

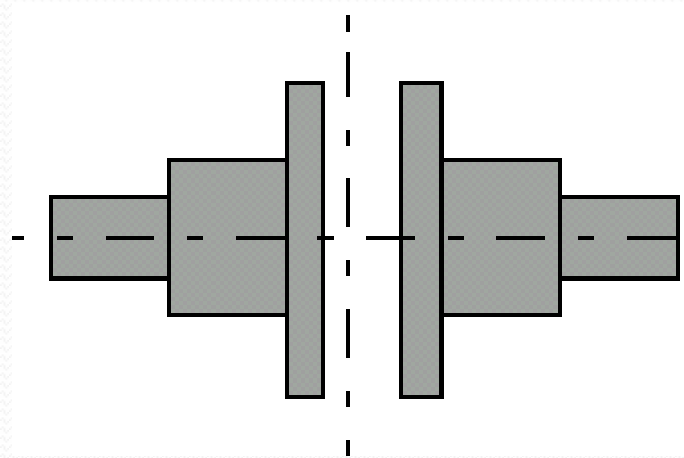


Training Program On Machine Alignment

**Prepared by,
Trushal Panchal**

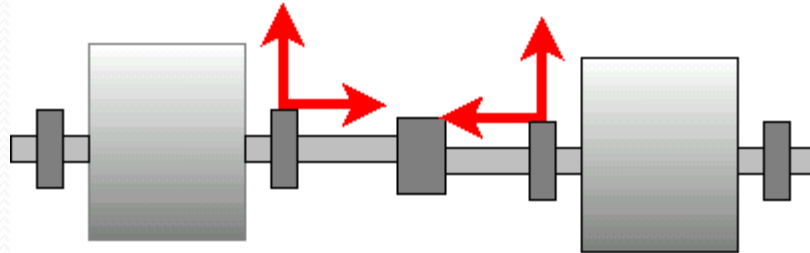
What is Alignment?

It is the process of positioning two (or more) machines that are coupled, so that Center lines of rotating shafts form a single line when the machines are working at normal operating temperature.

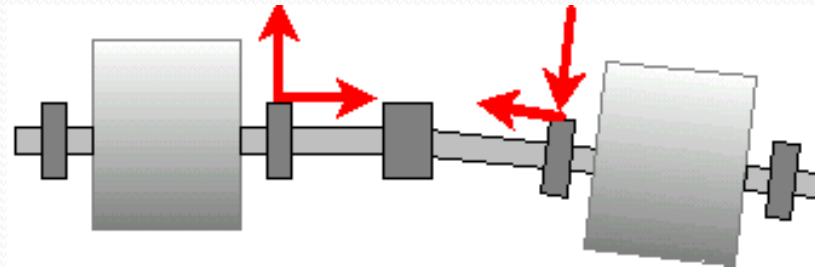


Types Of Misalignment

1. Off set

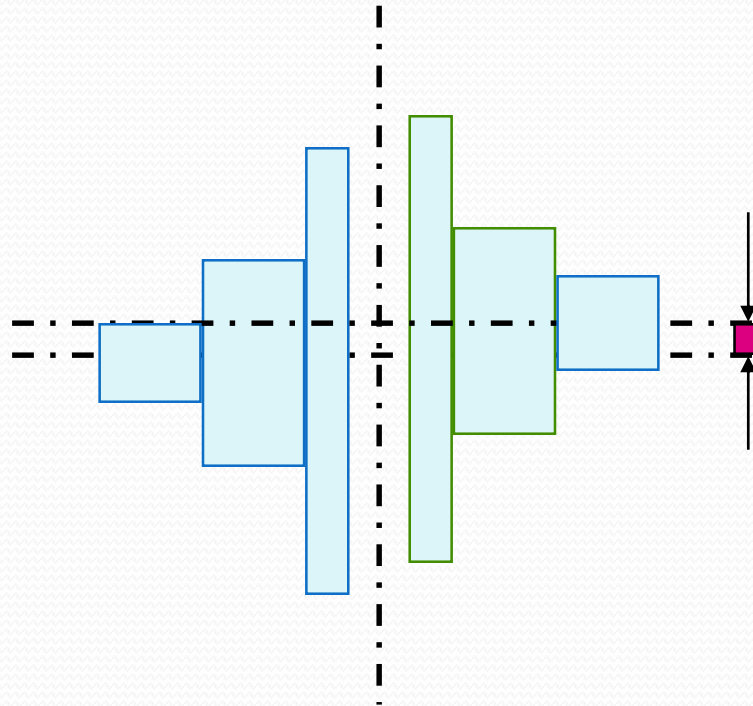


2. Angular

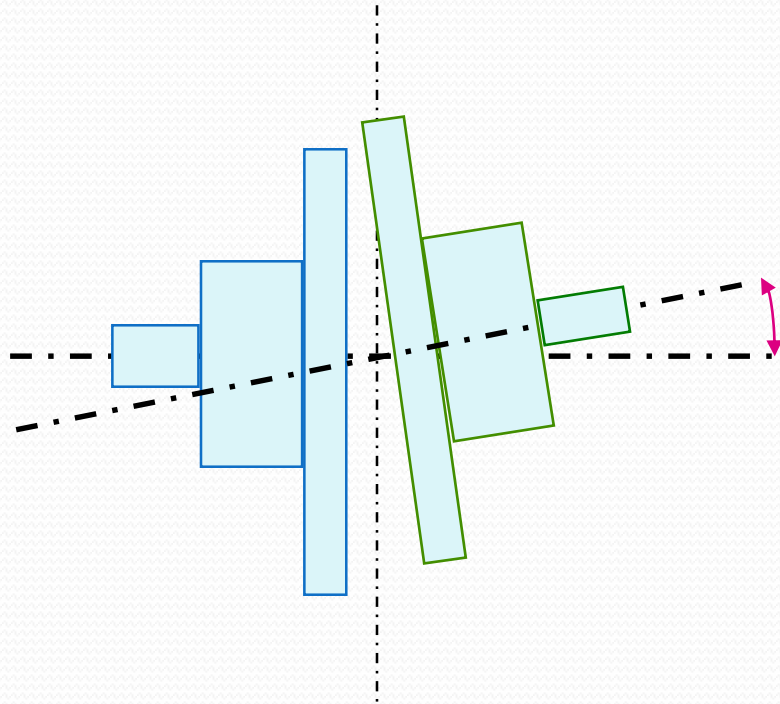


3. Skew - Combination of offset & angular

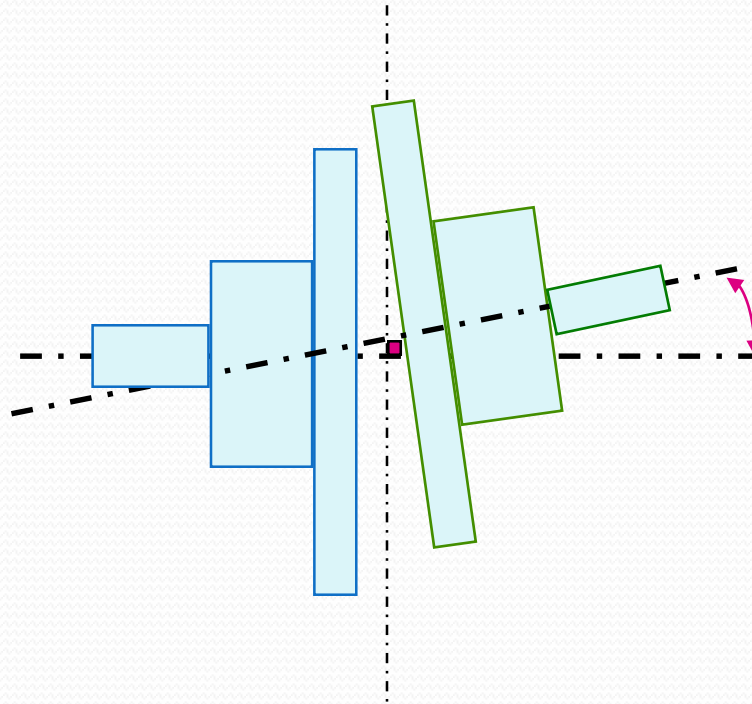
Offset Misalignment



Angular Misalignment



Skewed Misalignment



Causes Of Misalignment

- **Thermal expansion - Most machines align cold.**
- **Forces transmitted to the machine by pipe or support structure.**
- **Soft foot.**
- **Poor workmanship.**

Effects Of Misalignment

- More than 50% problems are due to misalignment.
- Causes vibration on the machine
- Vibration destroys critical parts of machines like bearings, gears, seals, coupling etc.
- Breaks lubricant film inside the bearing and increase friction.
- Increases load on the bearing.
- Increase 2 - 17% power consumption.
- Generates heat inside the coupling.

Recognition of Misalignment

1. Excessive Radial & Axial vibration
2. Premature / repetitive failure of bearing, seal, coupling.
3. Loose coupling elements.
4. Leakage from the seal.
5. Loose base bolts.
6. Coupling become hot while running.
7. High casing temperature.

Flexible Coupling

- Flexible coupling can handle some misalignment but it will generate heat and it will impose forces to the shafts.
- This will create vibrations, and couplings, seals and bearings will fail prematurely.
- A flexible coupling is however, necessary to handle the movement from cold to hot condition.

Alignment Methods

1. Rough Alignment

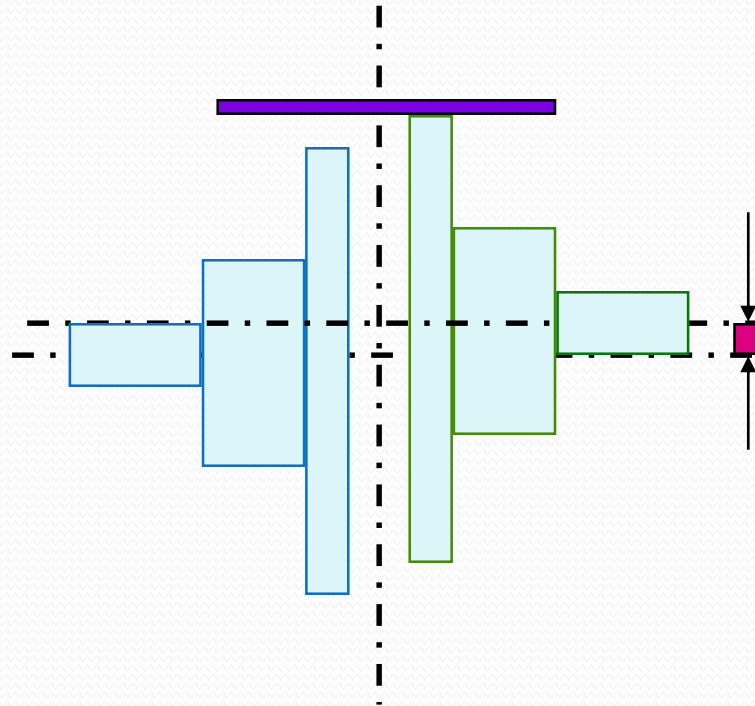
- Using straight edge,
Ruler, Feeler Gauge
- Twin wire method

2. Precision Alignment

- Using dial gauges
- Using Lasers

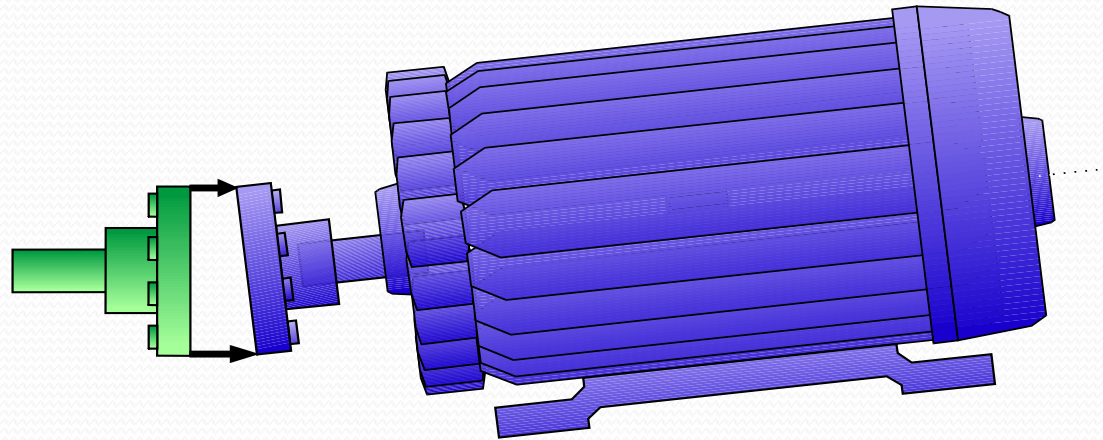
Rough Alignment

Using straight edge



Rough Alignment: Vertical Angular

- Measure the coupling gap at the top & bottom.
- Find the difference
- Gap difference = widest gap - narrowest gap



If the gap is wider at the top, correct angular misalignment by removing shims from front feet or by adding to the rear feet.. If the gap is wider at the bottom, remove shims from the rear feet or add to the front feet.

Rough Alignment: Vertical Angular

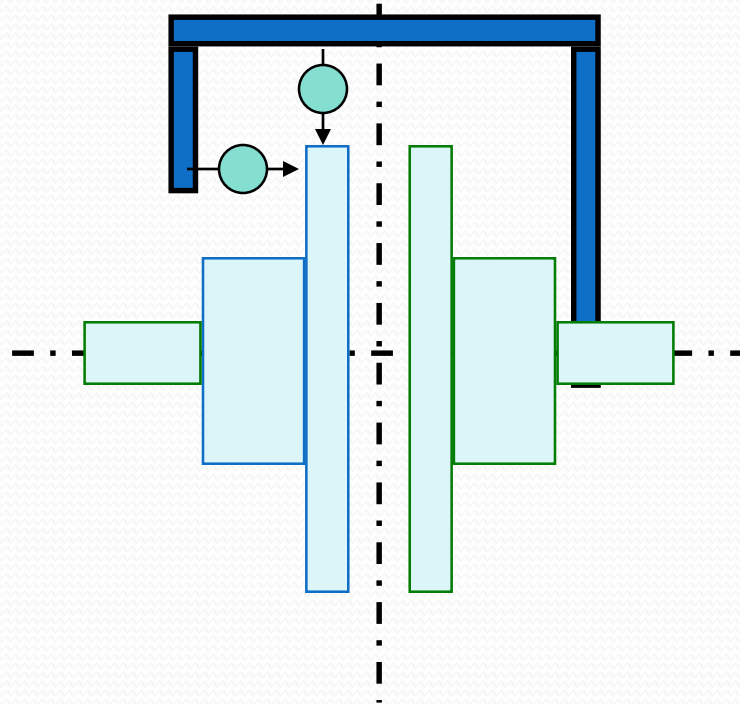
Angular correction:

$$\frac{\text{gap difference}}{\text{coupling diameter}} \times \text{distance between bolt centers}$$

Rough Alignment: Horizontal Corrections

- **You will solve horizontal angular misalignment and then horizontal offset misalignment.**
- **Repeat the process you performed vertically only this time measure in the horizontal axis.**

Face & Rim Method



Face & Rim Method

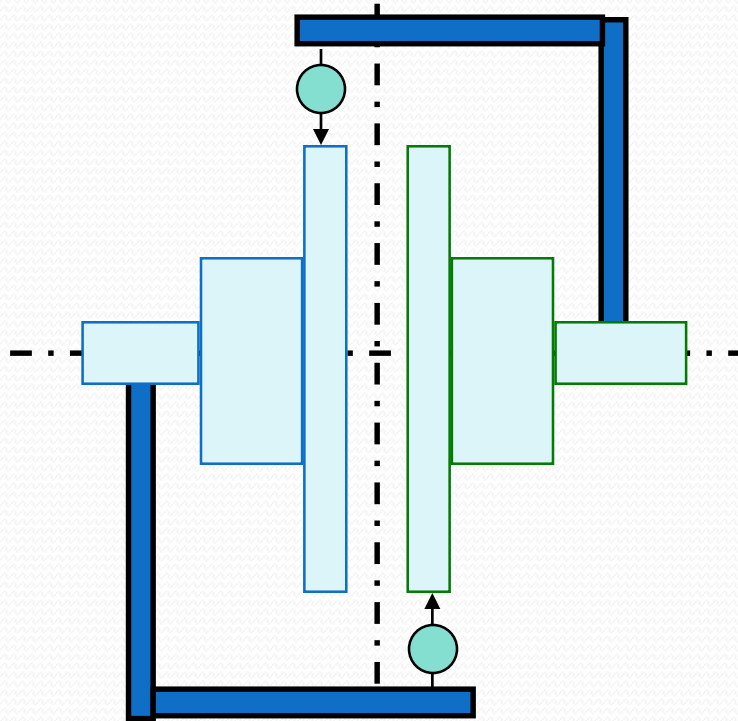
Advantages:

1. Good for large dia. coupling hubs where the shafts are close together.
2. To be used where one of the shafts can not rotate during alignment.
3. Easy to use.

Disadvantages:

1. Difficult to take face readings, if there is axial float in the shaft.
2. Requires removal of coupling spool.
3. More complex alignment calculation.

Reverse Indicator Method

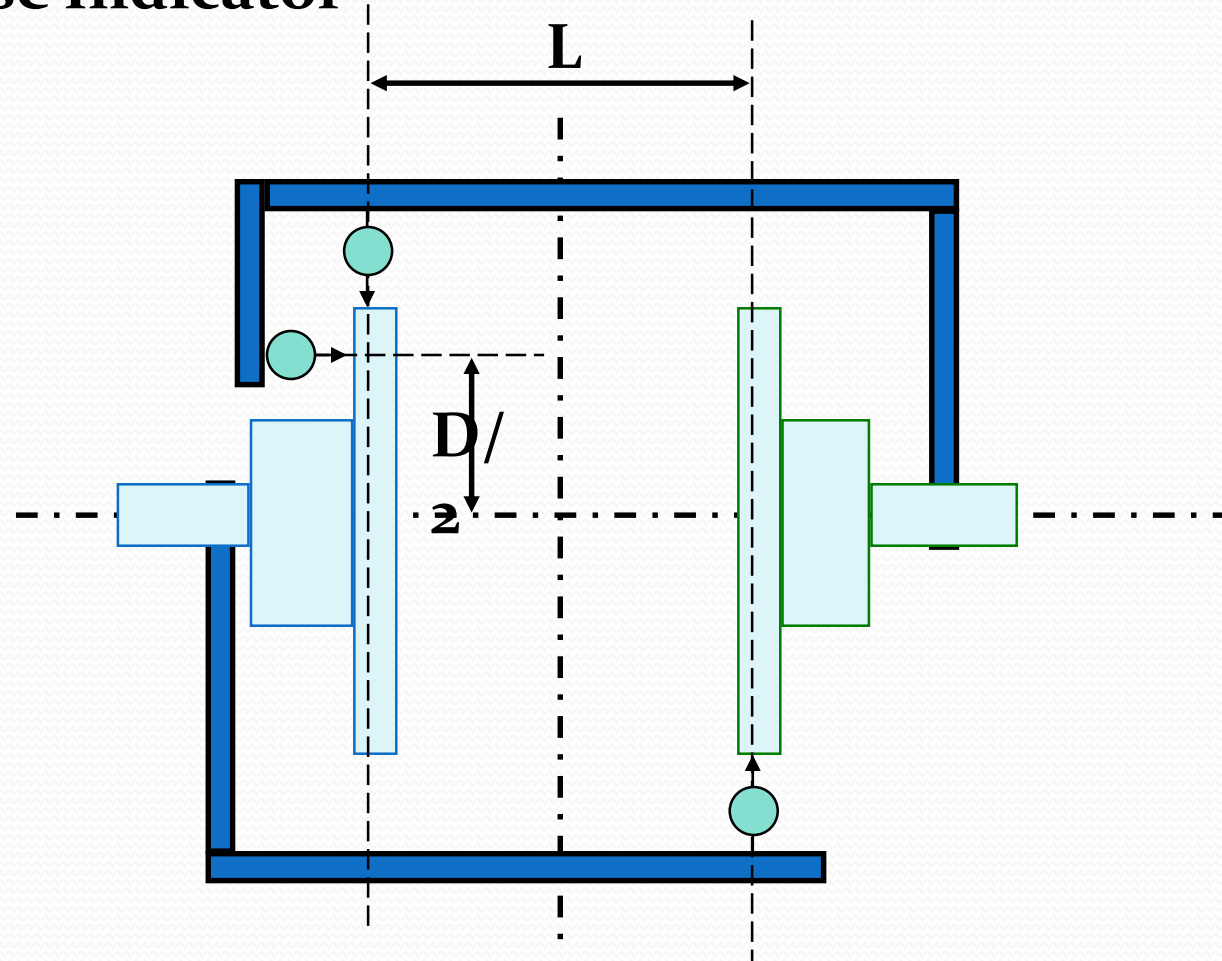


Reverse Indicator Method

Advantages:

- 1. More accurate than face & rim method.**
- 2. Readings are not affected by axial float.**
- 3. Possible to keep the coupling spool.**

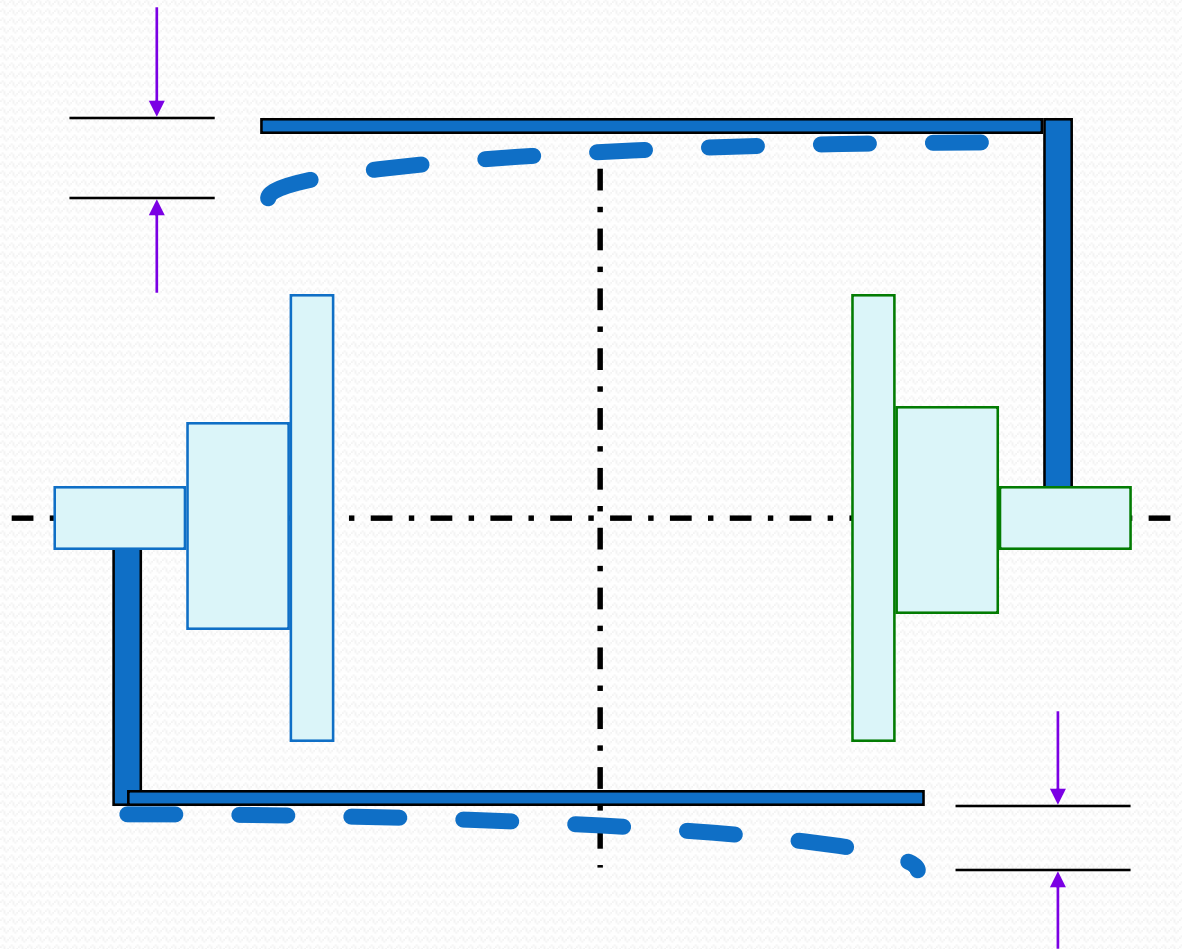
If $L > D$ Reverse Indicator



Alignment Tolerance

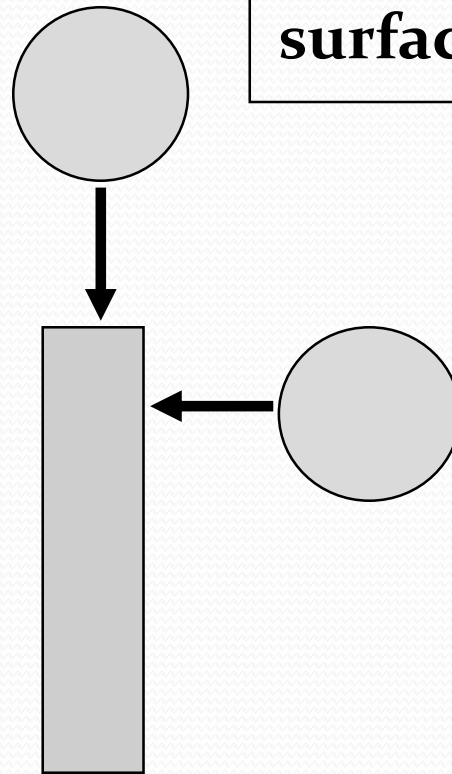
	Off Set	Angular
RPM	mm	mm / 100 mm
0000 – 1000	0.07	0.06
1000 – 2000	0.05	0.05
2000 – 3000	0.03	0.04
3000 – 4000	0.02	0.03
4000 – 5000	0.01	0.02
5000 – 6000	< 0.01	0.01

Indicator Sag



Fixing Of Dial Gauge

**Perpendicular to
the coupling
surface.**



Rules For Good Alignment

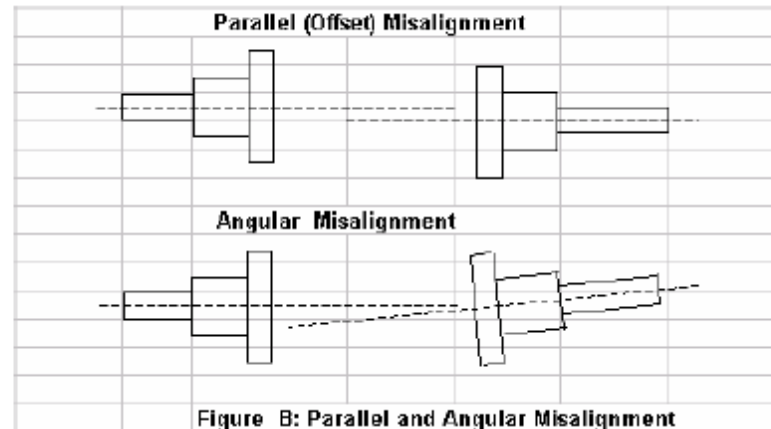
- **Clean the machine base. Remove rust burrs etc.**
- **Use steel or brass shims.**
- **Check indicator sag.**
- **Perform pre-alignment checks on Machine.**
- **Check dial gauges before taking readings.**
- **Use correct bolt tightening procedure.**
- **Don't lift the machine more than necessary.**
- **Try to put the stem of dial gauge perpendicular to the surface of coupling.**
- **Use jack bolts.**

SAFETY PRECAUTIONS

1. Before commencing work. Observe proper lock-out, Tagging and Isolation procedures. This may include purging of pumps and eliminating all stored energy.
2. Ensure all tools are in good condition and correct for the job. Use mandatory PPEs.

1.3 Misalignment Types:

Shaft misalignment can occur in the following ways, Parallel and angular misalignment. These are the two basic types of conditions that can exist in either the vertical or horizontal directions. Misalignment can occur in any combination of parallel and angular or both.



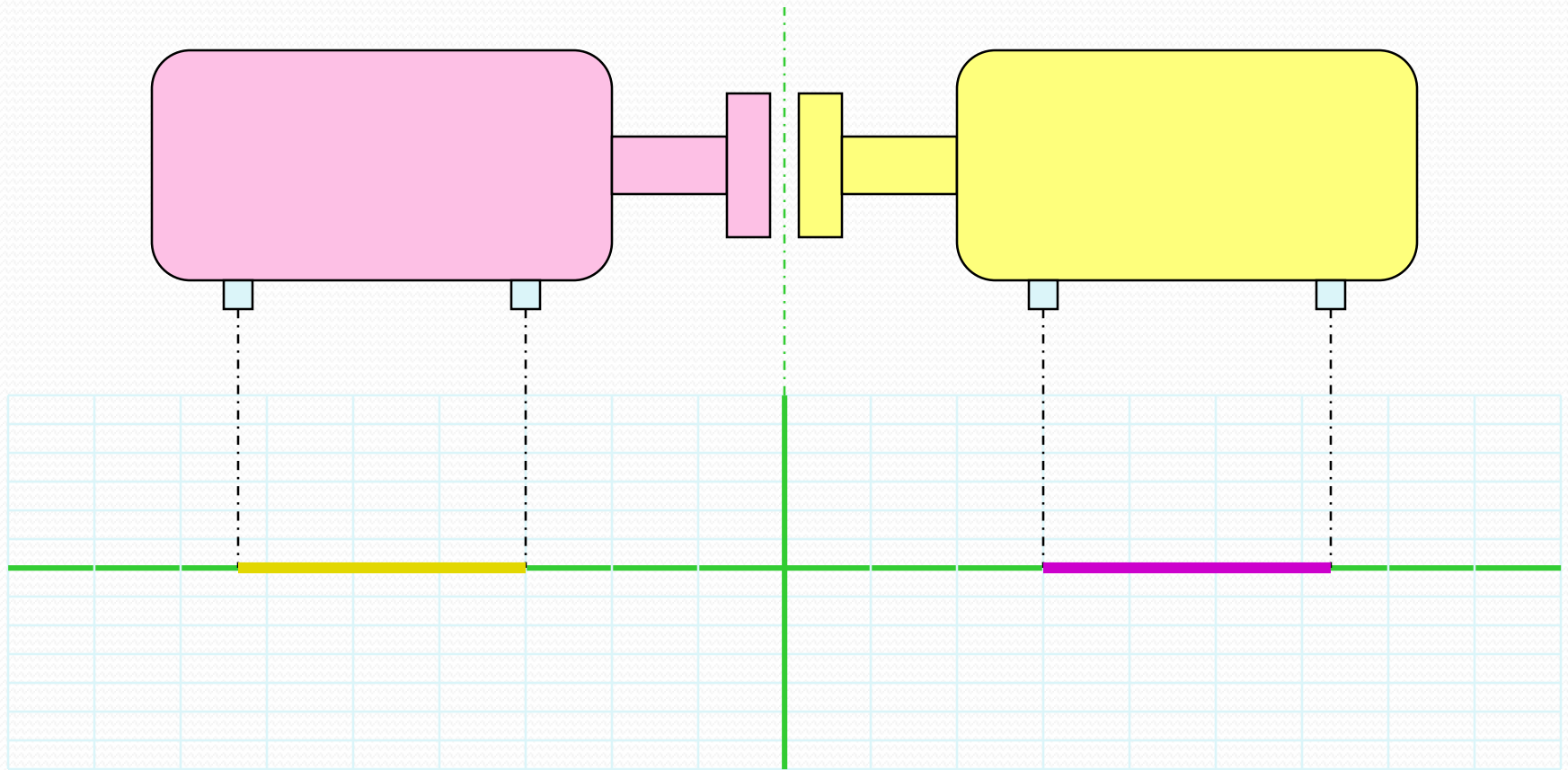
1.4 Excessive Run-out Conditions:

When carrying out coupling laser alignment any non-perpendicular run out in the shafts must be considered. There are three types shown below and any combination of the two may occur at any time. The permitted tolerances are shown in the table below.

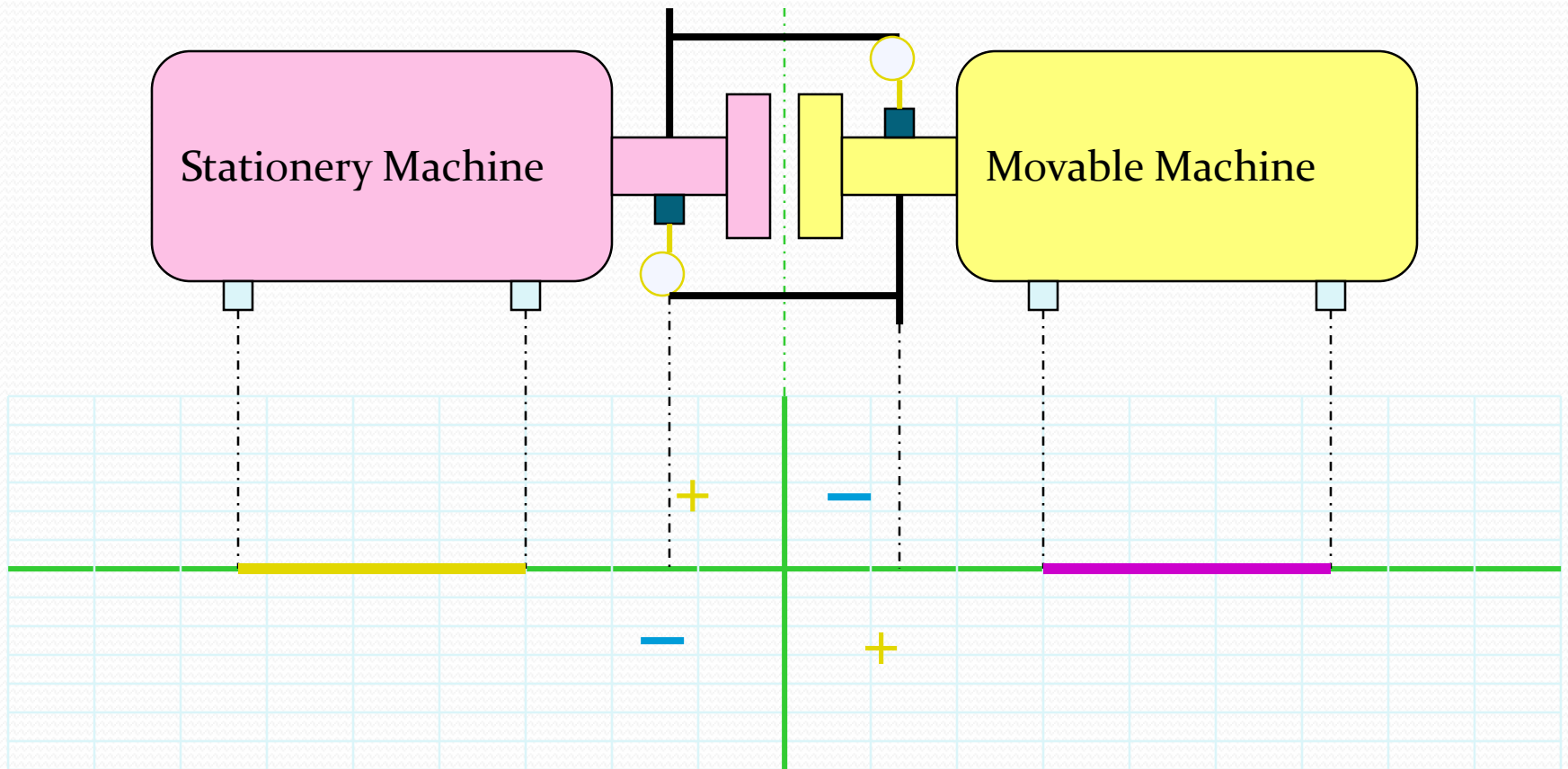
RPM	MAXIMUM ALLOWABLE TIR (Total Indicator Runout)	
	E	M
0-3600	.002"	0.05 mm
3600 and up	less than .002"	0.05 mm

Shaft Runout Tolerances

Graphical representation



Graphical representation



Graphical representation

Example 1

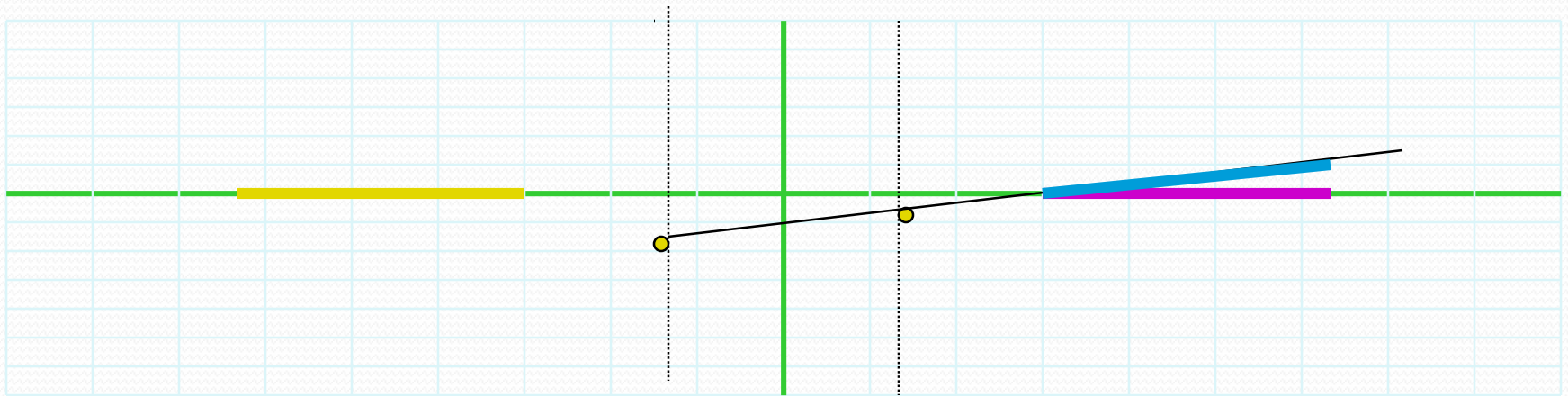
(Reverse Indicator Method)

SM Dial Reading: -1.50 mm

MM Dial Reading : +0.5 mm

Scale: Y-axis = 10:1

X-axis = 1: 5



Pre-alignment Checks

The Secret to Fast Alignment

- **Reduces errors**
- **Reduces re-work**
- **Machines maintain alignment position**
- **Simplifies the alignment procedure**

Pre-alignment objectives

- **Check and correct situations that effect machinery performance.**
- **Check and correct situations which cause problems in executing the precision alignment process**

Pre-alignment Procedures

- **Checking run out**
- **Checking pipe strain**
- **Correcting gross soft foot**
- **Setting the coupling gap**
- **Rough alignment**
- **Torquing bolts**
- **Precision soft foot**

Run Out

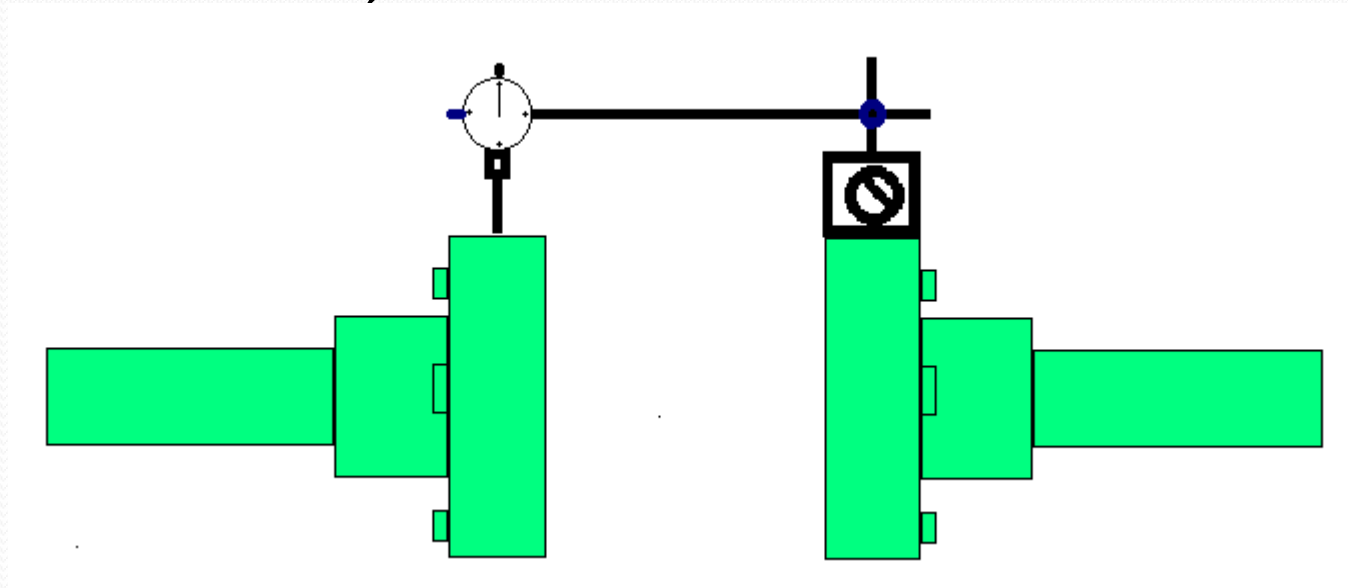
Run out is caused by:

- **Eccentric couplings**
- **“Out of round” couplings (Coupling hub bored off centre or Coupling hub skew bored)**
- **Bent shafts**

These problems cause imbalance and misalignment forces. Results: Increased vibration, increased energy dissipation, energy consumption and reduced bearing life.

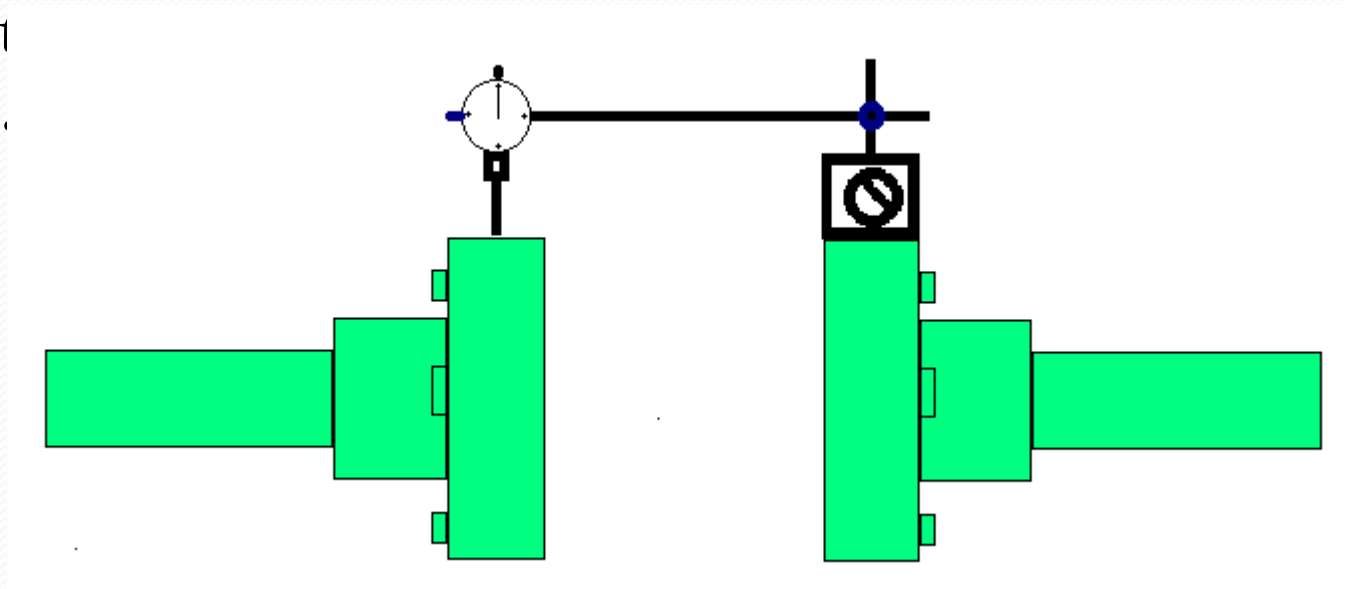
Checking Run Out

- You check run out with a dial indicator.
- The dial indicator is affixed with a magnetic base or a clamp.
- If the coupling is assembled, mount to the machine base or to an adjacent machine.



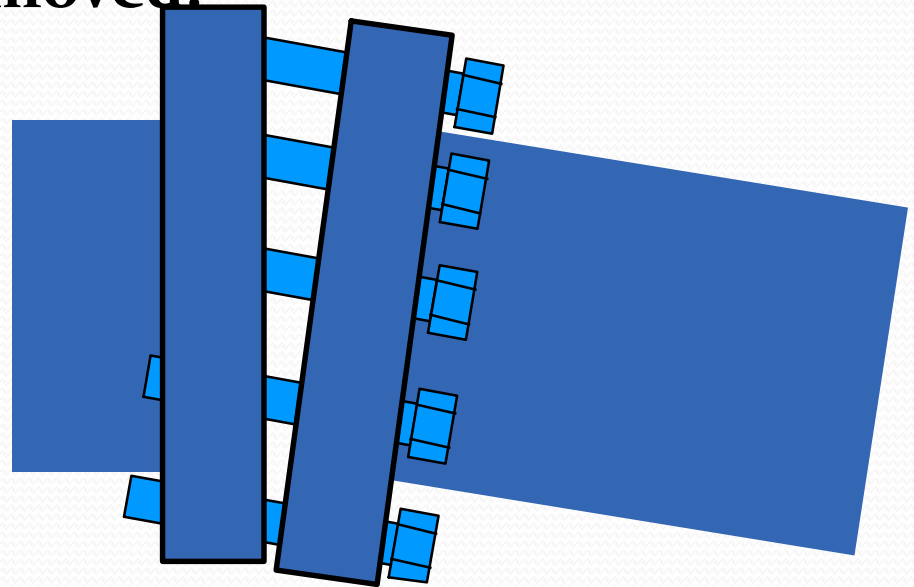
Checking Run Out

- The shaft to be checked is rotated when checking run out.
- Rotate slowly until the indicator reaches a maximum +/-.
- Zero the indicator.
- Rotate slowly until the indicator reaches a maximum +/-.



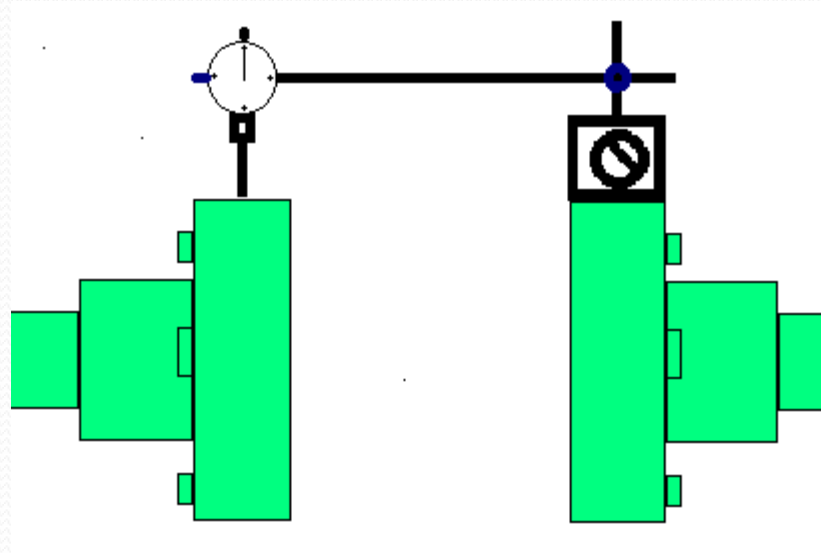
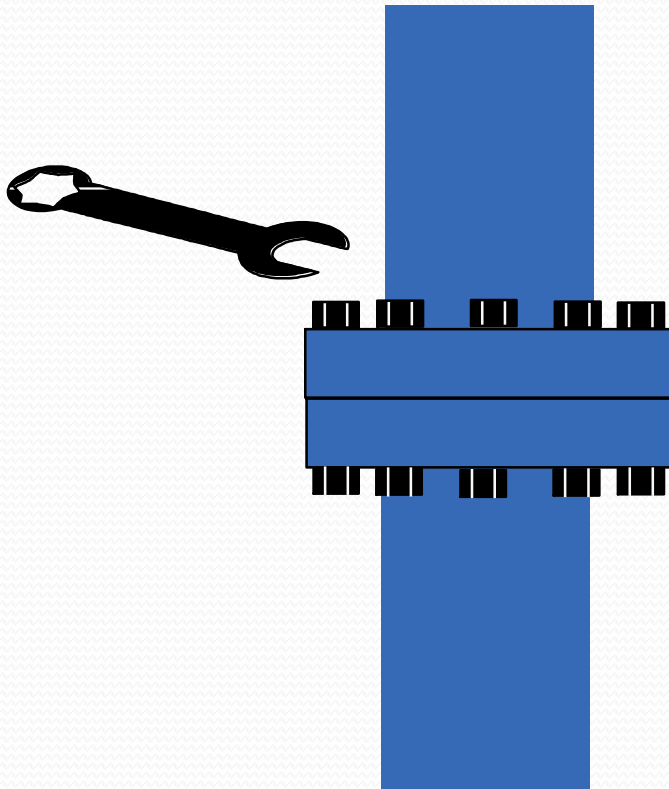
Pipe Strain

- Pipe strain is caused by pipes and flanges which are misaligned.
- Pipe strain causes distortion of the driven machine which results in bearing & seal misalignment.
- Pipe strain will effect the alignment process if the “stationary” machine is moved.



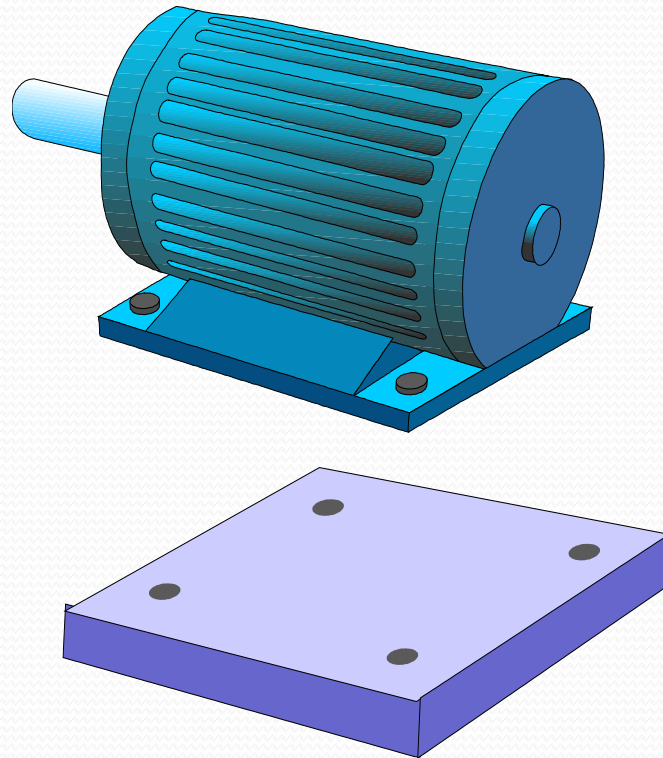
Checking Pipe Strain

- The effect of pipe strain can be checked using a dial indicator while the flange is loosened.



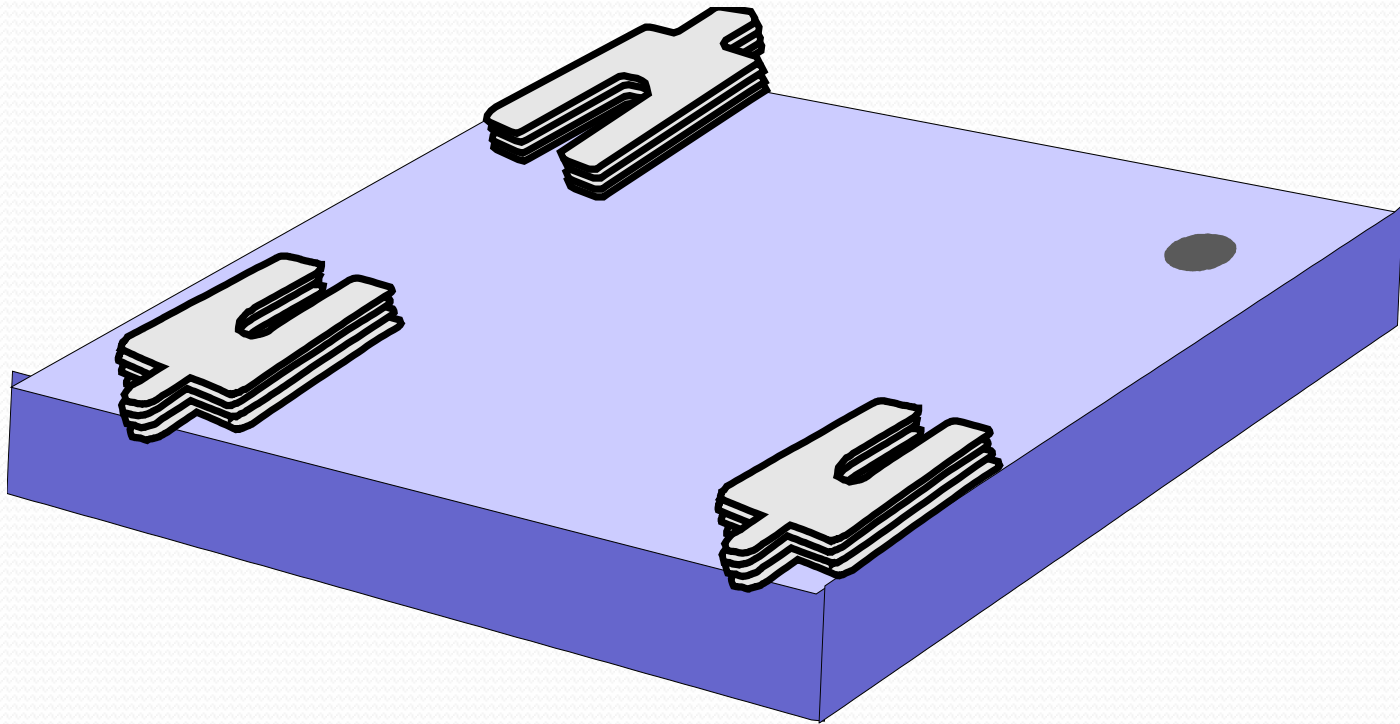
Soft Foot

- A soft foot is caused when the four motor feet or the four base pads are not in a common flat plane.



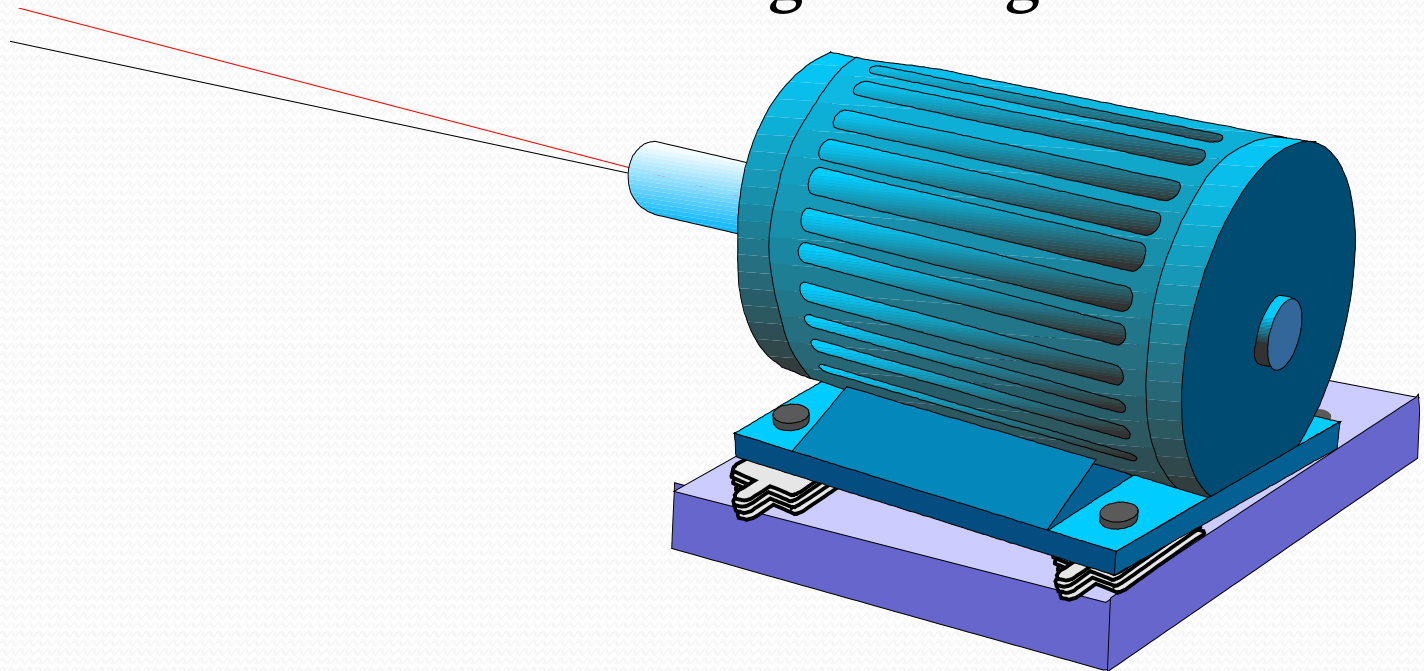
Soft Foot

- This condition is illustrated by placing shims only at three feet.



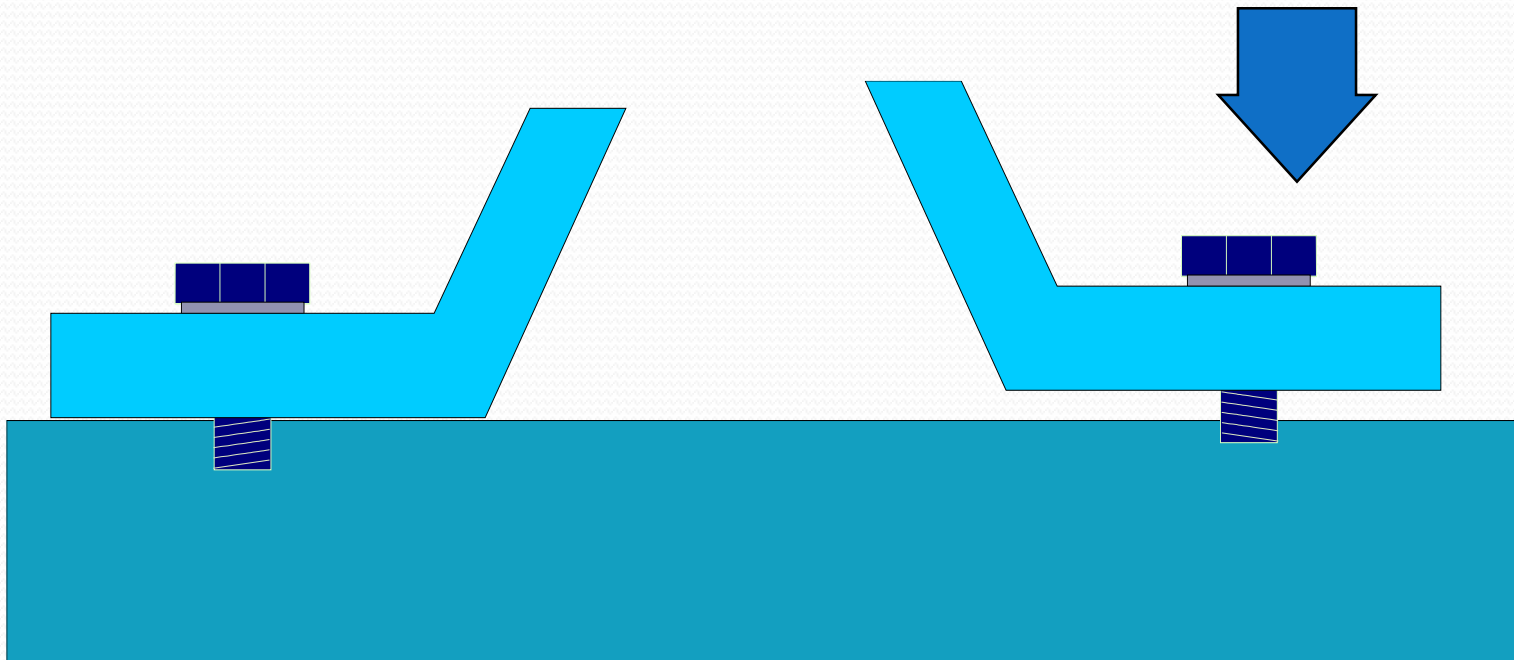
Soft Foot

- This condition will effect the alignment process because vertical positions will not be repeatable as you try to make corrections.
- Soft foot causes the motor frame to distort when the bolts are tight.
- This condition results in bearing misalignment.



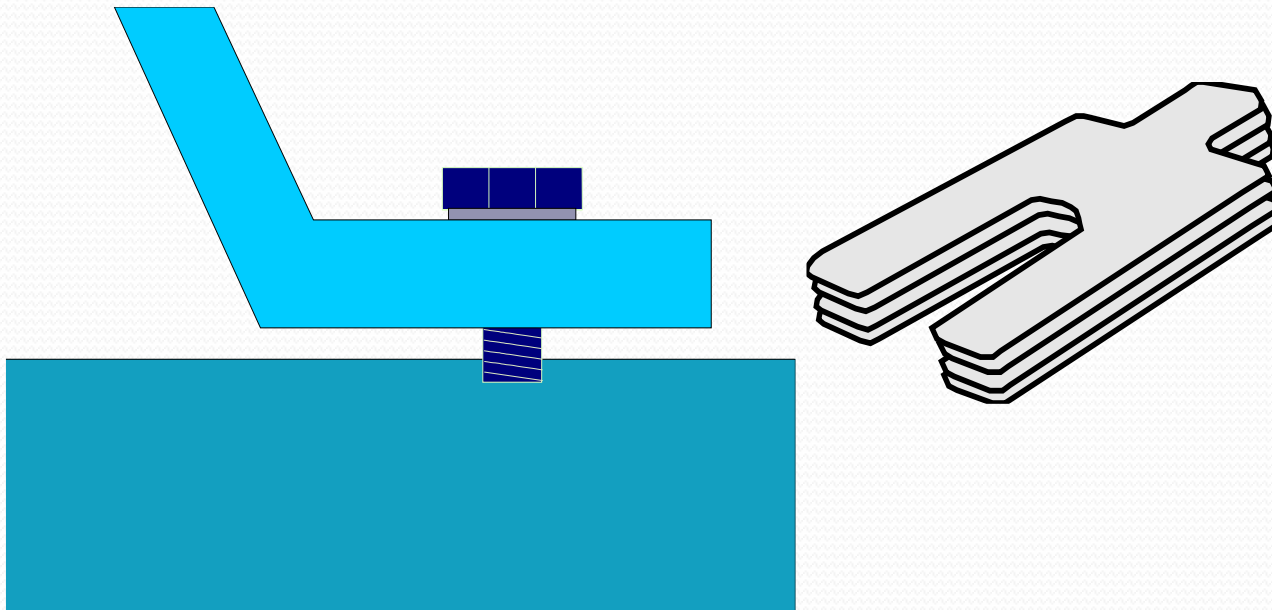
Soft Foot

- One type of soft foot is called “short foot”.



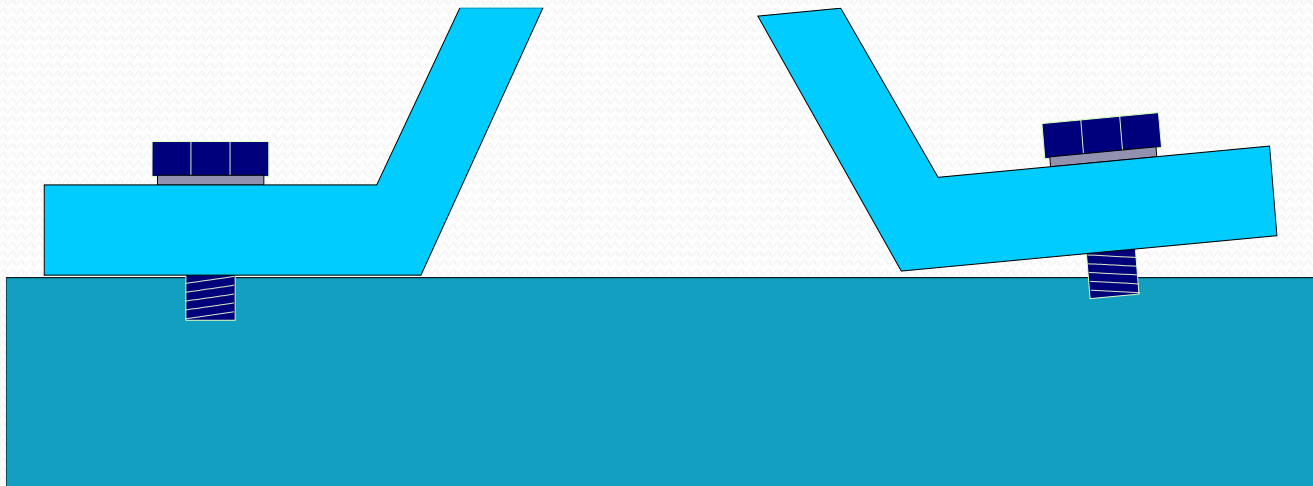
Soft Foot

- The problem is solved by adding shims to the short foot.



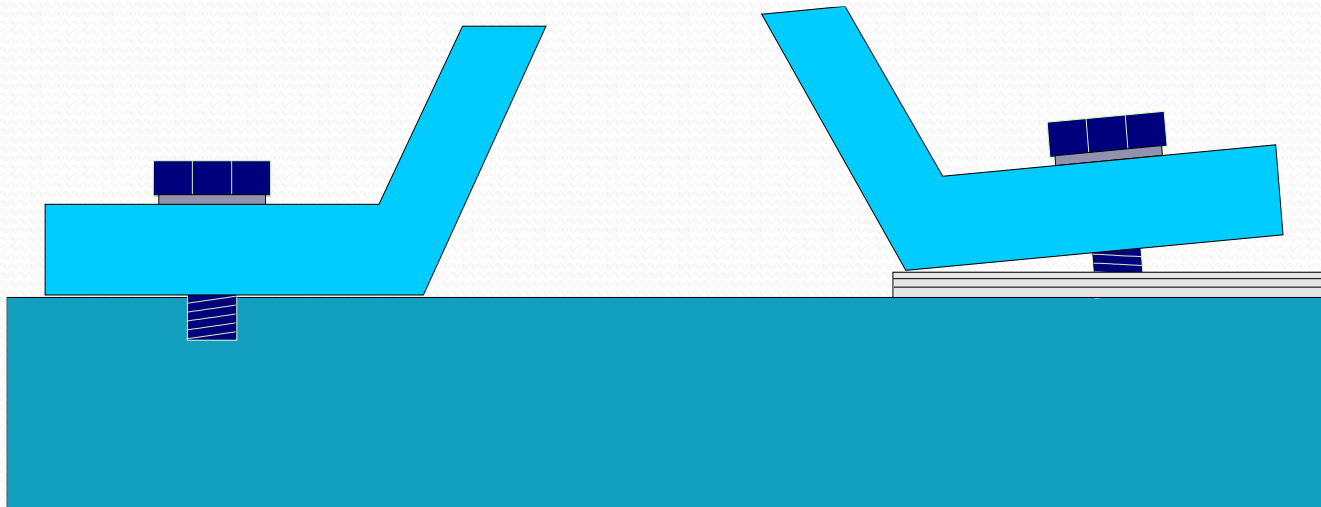
Soft Foot

- A second type of soft foot occurs as “angled foot”.



Soft Foot

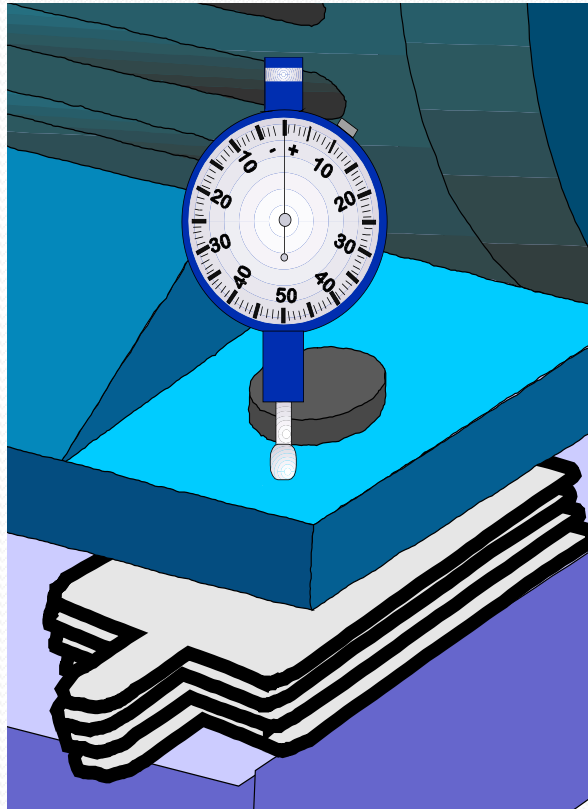
- The problem can not solved by adding shims to the short foot.
- You must correct the angle in this case.



Checking Soft Foot

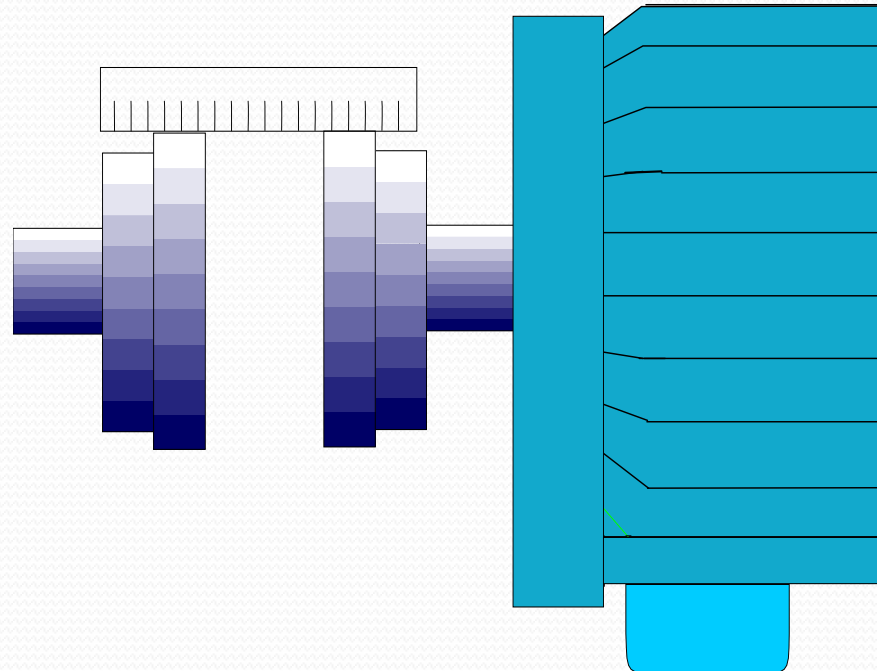
- In this activity, you only check and correct “gross” soft foot
- Start with all of the bolts loose.
- If there are no shims under the feet:
 - check for gross soft foot by trying to slip a .005” shim under each foot.
- If shims are under the feet::
 - check if any of the shims are loose.

Soft Foot



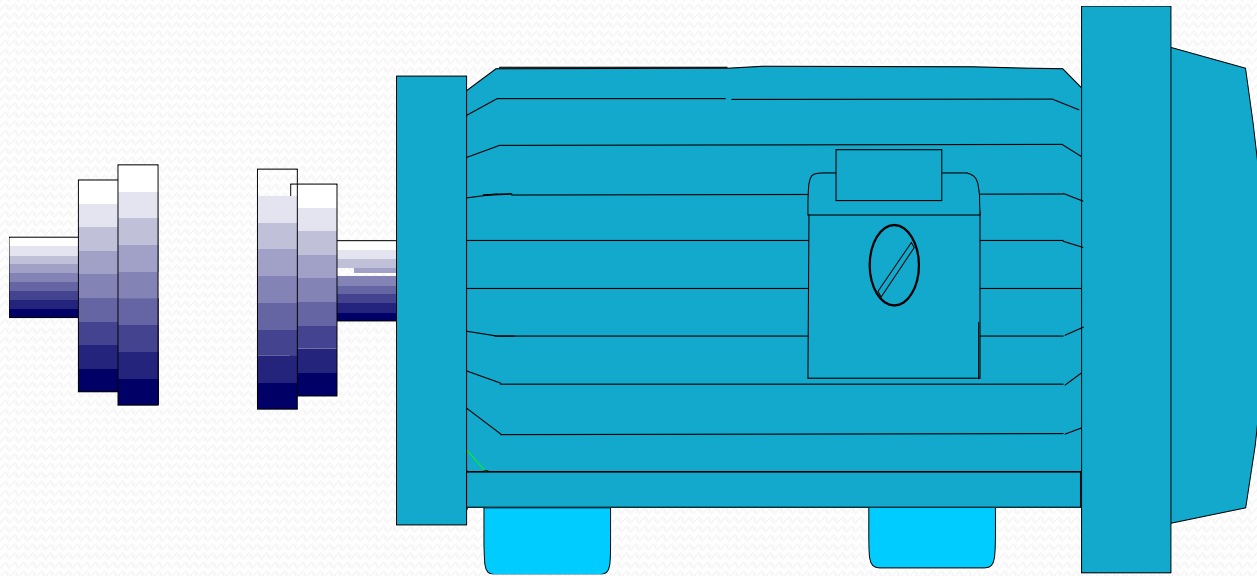
Coupling Gap

- An improper coupling gap causes excessive axial forces which result in increased bearing load.
- Improper gap can also cause destruction of an electric motor with plain bearings.
- The coupling gap should be set to the manufacturer's specification (to take care of thermal expansion in axial direction).



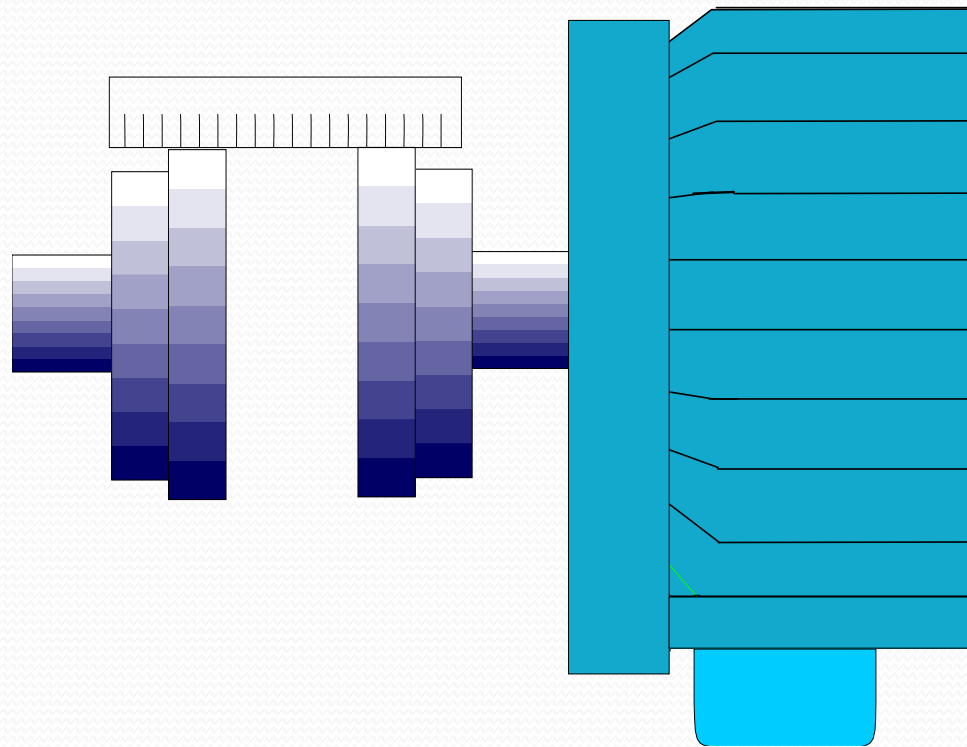
Coupling Gap

- Electric motors with plain bearings have endplay.
- Therefore, you must position the motor shaft at magnetic centre before setting the coupling gap.



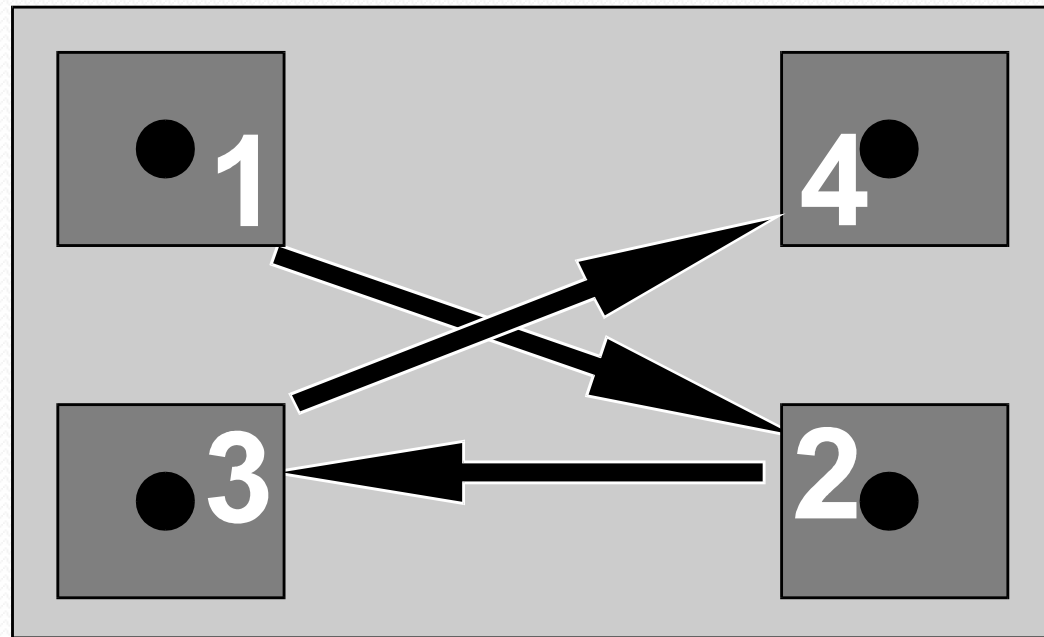
Setting the Coupling Gap

- You check the coupling gap with a scale, feeler gauge, taper gauge, or an inside micrometer.
- Move the motor axially to set the proper gap.



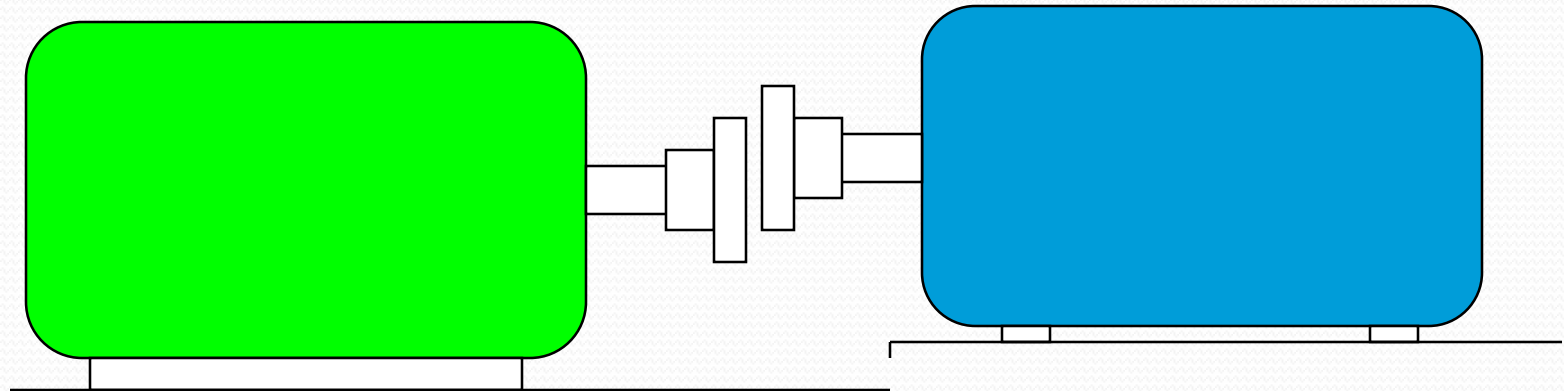
Tightening Hold Down Bolts:

- You will loosen and re-tighten the bolts several times during the alignment process.
- Bolts should always be tightened in a known sequence so that vertical positions are repeated as you re-tighten the bolts.

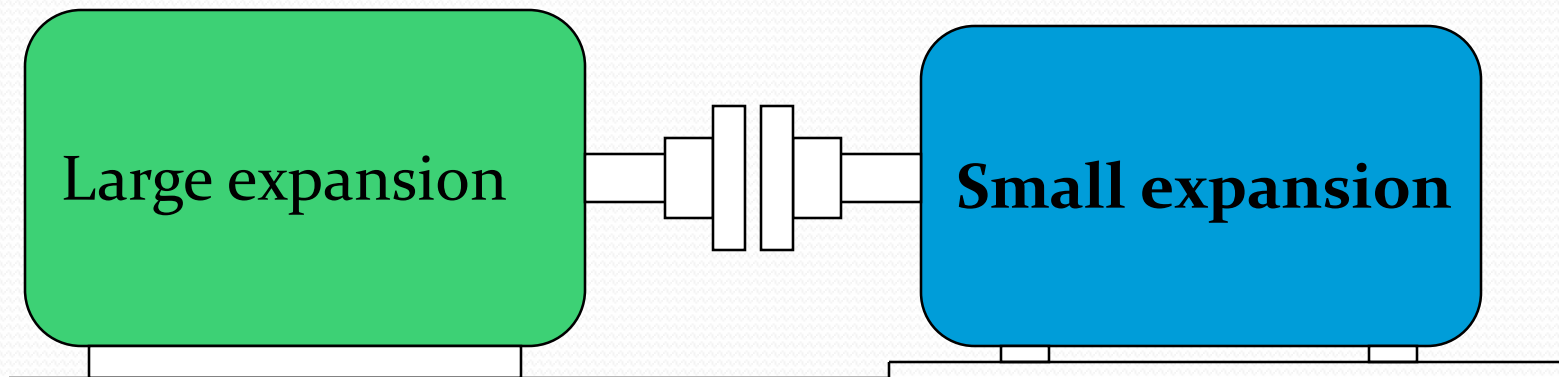


Thermal expansion

Intentional misalignment for cold machines

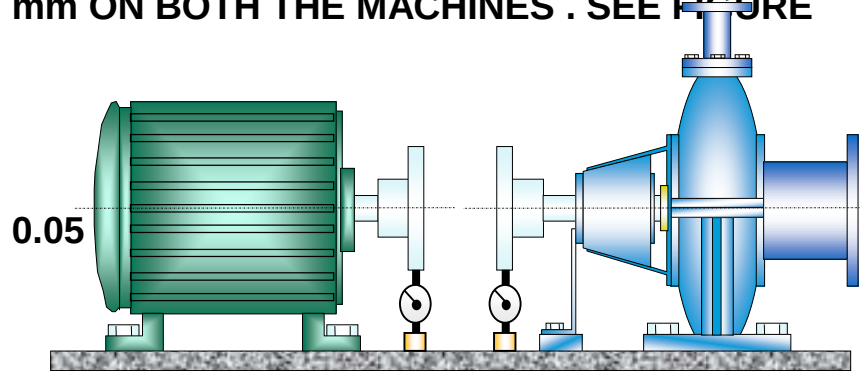


Proper alignment at operating temperature



IMPORTANT CONSIDERATIONS BEFORE STARTING ALIGNMENT

- ❑ MAKE SURE THAT RUNOUT AT THE SHAFT AS WELL AS COUPLING IS LESS THAN 0.05 mm ON BOTH THE MACHINES . SEE FIGURE



RUNOUT SHOULD NOT EXCEED

- ❑ DECIDE WHICH MACHINE WILL BE KEPT STATIONARY AND WHICH ONE WILL BE MOVED . GENERALLY, FOR A MOTOR PUMP COMBINATION , PUMP IS KEPT STATIONARY ,FOR A TURBINE PUMP COMBINATION , TURBINE IS KEPT STATIONARY.
- ❑ CHECK FOR RUSTY OR BROKEN SHIMS/TOO MANY SHIMS UNDER THE SUPPORT LEGS .NUMBER OF SHIMS SHOULD NOT EXCEED FOUR.
- ❑ MAKE PROVISION FOR MOVING THE MACHINERY (BOTH SIDEWISE AND UPDOWN MOTION) FOR SIDEWISE MOTION , USING JACK BOLTS IS THE PREFERRED METHOD. FOR UP-DOWN MOTION , WEDGING AT THE APPROPRIATE PLACE IS DONE AND THEN SHIMS ARE KEPT BELOW THE LEGS.

ALIGNMENT TOLERANCES

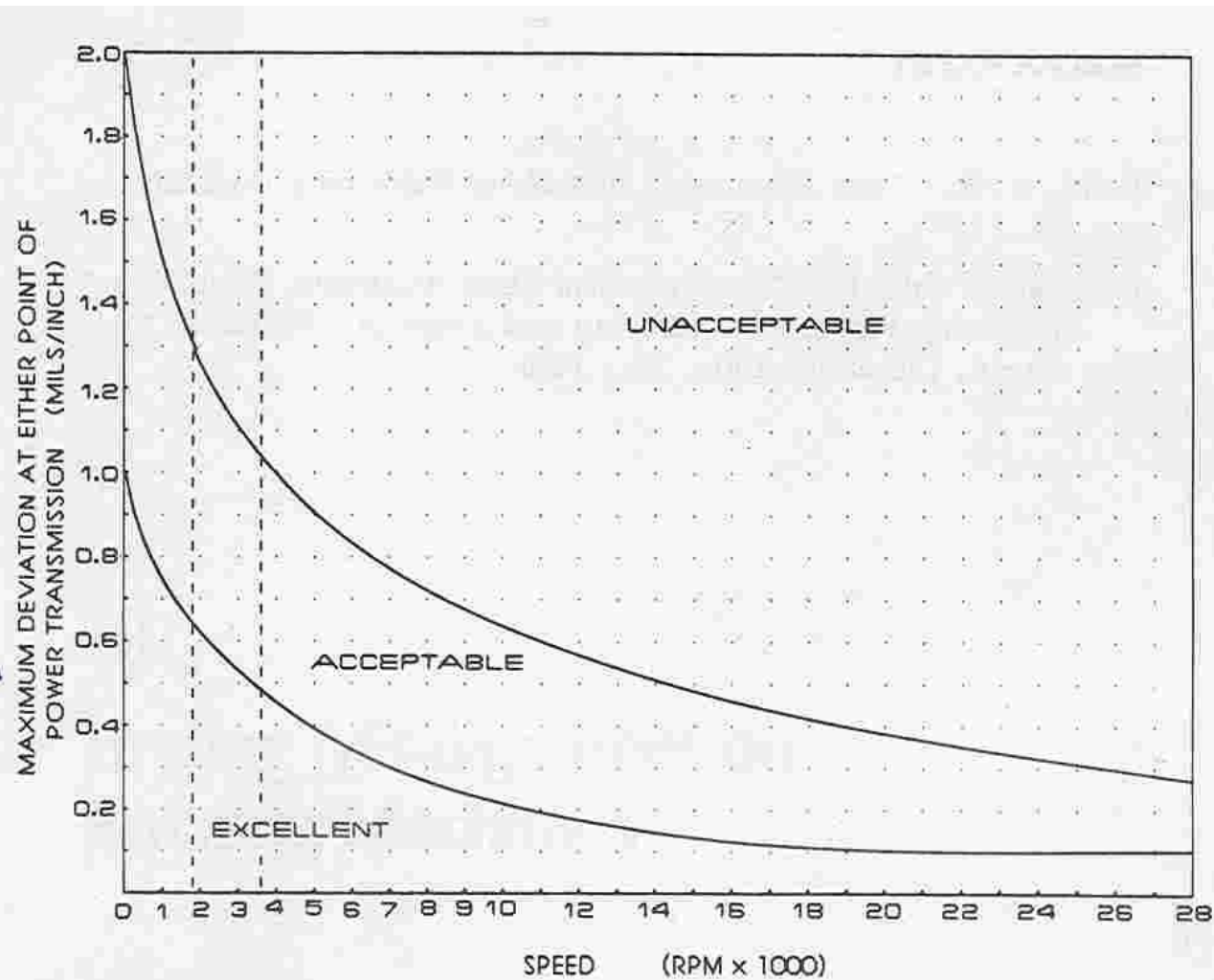
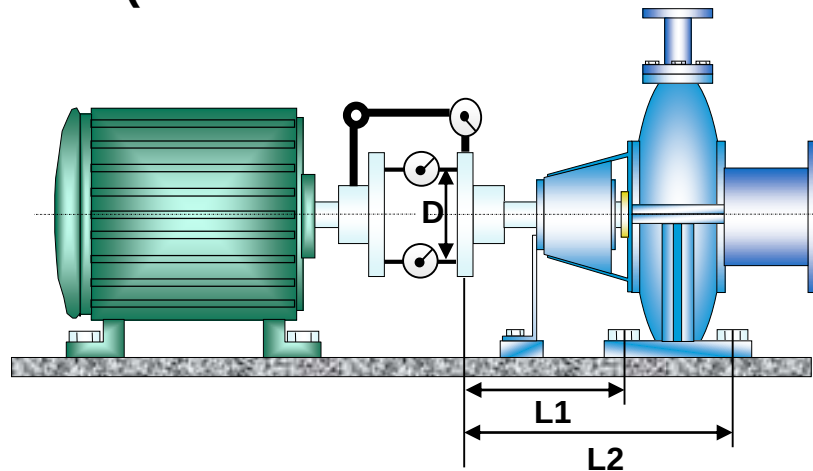


FIGURE 9.2 Guidelines for alignment tolerances.

ALIGNMENT PROCEDURE (TAKING ALIGNMENT READINGS) – STEP NO. : 1



- ☐ DIAL POINTER SHOULD PREFERABLY BE KEPT ON THE MACHINE TO BE MOVED.
- ☐ THE SUM TOTAL OF BOTH SIDE READINGS SHOULD BE SAME AS SUM TOTAL OF TOP BOTTOM READINGS. IN ACTUAL PRACTICE, WE CAN ALLOW A DIFFERENCE OF ABOUT 15%. THIS RULE IS CALLED VALIDITY RULE.

FOR
EXAMPLE
= 0.40

0.15	—	R	—	0.25
		0.36		

= 0.36

= 0.04

SUM TOTAL OF SIDE READINGS = 0.15 + 0.25

SUM TOTAL OF TOP BOTTOM READINGS = 0.00 + 0.36

DIFFERENCE = 0.40 – 0.36

THIS DIFFERENCE SHOULD BE LESS THAN 15 %
15 % OF 0.40 = 0.06

THUS DIFFERENCE IS LESS THAN 15 %. HENCE ALIGNMENT READING IS VALID.

IMPORTANT :

ALIGNMENT CORRECTION SHOULD BE ATTEMPTED ONLY WHEN

WHAT CHECKS TO DO IF ALIGNMENT READINGS ARE FOUND INVALID :

- ☐ **CHECK THE CLAMP FOR LOOSENESS. IF FOUND LOOSE, TIGHTEN.**
- ☐ **CHECK THE DIAL POINTER IS LEAVING CONTACT DURING ROTATION. IF SO, DO ROUGH ALIGNMENT WITH STRAIGHT EDGE FIRST.**
- ☐ **CHECK THE COUPLING FOR ECCENTRICITY / ELLIPTICITY AND SHAFT FOR RUNOUT. RECTIFY, AND ROTATE BOTH SHAFTS TOGETHER.**

IF STILL ALIGNMENT READINGS ARE FOUND INVALID, IT MEANS THAT THERE IS SAG IN THE DIAL CLAMP.

ALIGNMENT PROCEDURE – STEP NO. : 1

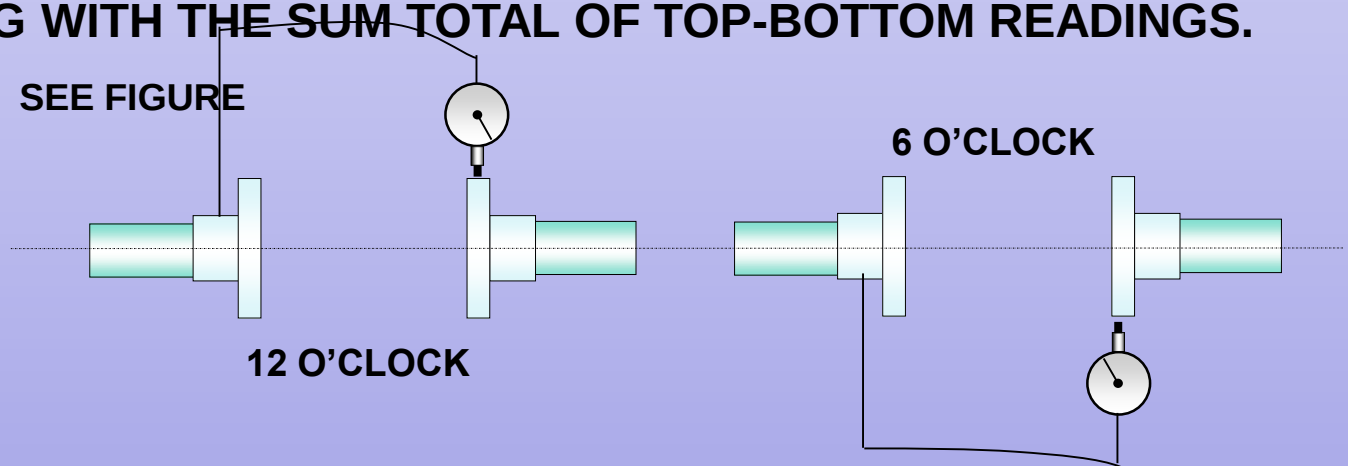
SAG MEASUREMENT AND CORRECTION

IMPORTANT :

THIS STEP IS TO BE CARRIED OUT ONLY IF THE SUM TOTAL OF SIDE READINGS

IS NOT MATCHING WITH THE SUM TOTAL OF TOP-BOTTOM READINGS.

- ❑ WHAT IS SAG ? SEE FIGURE

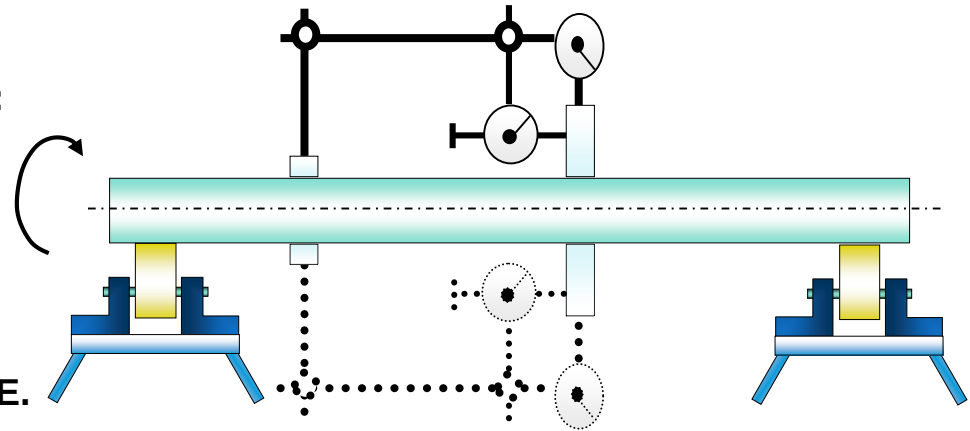


- ❑ WHEN DIAL IS AT 12 O'CLOCK POSITION, THE CLAMP BENDS TOWARDS THE COUPLING.
- ❑ WHEN THE DIAL IS AT 6 O'CLOCK POSITION THE CLAMP BENDS AWAY FROM THE COUPLING.
- ❑ THIS MOVEMENT OF CLAMP CAUSES CHANGE IN DIAL READINGS. DUE TO THIS CHANGE, SUM TOTAL OF TOP-BOTTOM READINGS DOES NOT MATCH WITH SUM TOTAL OF SIDE

ALIGNMENT PROCEDURE – STEP NO. : 2

- ❑ HOW TO REMOVE SAG ERROR FROM THE ALIGNMENT READINGS :

- ❑ MEASURE THE VALUE OF SAG WITH THE HELP OF SAG MEASUREMENT SETUP AS SHOWN IN FIGURE.



THIS SAG VALUE WILL BE NEGATIVE.

- ❑ ADD THE SAG VALUE TO THE ALIGNMENT READINGS AS SHOWN IN THE FOLLOWING EXAMPLE.

- ❑ AS WE CAN SEE, SUM TOTAL OF TOP-BOTTOM READINGS & SIDE READINGS IS NOT MATCHING. ALL THREE CHECKS, GIVEN IN STEP NO.:1 HAVE BEEN DONE. STILL DIFFERENCE IS COMING

DIAL READINGS FROM THE SAG MEASUREMENT SETUP ARE AS FOLLOWS.

IT MEANS THERE IS SAG OF 0.08 MM.

- ❑ THIS SAG VALUE WILL BE ADDED TO THE ALIGNMENT READING OF 12 O'CLOCK POSITION AFTER CHANGING THE SIGN FROM MINUS TO PLUS. MODIFIED READING IS AS FOLLOWS :

- ❑ NOW, SUM TOTAL OF SIDE READINGS AND TOP BOTTOM READINGS IS MATCHING. NOW, WE CAN PROCEED TO STEP NO. : 3 OF ALIGNMENT PROCEDURE.

ALIGNMENT PROCEDURE – STEP NO. : 3

CALCULATING MACHINERY MOVEMENT

IMPORTANT :

FOR BEST RESULTS ,RADIAL AND AXIAL ALIGNMENT CORRECTIONS SHOULD BE DONE TOGETHER. A TABLE FOR THIS PURPOSE IS SHOWN AS FOLLOWS :

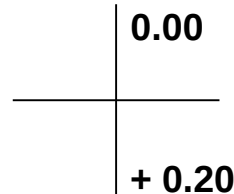
AMOUNT OF SHIMS REQUIRED AT		
	FRONT LEG	REAR LEG
FOR RADIAL ALIGNMENT	A mm	A mm
FOR AXIAL ALIGNMENT	B mm	C mm
FOR TOTAL ALIGNMENT CORRECTION	A + B mm	A + C mm

ALIGNMENT PROCEDURE – STEP NO. : 3A

CORRECTING RADIAL MISALIGNMENT

RADIAL CORRECTION VALUE IS HALF OF THE TOTAL INDICATOR READING.

FOR EXAMPLE :



- ☐ DIAL IS CLAMPED ON PUMP COUPLING AND POINTER IS ON MOTOR COUPLING.
- ☐ DIAL IS SET TO ZERO AT 12 O'CLOCK POSITION.
- ☐ DIAL IS READING +0.20 mm AT 6 O'CLOCK POSITION.
- ☐ THIS MEANS THAT MOTOR SHAFT IS DOWN (+ SIGN MEANS DIAL POINTER HAS GOT COMPRESSED.)
- ☐ THUS MOTOR SHAFT WILL HAVE TO BE LIFTED UP BY $+0.20/2 = 0.10$ mm . THAT IS, SHIMMING OF 0.10 mm IS REQUIRED AT ALL THE FOUR LEGS.

IMPORTANT :

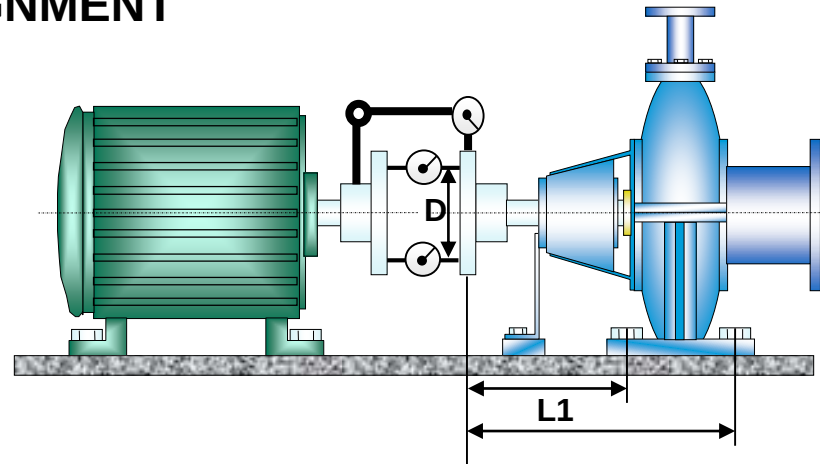
FOR RADIAL MISALIGNMENT CORRECTION , THE VALUE OF SHIMMING REQUIRED WILL BE SAME FOR ALL THE FOUR LEGS, AS WE SAW IN

THE ABOVE EXAMPLE.

ALIGNMENT PROCEDURE – STEP NO. : 3B

CORRECTING AXIAL MISALIGNMENT

SEE FIGURE :



□ D = DIAMETER ON WHICH THE DIAL IS MOVING. (APPROX. EQUAL TO COUPLING DIAMETER).

□ $L1$ = DIAMETER AT FRONT LEG FROM MOTOR COUPLING.

□ $L2$ = DISTANCE AT BACK LEG FROM THE MOTOR COUPLING.

SHIMMING REQUIRED AT FRONT / BACK LEG = $L1 \text{ OR } L2 \times \text{DIAL READING} / D$

EXAMPLE :

+ 0.30

□ DIAMETER OF DIAL TRAVEL D = 100 mm

□ DISTANCE OF FRONT LEG TO COUPLING $L1$ = 200 mm

□ DISTANCE OF BACK LEG TO COUPLING $L2$ = 400 mm

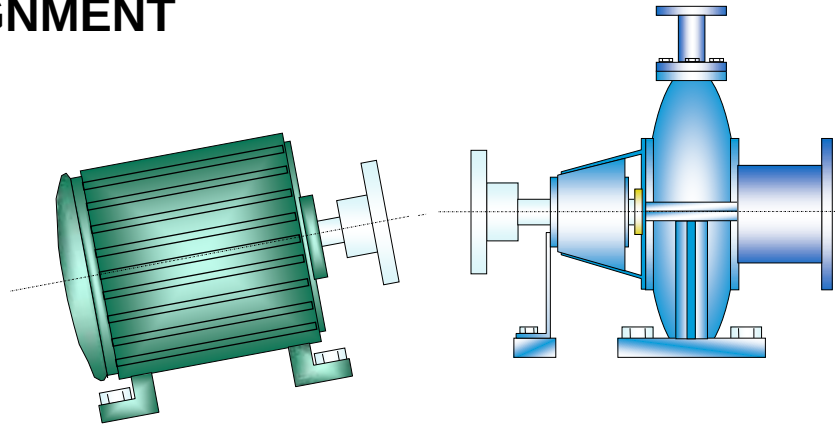
NOW, DIAL IS SET TO ZERO AT 12 O'CLOCK POSITION. DIAL READS + 0.30 AT 6 O'CLOCK POSITION

THIS MEANS THAT TOP GAP BETWEEN COUPLINGS IS MORE THAN BOTTOM GAP (+ SIGN MEANS DIAL POINTER HAS GOT COMPRESSED)

ALIGNMENT PROCEDURE – STEP NO. : 3B

CORRECTING AXIAL MISALIGNMENT

SEE FIGURE :



- ☐ THUS MOTOR SHAFT WILL HAVE TO BE LIFTED UP.
- ☐ SHIMING REQUIRED AT FRONT LEG = $L1 \times \text{DIAL READING} / D$
= $200 \times 0.30 / 100 = 0.60 \text{ mm}$
- ☐ SHIMING REQUIRED AT BACK LEG = $L2 \times \text{DIAL READING} / D$
= $400 \times 0.30 / 100 = 1.20 \text{ mm}$

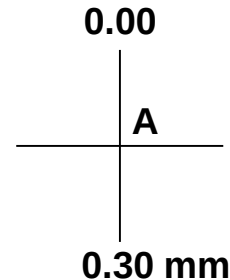
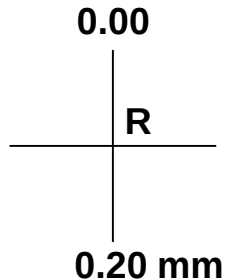
IMPORTANT :

FOR AXIAL MISALIGNMENT CORRECTION , THE AMOUNT OF SHIMS REQUIRED TO BE ADDED OR REMOVED IS DIFFERENT FOR THE FRONT LEGS AND BACK LEGS.

ALIGNMENT PROCEDURE – STEP NO. : 3C

CORRECTING TOTAL MISALIGNMENT

AS PER OUR EXAMPLE, THE TOP BOTTOM READINGS ARE :



SHIMING REQUIRED FOR RADIAL & AXIAL MISALIGNMENTS RESPECTIVELY HAVE BEEN CALCULATED ON THE PREVIOUS SLIDES. THE TOTAL SHIMING REQUIRED IS CALCULATED AS FOLLOWS :

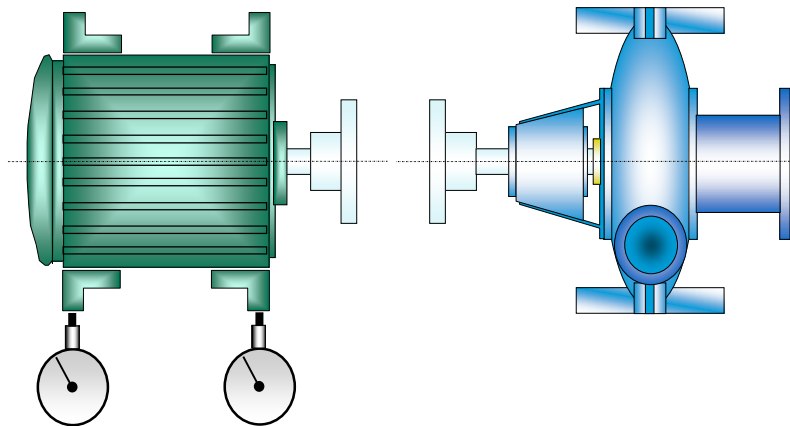
AMOUNT OF SHIMS REQUIRED IN		
	FRONT LEG	REAR LEG
TO CORRECT RADIAL ALIGNMENT	+ 0.10 mm	+ 0.10 mm
TO CORRECT AXIAL ALIGNMENT	+ 0.60 mm	+ 1.20 mm
TOTAL ALIGNMENT CORRECTION	$0.10 + 0.60 = 0.70$ mm	$0.10 + 1.20 = 1.3$ mm

THUS, IN ORDER TO DO TOTAL (RADIAL + AXIAL) ALIGNMENT, PUT SHIMS OF 0.70 mm IN FRONT LEG AND 1.3 mm IN BACK LEG OF MOTOR IN OUR EXAMPLE.

ALIGNMENT PROCEDURE – STEP NO. : 4

MOVING THE MACHINERY

- ❑ FOR TOP-BOTTOM MOVEMENT SHIMS ARE ADDED OR REMOVED FROM BELOW THE FEET OF THE MACHINE TO BE MOVED. FOR THIS PURPOSE, THE MACHINE IS LIFTED UP BY WEDGING, AND THEN SHIMS ARE ADDED OR REMOVED.
- ❑ FOR SIDE WISE MOVEMENT, USING JACKBOLTS IS THE PREFERRED METHOD. A LIGHT HAMMER CAN ALSO BE USED ON SMALL MACHINES. THE MOVEMENT SHOULD BE CLOSELY MONIORED BY TWO DIAL GAUGES, AS SHOWN IN THE FIGURE.



IMPORTANT :

AFTER MAKING THE REQUIRED MOVEMENT, ONE FINAL ALIGNMENT READING SHOULD BE TAKEN.

CONCLUSION

WHICH ALIGNMENT TO DO FIRST : TOP-BOTTOM OR SIDE WISE ALIGNMENT

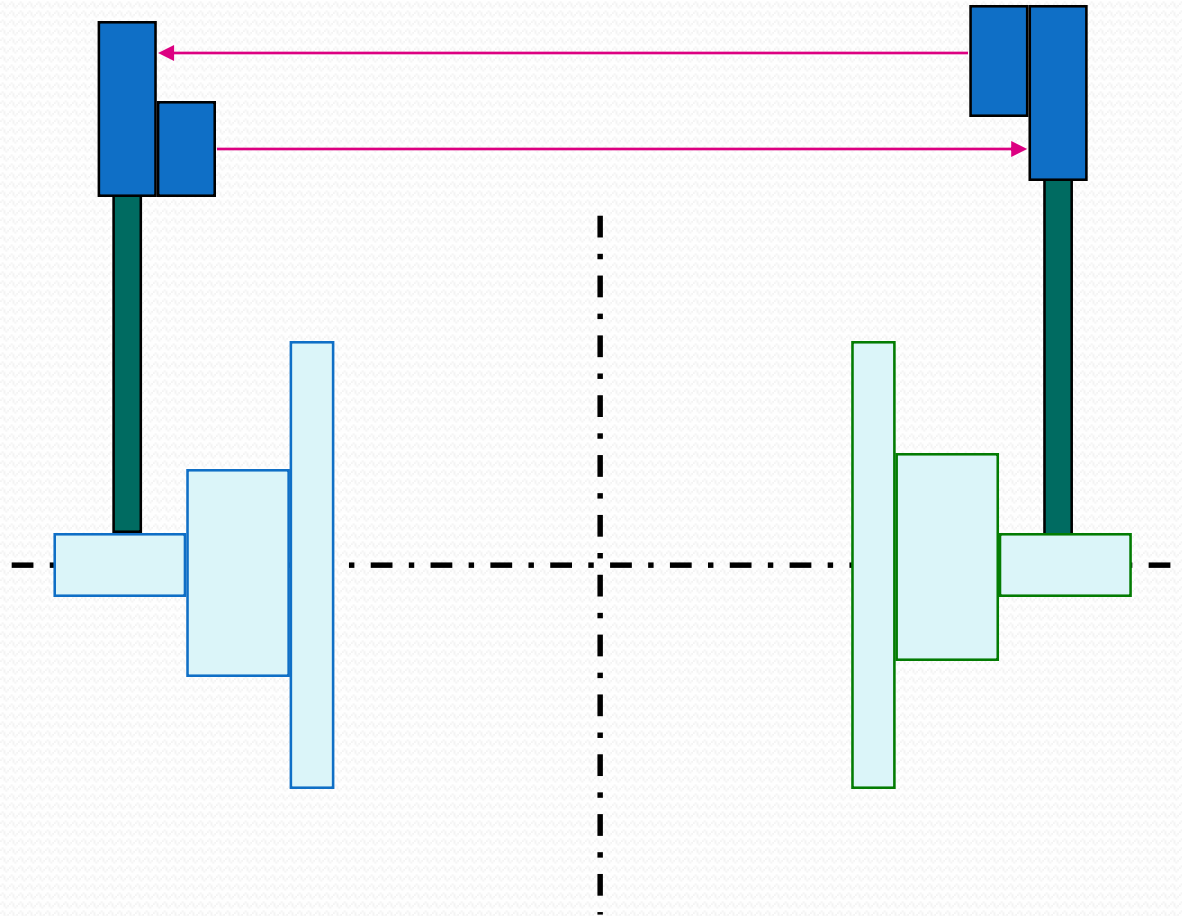
- ❑ WE HAVE TO SEE THAT IT IS VERY CONVENIENT TO DO RADIAL AND AXIAL ALIGNMENT CORRECTION TOGETHER.
- ❑ HENCE, WE CAN SAY THAT ULTIMATELY THERE ARE ONLY TWO TYPES OF MISALIGNMENTS – TOP-BOTTOM (RADIAL + AXIAL) MISALIGNMENT AND SIDE WISE (RADIAL + AXIAL) MISALIGNMENT.
- ❑ FOR BEST RESULTS TOP-BOTTOM ALIGNMENT SHOULD BE DONE FIRST, FOLLOWED BY SIDE WISE ALIGNMENT. THE REASON IS THAT IF YOU DO SIDE WISE ALIGNMENT FIRST, THEN WHILE DOING TOP-BOTTOM ALIGNMENT, SIDE WISE ALIGNMENT WILL AGAIN GET DISTURBED.
- ❑ HOW EVER, IF DURING STEP NO. : 1 (TAKING ALIGNMENT READINGS) IT IS FOUND THAT SIDE WISE MISALIGNMENT IS VERY LARGE AS COMPARE TO TOP-BOTTOM MISALGNMENT, THEN ROUGH ALIGNMENT (OF SIDE WISE) SHOULD BE DONE FIRST. AFTER THAT FINAL TOP-BOTTOM ALIGNMENT AND THEN FINAL SIDE WISE ALIGNMENT SHOULD BE DONE.

5. REMOVE COUPLING GAURDS AND COUPLING SPOOL PIECE IF NECESSARY. MEASURE THE SHAFT AND COUPLING HUB RUN OUT ON BOTH UNITS. INSPECT COUPLING FOR ANY DAMAGE OR WORN PARTS. KEEP TRACK OF THE COUPLIG PARTS AND LABEL THEM IF NECESSARY. IF EQUIPMENT IS GOING TO BE REMOVED FOR SERVICING, MAKE PUNCH MARKS ON CASING AND BASEPLATE AS A REFERENCE DURING REINSTALLATION.
6. CHECK FOR SOFT FOOT, CASING OR FRAME WARPAGE, EXCESSIVE STATIC PIPING OR CONDUIT FORCES, DAMAGED OR RUSTY SHIMS, LOOSE FOUNDATION BOLTS. ETC. CORRECT ANY OF THE POTENTIAL PROBLEM AREAS.
7. TAKE AND RECORD A SET OF ALIGNMENT READINGS.
8. CALCULATE AND PERFORM THE NECESSARY AXIAL , VERTICAL AND HORIZONTALS MOVE. RECHECK ALIGNMET, CALCULATE AND MOVE UNTILL EQUIPMENT IS WITHIN ACCEPTABLE ALIGNMENT TOLERANCES. TORQUE FOUNDATION BOLTS TO REQUIRED VALUES. RCORD FINAL ALIGNMENT READINGS.



LASER ALIGNMENT

Laser Alignment



Laser

Light Amplified By Stimulated Emission Of Radiation

- Laser was originally emitted by charge sent through a gas mixture of Helium & Neon.
- Now it is generated by a low power semi conductor diode with collimating lenses.
- Modulated to avoid interference from other light source
- It is collinear.
- Single wave length of 670 nm.
- Class II Laser is used for Laser Alignment System.

Laser Alignment

Advantages:

1. Easy to use.
2. Use Reverse Indicator Method.
3. Machine does the calculations.
4. 0 - 20m max. working distance.
5. Selectable high resolution 0.1, 0.01, 0.001mm.
6. No indicator sag.
7. Soft foot measurement program.
8. Horizontal shaft alignment with min 60° rotation.
9. Vertical shaft alignment program.

- 
- 10. Thermal or offset compensation.**
 - 11. Machine train alignment program.**
 - 12. Cardon shaft alignment.**
 - 13. Straightness, Flatness, Perpendicularly,
Parallelism measurement.**
 - 14. Spindle alignment.**
 - 15. Static feet correction.**
 - 16. Continuous monitoring.**

USING THE XA IN CLOCK MODE

The Clock method of collecting alignment data replicates the dial indicator method of taking readings at the cardinal clock positions: 9:00 and 3:00 for the horizontal misalignment; 12:00 and 6:00 for the vertical misalignment. On the XA systems, the Clock method of collecting alignment data allows great flexibility when faced with uncoupled alignments or with equipment in tight spaces where sensor placement and rotation might be a challenge.

The steps below will guide you through an alignment using the Clock method. Additional details on sensor setup and entering dimensions can be found in Chapter 2.

1. SET UP THE XA

- 1.1. Turn on the XA to allow to boot up.
- 1.2. Mount the 'S' sensor on the stationary shaft.
- 1.3. Turn on 'S' sensor by pressing the power button on the Bluetooth module.
- 1.4. Mount the 'M' sensor on the movable shaft in the same plane as the stationary sensor.
- 1.5. Turn on 'M' sensor by pressing the power button on the Bluetooth module.
- 1.6. From the main menu, touch the horizontal alignment icon.



- 1.7. You will be prompted to select the speed of the equipment that you are aligning. Press OK to return to the alignment screen



- 1.8. Aim the lasers
- 1.9. Using the wrench, tighten the nuts another half turn to ensure the brackets will not rock on the shaft.
- 1.10. Touch the Tools icon.



- 1.11. Touch the Measurement Method icon.



- 1.12. Touch the Clock Method icon



- 1.13. Touch OK to return to the Tools menu.
- 1.14. Touch the Exit door icon to return to the alignment.

CHAPTER 10

2. ENTER DIMENSIONS

- 2.1. Touch the "?" to input the dimension from the keypad.
- 2.2.



The first dimension to enter is the distance from the S to the M sensor. Measure from center of post to center of post.

- 2.3. Measure and enter the correct dimension. Press OK.
- 2.4. The next dimension is from the center of the coupling to the center of the movable sensor. If the dimension in the display is not correct (one sensor is closer to the center of the coupling), measure and enter the correct dimension. Press OK.



- 2.5. Measure from the center of the movable sensor post to center of the front movable foot. Enter the dimension on the keypad and press OK.
- 2.6. Measure and enter the dimension from the front movable foot to the rear movable foot and press OK.



3. MEASURE MISALIGNMENT

- 3.1. Viewing the machine from the movable to the stationary, rotate the sensors to the 9:00 position. The starting measurement is registered by pressing the measurement button flashing on the screen.



- 3.2. The sensors are then rotated to the 3:00 position.



- 3.3. The second measurement is registered by touching the measurement button.
- 3.4. The sensors are then rotated to the 12:00 position.
- 3.5. The third and final measurement is registered by pressing the measurement button.

USING THE XA IN CLOCK MODE



4. ALIGNMENT RESULTS

- Both the vertical and horizontal alignment results are displayed.



- Only the angle and offset values determine the alignment condition.
- Displayed foot values are for making necessary corrections.
- If all values are acceptable, a green check mark will appear above the coupling icon. Skip to Section 8-Document.
- An orange circle or red exclamation point will be displayed if any value is unacceptable. Proceed with next step.

5. THE VERTI-ZONTAL COMPOUND MOVE: CORRECTING VERTICAL MISALIGNMENT

- 5.1. Press shim icon in bottom right-hand corner.



- 5.2. Loosen all bolts holding down the movable element.

- 5.3. Follow instructions on screen for removing or inserting shims.



- 5.4. Do not retighten hold down bolts yet.

6. CORRECTING HORIZONTAL MISALIGNMENT

- 6.1. The horizontal corrections are done with live readings. Press icon in bottom right-hand corner.



- 6.2. Values are live in the direction the sensors are pointing. Rotate the sensors back to 3:00.



- 6.3. Positive values: the machine is away from you; adjust it toward you in the direction of the arrow. Negative values: the machine is toward you; adjust it away from you. Start with the largest number first.



- 6.4. Adjust the movable machine until the angle and offset are within tolerances.
- 6.5. Tighten feet using sequence established in the pre-alignment steps.

7. RE-MEASURE

- 7.1. To re-measure, press the re-measure button. Press the re-measure button again on the confirmation pop-up.



- 7.2. Follow the steps from Section 3 above to complete the measurement process.
- 7.3. Verify the results are within tolerance.

8. DOCUMENT

- 8.1. After re-measuring, press the file save icon.



- 8.2. Tap in the white file name area.



- 8.3. Enter the name from the keyboard. Press OK



- 8.4. Press OK again to save file in My Measurements





THANK YOU