Shaft Alignment

General

Before starting any type of shaft alignment the “end result” or “goal” must be understood.
Goal -The rotating shaft centerlines, when at the operating temperature, are relative to each other so that minimal offset in the vertical, horizontal or angular planes is present. This means that when the alignment is performed it must be at operating temperature or the cold offset required must be calculated prior to aligning to allow for temperature increase or decrease.

Flexible couplings are not designed to compensate for poorly aligned rotating shafts. Flexible couplings must operate within the confines of their alignment limits. This means that the alignment limits must not be exceeded when operating at the normal equipment operating temperature.

When performing a cold alignment the target readings or offsets should not include any tolerance allowed by the coupling manufacturer. Ideal indicator readings should be as close as possible to the estimated cold offset target.

Cold offset calculation = Delta “T” x length (inches) **x C**

C = .000006 for mild steel/cast iron
Length = centerline of the shaft to the mounting base distance
Delta “T”= temperature at the time of alignment plus or minus the operating temperature

Check for Soft Foot

“Soft foot” occurs when the equipment is not sitting flat on its base or it "rocks". The tightening of all hold down bolts can eliminate the rocking. However, when the bolts are tightened to eliminate the “ rocking “ it distorts the casing and could place stress on the bearings or casing. This stress could cause vibration or other damage. The “rocking” or “soft foot” can be eliminated by properly shimming the mounting foot.

Mount a dial indicator to the motor frame or other stationary structure. Locate the indicator to read the top of the mounting foot (be sure to allow room for the mounting bolt wrench to loosen the mounting bolt without hitting the dial indicator). Start with all the mounting bolts tight and zero the dial indicator and loosen the indicated bolt. The dial indicator should not move more than .002” max. Inspect all the mounting bolts in a similar manner. Correct for any mounts that exceed the .002” max allowable by adding shims under the foot.

Indicator Sag

“Indicator Sag” occurs due to the effects of gravity on the dial indicator mounting system. To determine the “sag”, mount the dial indicator on a piece of pipe using care to keep the mounting the same as when it is attached to the couplings to be aligned. (The linear distance has the most affect so be sure to have the distances equal).

Zero the dial indicator on the top of the pipe; rotate the pipe 180° .The gravitational effect on the set-up can be determined by reading the indicator difference from the zero to the 180° positions. This Delta reading can be algebraically subtracted from the alignment readings obtained at the 180° position. The 180° reading will always be a negative number. This gravity effect does not need to be subtracted from the horizontal or side-to-side readings.

Starting the Alignment – The below procedure applies to the Rim and Face method only!

1. Loosen the bolts and inspect the mounting holes. Make sure that there is sufficient clearance to allow for the side-to-side movement of the component. If the clearance is not sufficient, the component may become bolt bound and the alignment may not be able to be completed. It is helpful to use a straight edge across the coupling to determine if the bolt hole clearance will be adequate.

2. Check to see that there is approx 1/8" of shims under the foot so that the component can be lowered if required. Keep the shims as thick as possible to reduce the amount of shims necessary.

3. Check for soft foot and correct as necessary.

4. Mount the dial indicators and determine the distance across the coupling. Remove the indicator mounting system and determine the sag and reinstall the indicators.

5. Determine the distance from the dial indicator location on the coupling, to the front foot and from the dial indicator location to the rear foot. A straight edge or level placed on the coupling half where the indicator is located will be helpful in determining this distance. The more accurate the distance, the easier it will be to calculate the shim thickness required to correct the vertical angular offset.

6. Mount the dial indicator to read the face of the coupling half. The placement of the dial indicator on the inside and or the outside of the coupling half will determine whether the shims will be added to or subtracted from the component feet.

7. Zero the indicator at the 12 o'clock position and rotate both of the coupling halves together. This will eliminate any run out that may be present in the shafts or coupling. **It is important to have any floating shafts placed against a shoulder or thrust bearing to prevent axial movement during rotation. Check the thrust position at each location prior to recording the reading.** Rotate the halves to the 3 o'clock, 6 o'clock, and 9 o'clock positions and record the readings. It is better to have the dial indicator reading the fixed component, and the bracket mounted on the moveable component. Record the clock face numbers facing the fixed component.

8. The difference in the face readings from the 12 o'clock to the 6 o'clock position is the vertical angular offset or **misalignment**. Use this misalignment "delta" reading to determine the shims required to be "added to" or "removed from" the component feet to correct the angular offset.

$$\textbf{Shims required} = \frac{\textbf{Misalignment reading (delta)x distance of bolt centers (F or R)}}{\textbf{Diameter of the coupling or jig}}$$

9. Use this same calculation to determine the amount of movement required to correct the horizontal angular offset (misalignment) as recorded at the 3 o'clock and the 9 o'clock face positions. Place dial indicators on the moveable component feet and move the component as necessary to correct the angular offset (misalignment). Another method would be to use the dial indicator on the coupling face and move the component until the readings are one half of the indicated delta misalignment reading or the readings are the same at the 3 o'clock and 9 o'clock positions. Use care to not move the component in the horizontal parallel plane.

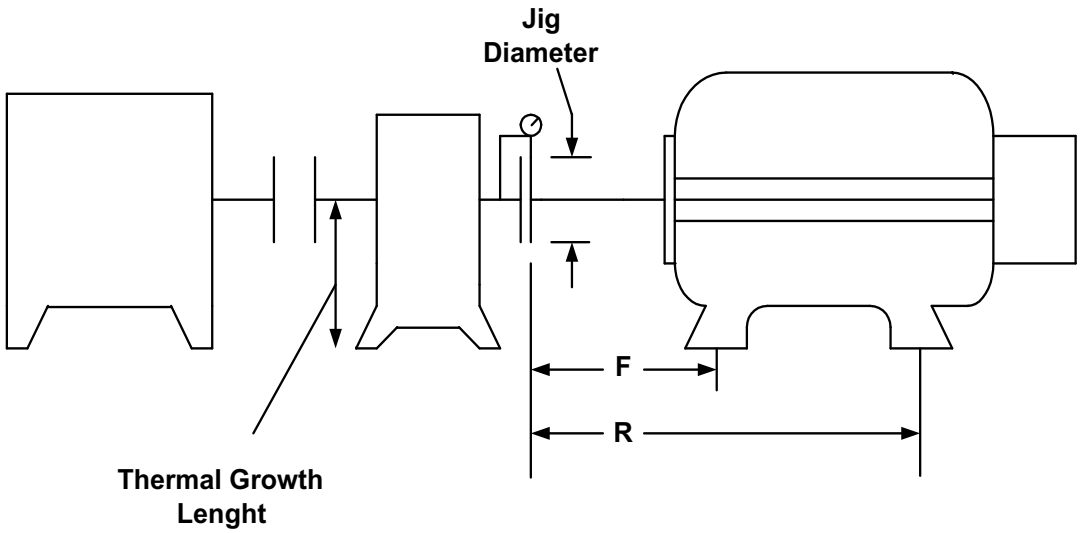
10. Place the dial indicator on the rim of the coupling half. Zero the indicator at the 12 o'clock position and record readings at the 3 o'clock, 6 o'clock and 9 o'clock positions. The sum of the 12 o'clock and 6 o'clock readings is the **Total Indicator Reading (TIR)**. Repeat the procedure to be sure that the readings

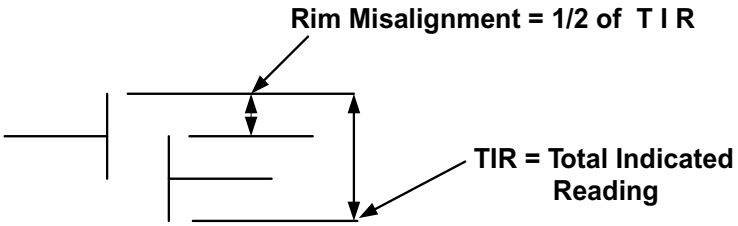
are the same. This will insure that the mounting system is secure. Subtract the dial indicator sag from the **TIR**. Divide the **TIR** by 2 and this is the amount of shims to be "added to" or "removed from" the moveable component. To correct the 3 o'clock and 9 o'clock positions just divide the **TIR** by 2 and this is the distance to move the component horizontally. Remember the sag does not affect the side-to-side measurement.

11. Tighten the mounting bolts to the required torque and recheck the alignment. The readings should not change; any change would indicate that there is possible bolt binding or soft foot present.

12. After the system has been operating for 4 or more hours at the design or maximum operating temperature, check the alignment in the hot condition. If the cold alignment has been properly calculated there should be no correction necessary, if the alignment is not correct, make the necessary corrections and note the temperature and the offset for future reference.

$$\text{Angular Shim Thickness} = \frac{\text{Face Misalignment (Delta) X Distance (F) or (R)}}{\text{Jig Diameter}}$$





Thermal Growth Prediction = Delta "T" x Length x C

C = .000006" for mild steel / cast iron
Delta "T"= The difference in the equipment temperature at the time of alignment to the temperature when the equipment is operating