

# Sof' Shoe® Shims Eliminate Angular Soft Foot Problems

• Increase Productivity • Extend Motor Life • Reduce Maintenance



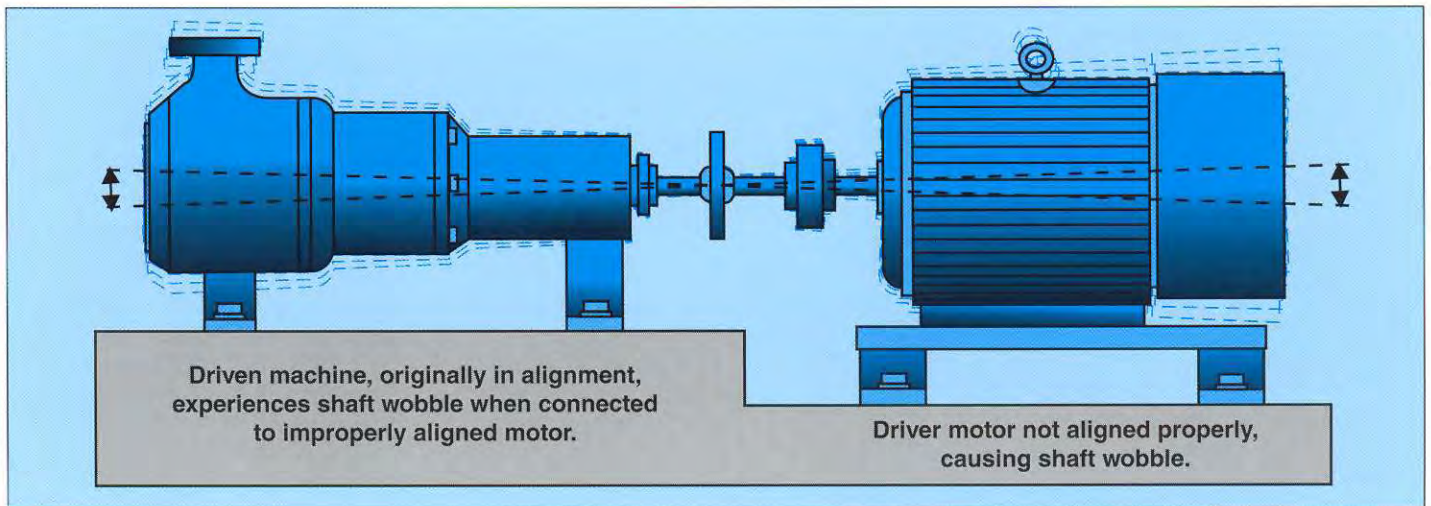
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# Angular Soft Foot Robs Productivity, Shortens Motor

The effects of ordinary soft foot on motors, fans, and blowers — lost productivity, shorter motor life, and increased maintenance — are generally recognized by most maintenance supervisors. But even in today's increasingly sophisticated maintenance programs, an equally significant condition — **angular soft foot** — often goes undetected.

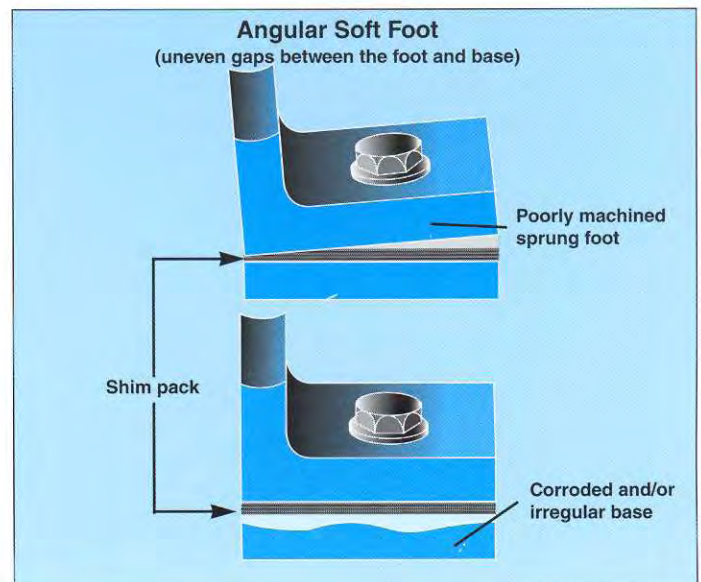
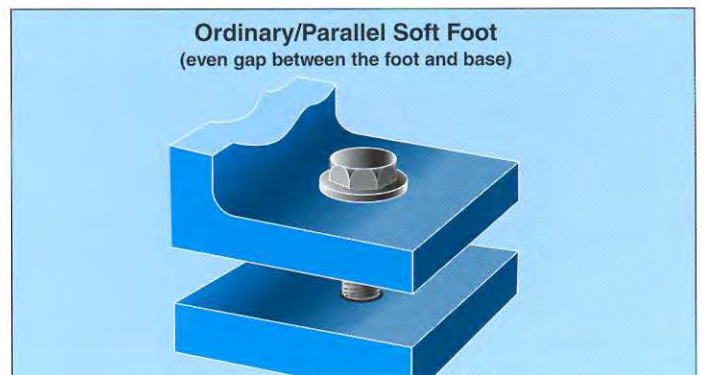


## What is ordinary soft foot?

Ordinary soft foot is the gap between the foot of a motor, fan, or blower and the base to which it is bolted. To properly align the shafts of motors and pumps — or other equipment — all four feet of the motor must be in the same plane (though not necessarily level). Thus, when one foot rises above the base when the hold down bolt is loosened, the four feet are clearly not planar. This movement is typically measured by a dial indicator and is commonly treated with stainless steel slotted motor shims.

## Does your maintenance program inspect for angular soft foot?

While the even, consistent gap between a motor and base has been considered in most maintenance programs, a less easily recognized soft foot — known as angular soft foot — has not received the attention it deserves. **Angular soft foot refers to an uneven or irregular gap between the foot and the base.** When a dial indicator check indicates a soft foot, all four corners of that foot should be checked further with feeler gages. These measurements should include gaps above and below the existing shim packs. If the total gap measured for any corner is different from the other corners, there is some angularity. When this angularity is greater than .001 per inch of foot, angular soft foot is present and must be corrected before alignment is started. If this condition goes uncorrected, it will degrade alignment, reducing the motor's efficiency, translating to additional capital expenditures.



# or Life, and Increases Maintenance Demands

## Why is angular soft foot so destructive?

Tightening a motor foot that has angular soft foot forces that foot to make contact with the base, creating unwanted stresses on the motor housing through the motor's leg. These stresses can distort the motor housing and twist bearings, bending the shaft and causing shaft wobble (Figure A).

Thus, angular soft foot will cause:

- extra strain on the bearings and seals
- eccentricity of the motor air gap, reducing efficiency and increasing heat
- excess strain and wear on couplings.

Ultimately, the result will be premature bearing failure and shorter motor life.

## How can you recognize angular soft foot?

Inconsistent flat rise readings during alignment indicate angular soft foot. Correcting for soft foot based on these inconsistent dial or laser readings may measure the spring of a foot and not the actual ordinary, co-planar flat rise. Standard shimming simply lifts the problems, leading to a continual repetition of the process — often called “chasing your tail.” While instruments can determine the presence of soft foot due to a foot rising, even the most precise instrumentation cannot differentiate between **flat** rise and **angular** rise. Feeler gages are still required (Figure B).

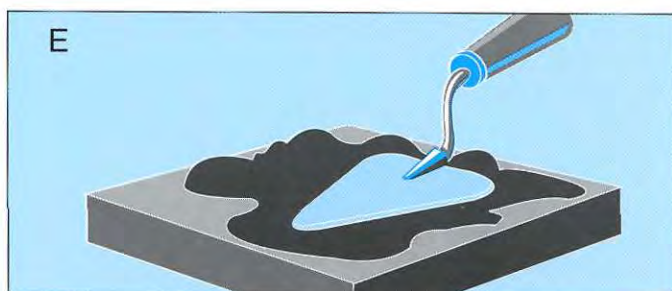
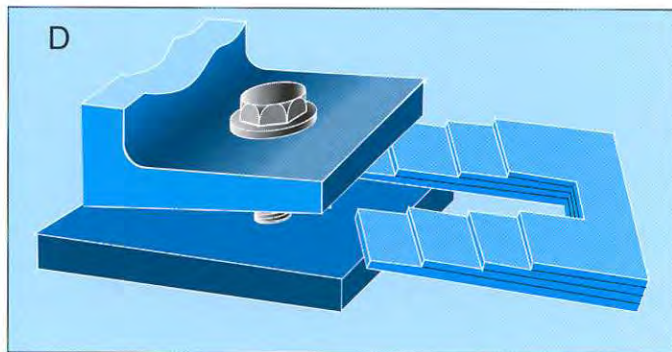
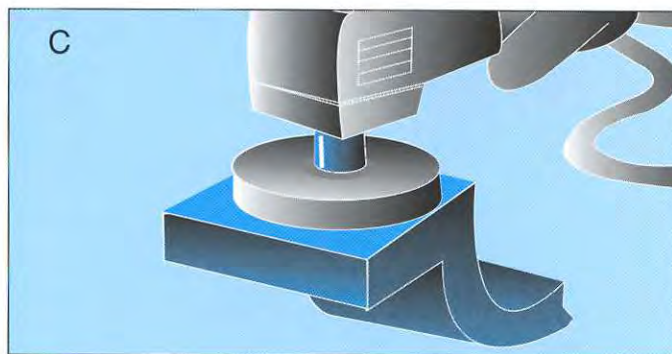
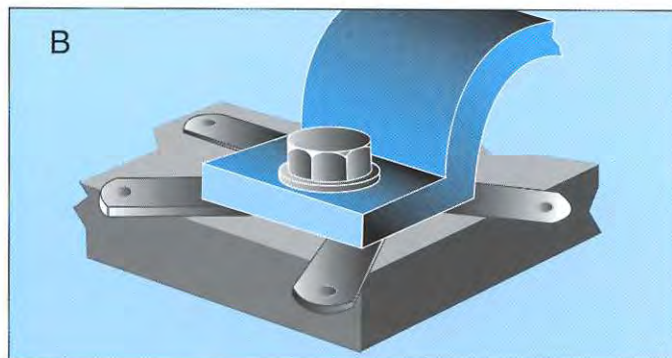
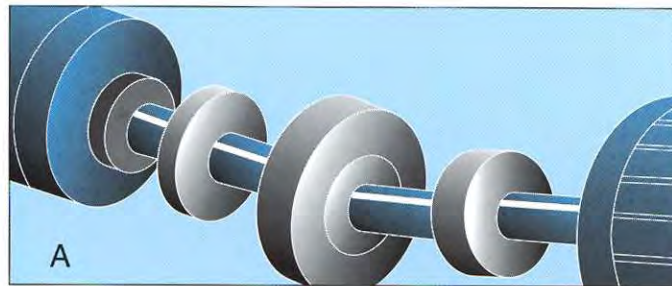
When flat rise is detected in any foot, the next step is to check the gap under that foot (above and below the shim pack) with feeler gages at each corner. If these measurements are not all the same, the motor may have an angular soft foot condition.

## What are the traditional cures for angular soft foot?

The most effective cure for angular soft foot requires removing the driver and milling the base or feet. However, this is both costly and inefficient, due to machine downtime. In addition, milling is usually impractical for larger motors and turbines (Figure C).

Laminated or hand cut step shims can be effective, but preparing such shims is very labor intensive and time consuming (Figure D).

Finally, a corroded base can be replaced or rebuilt with poured epoxy. This solution necessitates significant machine downtime and lost production (Figure E).



# The Sof' Shoe Alternative

## How do Sof' Shoe shims work?

Precision Brand Sof' Shoe shims — made of a specially formulated elastomer — efficiently fill the irregular gaps between feet and bases, eliminating angular soft foot problems.

A Sof' Shoe shim above the motor shim pack, with another Sof' Shoe shim below the shim pack, will cold flow and set to fill any irregular gaps, thus creating complete surface contact between the foot and the base. In essence, the Sof' Shoe becomes an instant step shim.

## What makes Sof' Shoe shims so effective?

The unique properties of Sof' Shoe shim material eliminate irregular gaps and give the foot complete support. During initial alignment, the shims will return to their original form so shimming adjustments can be made. As a result, the stainless shim pack thickness can be adjusted to correct for any vertical misalignment and to make horizontal adjustments. Sof' Shoe shims then take a permanent set after ten to fourteen days under standard bolt torque compression. The Sof' Shoe's unique compressive property translates to instant motor startup after alignment.

## What is the difference between yellow and blue Sof' Shoe?

Sof' Shoe shims are available in two thicknesses to match your specific requirements. Either thickness shim has a 12% flat compression under standard bolt torque but will absorb the angularity of nearly half its thickness.

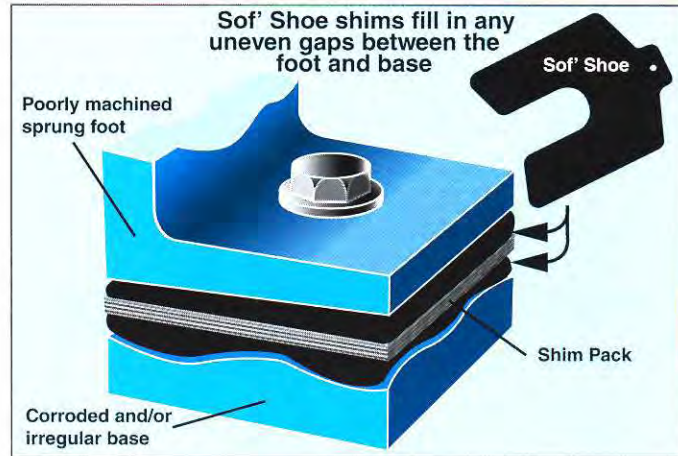
- .045" yellow Sof' Shoe shims compress to .040" and absorb up to .020" of angularity.
- .020" blue Sof' Shoe shims compress to .0175" and absorb up to .010" of angularity.

If the angularity per inch of a motor foot is less than .003", replace .035" of the existing metal shim pack with two blue (.020") Sof' Shoe shims — one next to the foot, one next to the base. These two blue shims will compress to .035" (total) under standard bolt torque.

If the angularity per inch is equal to, or greater than, .003", replace .080" of the metal shim pack with two yellow (.045") shims — one next to the foot, one next to the base. These two yellow shims will compress to .080" (total) under standard bolt torque.

With either blue or yellow Sof' Shoe shims, the final thickness adjustment is made with stainless steel slotted shims in the shim pack.

Both yellow and blue thicknesses are available in four sizes, as shown in the table to the right.



## Sof' Shoe specifications

Retain about 50% flexibility to conform to any irregularity on a foot or base — even after compressing permanently over 10-14 days

Stable to 225°F

A Sof' Shoe pin is included in every package to help with inventory control

The density of Sof' Shoe is greater than water

UPC No.	Description	Shim Thickness (inches)	Pieces per Package
49105	2" x 2" with 5/8" slot (blue)	.020	10
49125	2" x 2" with 5/8" slot (yellow)	.045	10
49110	3" x 3" with 3/4" slot (blue)	.020	10
49130	3" x 3" with 3/4" slot (yellow)	.045	10
49115	4" x 4" with 1-1/4" slot (blue)	.020	10
49135	4" x 4" with 1-1/4" slot (yellow)	.045	10
49120	5" x 5" with 1-5/8" slot (blue)	.020	10
49140	5" x 5" with 1-5/8" slot (yellow)	.045	10

For very large machines or custom shapes, flat sheets are available by special order for your own fabrication.

Here's what  
a spokesman  
for a large Gulf Coast  
petroleum refinery  
says about  
Sof' Shoe shims



*“ The Sof' Shoe shims provide a quick, interim solution to the angular “soft foot” problem until the motor/base-foot surfaces can be corrected by machining during the next repair. Because of its desirable cold flow and set properties, the Sof' Shoe permanently conforms to the shape of the irregular surface, to cure in place (retaining flexibility) so they cannot be reused. Since they are intended as an interim solution, this is an asset, not a liability. ”*

NOTE: This major oil company prides itself on properly machining feet and bases, thus designating Sof' Shoes as an interim solution. You can, in fact, count on Sof' Shoes to last indefinitely, holding their shape and your alignment as long as necessary. A plant of the world's largest tape company has vibration-analyzed 10 laser alignments before and after Sof' Shoes, documenting substantial improvement and alignments that have held solidly for eleven months, and they are still in use.

## Sof' Shoe®

The alignment solution for **angular soft foot**.  
Sof' Shoe is the cure for:

- a corroded foot or base
- a sprung foot
- a poorly machined foot on either the driver or the driven machine
- a crooked weld on a broken foot
- a convex or crowned steel base
- I-beam rails not properly machined after being welded into place
- grout deterioration or settling
- poorly assembled sectional blowers



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Web: <http://www.precisionbrand.com>

Precision Brand SOF' SHOE shims are available at:

# PRECISION BRAND®



## SOF' SHOE® DIRECTIONS FOR RELIABLE ANGULAR SOFT FOOT CORRECTION, FOLLOW THESE ALIGNMENT STEPS:

NOTE: Good alignment means correcting the driven machine as well as the driver, when applicable.

1. Number the "driver" feet on your sketch or form to keep track of soft foot measurements.
2. Loosen all the hold down bolts on the motor. If any bolts are loose, the foot may have been soft. Check the foot for cracks or welds, as this may have been a long time problem.
- 2a. If it is a replacement motor, rock the motor on the base; shim until it is stable. (Best if the driver and driven bases are level as well as being planar, that is all four feet are in the same plane. However, in the "real world" level is not often attainable but, planar is a must for good alignment.)
3. Tighten all feet **evenly** with a torque wrench and if necessary crowsfeet also, or with your own "calibrated elbow" as a last resort.
4. Zero a dial indicator on a magnetic base at foot number 1, back off the hold down bolt and record the amount of rise.
5. Check under all four corners of the foot with PRECISION BRAND® Feeler Gages. Each corner's measurement should combine any gap on top of and beneath the shim pack. If the measurements from each corner of the motor foot differ, this indicates angular soft foot.
6. To determine how severe a foot's angularity is: subtract the smallest corner feeler gage reading from the largest corner; then divide the remainder by the width of motor foot (in inches) to find the foot's angularity per inch. Record the angularity per inch for the foot.
7. Retighten that foot. Check the opposite diagonal foot the same way. Now do the other diagonal pair before correcting any foot. Replace badly corroded or dirty shim packs with new PRECISION BRAND® Stainless Slotted Shim. Before inserting new, clean shim under a foot, try to remove any residue, oil and corrosion by sliding a cloth or abrasive screen strip between the foot and the base. If one diagonal pair of feet has a "zero" rise and the other diagonal pair has a rise, carefully read 8c.
- 8a. To correct angularity of a foot -  
If the angularity per inch of a motor foot is less than .003, replace .035" of the existing shim pack with two (blue) SOF' SHOE® shims, one next to the foot, one next to the base. [Two blue SOF' SHOE® shims will compress to .035" (.0175" x 2) under standard bolt torque.] Subtract .035" from the original shim pack thickness\* and replace only the difference with PRECISION BRAND® Stainless Slotted Shim between the SOF' SHOE® shims, then add what is needed to relieve the ordinary soft foot flat rise stress as described in 8b.
- 8b. To correct ordinary soft foot flat rise -  
While correcting for angularity of a foot, add together the rise measurements from both feet in the diagonal and divide by two. The result represents the average ordinary soft foot flat rise which tells you what thickness needs to be added to each foot's existing shim pack in that diagonal.
- 8c. If one diagonal pair of feet has a "zero" rise and the other diagonal pair has a rise of < .020" reduce the average soft foot flat rise per foot of the bad diagonal by 10% before correcting. If one diagonal pair of feet has a "zero" rise and the other diagonal pair has a rise of > .020" reduce the average soft foot flat rise per foot of the bad diagonal by 20% before correcting.
9. If either diagonal does not have angular soft foot, calculate the average ordinary soft foot flat rise of the diagonal pair and correct with PRECISION BRAND® Stainless Slotted Shim.
10. Once you calculate the correct SOF' SHOE® and PRECISION BRAND® Stainless Slotted Shim to place under each motor foot, slide the shims under all feet, keeping the shim's slot edges away from the bolt to avoid creating burrs and lips on the shims. Then tighten the bolts to standard bolt torque. Burrs or lips on the shims can also degrade the alignment. SOF' SHOE® shims may curl slightly under standard bolt torque, this just shows that they are absorbing all the irregularities of the foot and/or base.
11. Recheck the motor's rise by placing the dial indicator back on each foot and backing off (loosen) the bolt. If the dial indicator measures a rise of .010" per foot or less with two yellow SOF' SHOE® and .005" or less with two blue SOF' SHOE® you have corrected the angularity. Many 'cured' feet will show some dial rise but will not allow insertion of PRECISION BRAND® Feeler Gage. This rise represents only temporary compression. Go ahead and align with confidence.

NOTE: We highly recommend the use of two SOF' SHOE® shims for each "driver" foot showing angular soft foot as outlined in these instructions to insure motor alignment because the source of angular soft foot is often not detectable. However, if you can determine without any doubt which, the foot or the base, is the cause of the angularity, then only one SOF' SHOE® Shim placed next to the problem surface would be necessary. In most "driven" machine applications the use of two SOF' SHOE® shims is not necessary since many driven feet have no shim packs and SOF' SHOE® shims contact both the foot and the base.

\*For the driver, it is good standard alignment practice to always have a min. of 1/8" (.125) thick shim pack (using no more than 5 shims) under each motor foot for motors up to 250 HP. For larger motors a min. of 1/4" (.250) shim pack thickness is recommended.

# ANGULAR SOFT FOOT CALCULATION CHART

**CORNER #A**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #B**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #D**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #C**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**FOOT # 1**

A B  
D C

[ ] - [ ] = [ ]  
(largest total corner gap) (smallest total corner gap) (difference)

[ ]  
= [ ]  
(inch width of motor foot) (foot #1's angularity per inch)

**CORNER #A**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #B**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #D**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #C**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**FOOT # 2**

A B  
D C

[ ] - [ ] = [ ]  
(largest total corner gap) (smallest total corner gap) (difference)

[ ]  
= [ ]  
(inch width of motor foot) (foot #2's angularity per inch)

**CORNER #A**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #B**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #D**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #C**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**FOOT # 4**

A B  
D C

[ ] - [ ] = [ ]  
(largest total corner gap) (smallest total corner gap) (difference)

[ ]  
= [ ]  
(inch width of motor foot) (foot #4's angularity per inch)

**CORNER #A**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #B**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #D**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**CORNER #C**  
(Total Gap)  
[ ]  
(shim pack + gap above & below)

**FOOT # 3**

A B  
D C

[ ] - [ ] = [ ]  
(largest total corner gap) (smallest total corner gap) (difference)

[ ]  
= [ ]  
(inch width of motor foot) (foot #3's angularity per inch)