly 50 lbs. of R-22 when at a 20" vacuum level. A seal dripping 70 drops/min running 10 hrs/day 260 days/yr. will emit roughly 58 lbs of R22 for that year in "de minimis" release. So, will you lose more refrigerant by repairing it now than in waiting for the next scheduled maintenance?

There is no pass-fail criteria that applies to every job or every model. Is it getting worse or can the customer live with it the way it is? Are you risking the charge or not?

This is how you decide whether to repair.

Positioning The Shaft Seal Shoulder When Replacing The Thrust Assembly:

See figure 6

This assumes the seal was correctly adjusted initially.

When replacing the thrust bearing, the shim behind the thrust bearing determines shaft position. The shim behind the counterthrust bearing determines thrust float.

Calculate dimension "C" using the EXISTING Mating Ring.

Place the required shim thickness behind the thrust bearing to set dimension C (+-) 0.002 in.

Measurements:

Take all measurements with the shaft in the thrust position.

C = Outer seal flange to outer surface of Mating Ring. Ring must be locked to the

shaft. Use a depth micrometer to make the measurement.

D = Outer seal housing face to open end of seal casing.

E = Outer seal housing bolt ring thickness.

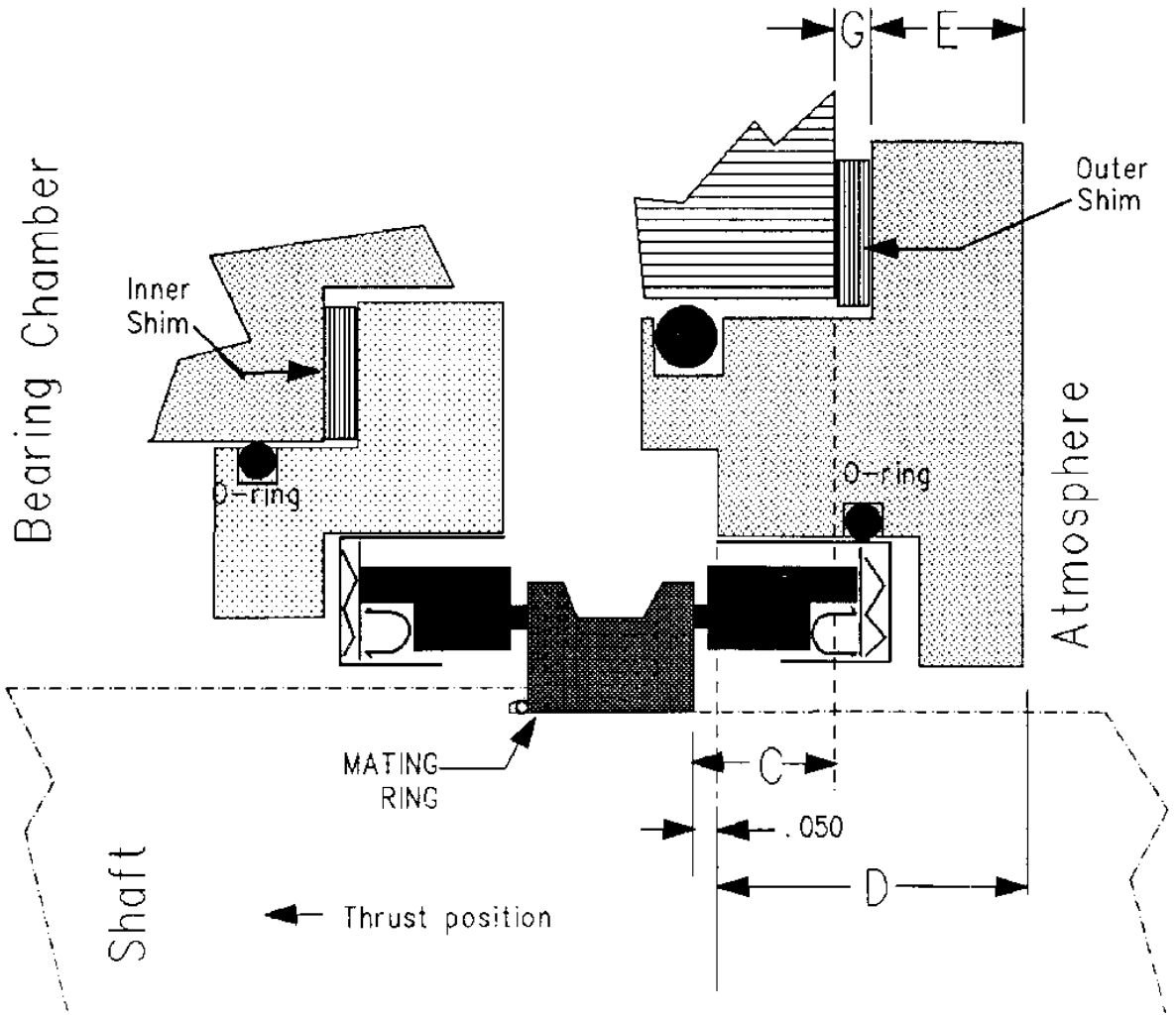
G = Shim thickness

Calculation:

C = D + 0.050 - E - G

17FA (single shaft) Positioning shaft seal shoulder when replacing thrust

Assuming correct initial seal adjustment



When replacing thrust bearing the shim behind the thrust determines shaft position.

Calculate dimension C using the EXISTING Mating Ring.

Place the required shim thickness behind the thrust bearing to set dim. C +– 0.002 in.

Adjust thrust float by adjusting shim behind counterthrust brg.

MEASUREMENTS:

C=Outer seal flange to outer surface of Mating ring. Ring must be locked to the shaft. Use depth micrometer.
D=Outer seal hsg. face to open end of seal casing.
E=Outer seal hsg. bolt ring thick.
G=Shim thickness

CALCULATION:
C = D + 0.050 – E – G

MEASUREMENTS TO MATING RING SHOULD BE TAKEN WITH THE SHAFT IN THE THRUST POSITION

Figure 6

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