



Advanced Wheelend Technologies

# Trailer axles Procedure Manual for



## " Optimum - Contact "

New method of repairs for  
air brake cam-bushings  
( CAN Pat. Pend. # 2,275,480 )  
( U.S. Pat. Pend. # 09/576483 )



THE EFFICIENT AND DURABLE SOLUTION FOR HEAVY VEHICLE AIR BRAKE  
CAM-BUSHING REPLACEMENT

Part# **SMCO-TA-1.2**

" OPTIMUM-CONTACT " is a patented method of repair.

The method and its related products are subject to international laws on patents and trade marks.

## Table of contents

<b>Section A</b>	
Introduction	4
Conventional method	5
" <u>OPTIMUM-CONTACT</u> " method	6
<b>Section B</b>	
Installation procedure	9 to 32
Step 1 - Preparation and cleaning of the axles	9
Bushing installation tool description	10
Step 2 - Bushing installation on trailer axles	10
Step 3 - Measuring the camshafts	16
Step 4- Cutter selection according to cam size	17
Align-boring tool description	17
Step 5 - Align-boring the spider bushing on trailer axles	18
Step 6 - Align-boring the center bracket bushing	21
Step 7 - Checking the side-play of the camshaft	25
Step 8 - Installing the dust seals and O-Rings	26
Step 9 - Re-assembly of brake components	29
<b>Section C</b>	
- Recommendations	29
- Lubrication requirements	29
- Micrometer ( reading the dimension scale)	30
- Reamer selection chart 1 1/2" and 1 5/8"	31
- Notes	32
- Tool maintenance	33
- Tooling and shop supplies checklist	34
- Service bulletins	35
- Technical support line	36

## INTRODUCTION

Every year, road safety regulations, specifications and vehicle maintenance practices are reviewed, modified and improved. Although many in the trucking industry disagree on the righteousness of these measures, all agree that these standards will only get tougher in the years to come.

The POLYMAX 2000 " Optimum-Contact " method of repair shown in this manual is intended to help resolve most cam-bushing related problems, regarding heavy vehicle air brakes.

Problems like:

- Excessive brake chamber pushrod travel (when applying brakes).
- Premature and unequal wear of the brake linings.
- Insufficient adjustment of the slack adjusters.
- Road safety inspection compliance problems.
- Premature wear of the cam & bushing assembly.

Following Extensive study of the cause of all these problems, it became clear to us at POLYMAX 2000 that they are all related to excessive side-play of the " S " camshafts in their respective bushings. It became obvious that, due to the exaggerated initial side-play obtained when replacing the cam-bushings, the dust seals cannot perform properly and thus allow contaminants to enter the cam-bushing assembly and contribute largely to its rapid deterioration. Among these contaminants are water, dirt, sand, salt or calcium, and other abrasives. These are collected from the road or from cargo spillage. All these contaminants have different effects on the cam-bushing assembly.

Because of it's higher density, water seeps in the cam-bushing assembly and causes grease to float out of the assembly. That's why we usually find these cam-bushing assemblies to be dry (lube-free) when we lubricate them.

Although water seems to be gone from the assembly when it dries up, it leaves the other contaminants contained in it and they remain in the cam-bushing assembly. This dirt becomes a grinding compound and contributes largely to the wear and tear of the assembly.

The repair method discussed in this manual removes all side-play between the camshaft and it's bushings. This enables the dust seals of this assembly to perform properly, preventing contamination of the assembly and preserving the lubricant in it.

## CONVENTIONAL CAM-BUSHING SYSTEM

A FIT OF .020" TO .050" IS COMMONLY USED

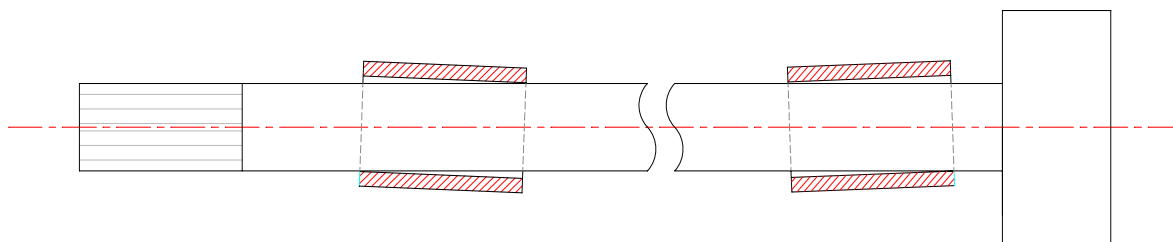


Fig. 1

It is necessary to provide plenty of inside clearance when manufacturing the cam-bushings in order to fit the camshaft regardless of any warping or bad alignment of the center holding plates or the spiders due to loose fabrication tolerances or abuse. (See fig.1 and 2).

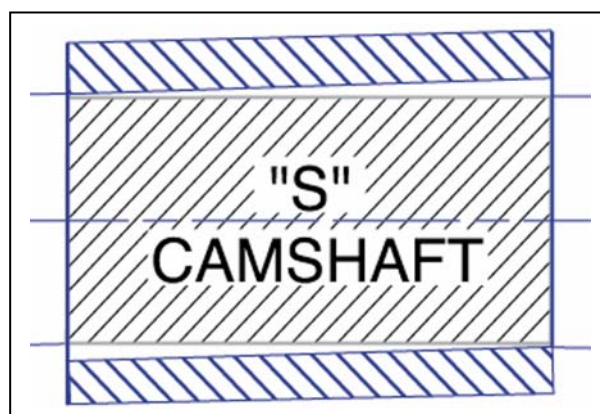


Fig. 2

Therefore, due to this loose clearance, we end up with a side-play of .020" to .050" right at the beginning of the cams service life. Sometimes the side-play seems to be less than .030" but that is only because the cam-bushings are offset in their bores and take up most of the slack in the bushings (see fig. 2). In this case, only the very tip on the side of the bushing is in contact with the shaft reducing play and since all the friction pressure is concentrated in this very narrow spot, the cam-bushing will wear out very quickly until the shaft touches all across the bushing. We rapidly end up with a lot of slack.

### HERE IS WHY THIS CONVENTIONAL METHOD OF REPAIR CAUSES PREMATURE WEAR OF THE CAMSHAFT AND THE BUSHINGS

Ideally, dust seals can only allow a maximum side-play of .004" before they start letting water, dust and other contaminants in the cam-bushings. Water is heavier than petroleum grease and sets at the bottom of the assembly causing the grease to float its way out of the cam-bushings, leaving the abrasives and contaminants working in a grease less environment. This allows both the camshaft and cam-bushings to wear very rapidly. In a very short time, enough side-play is attained to cause many additional problems.

HERE IS A LIST OF PROBLEMS CAUSED BY EXCESSIVE SIDE-PLAY  
OF THE "S" CAMS AS THE CAM-BUSHINGS WEAR OUT:

- The more slack there is, the more water and contaminants get in the cam-bushings.
- Tests have shown that with only .035" play, the automatic slack adjusters' adjustment capacity starts to decrease rapidly.
- Brake chamber pushrod travel gets longer as the slack adjusters react less to their adjustment levers' action.
- Added friction in the cam-bushings reduces available power transmitted to the brakes
- Premature wear of the lower friction lining due to continuous friction in the brake drum after releasing the brakes, a result of the slop in the cam-bushing assembly.
- Damage to the rollers on the brake shoes caused by the percussion in the cam-bushing.
- Overheating of the brake components and the wheel bearings.
- Oil seal failure due to continuous overheats.
- Brake stroke compliance failure during routine and road safety inspections.
- Brake noise
- Rise of maintenance costs.

## " Optimum-Contact " Cam-bushing system

HERE IS HOW WE HAVE SOLVED THE PROBLEM

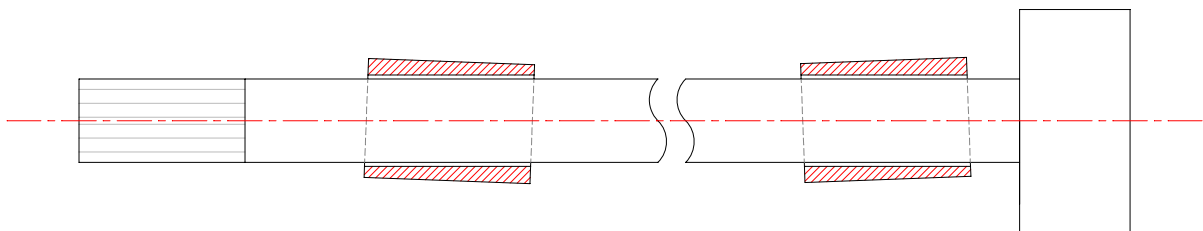
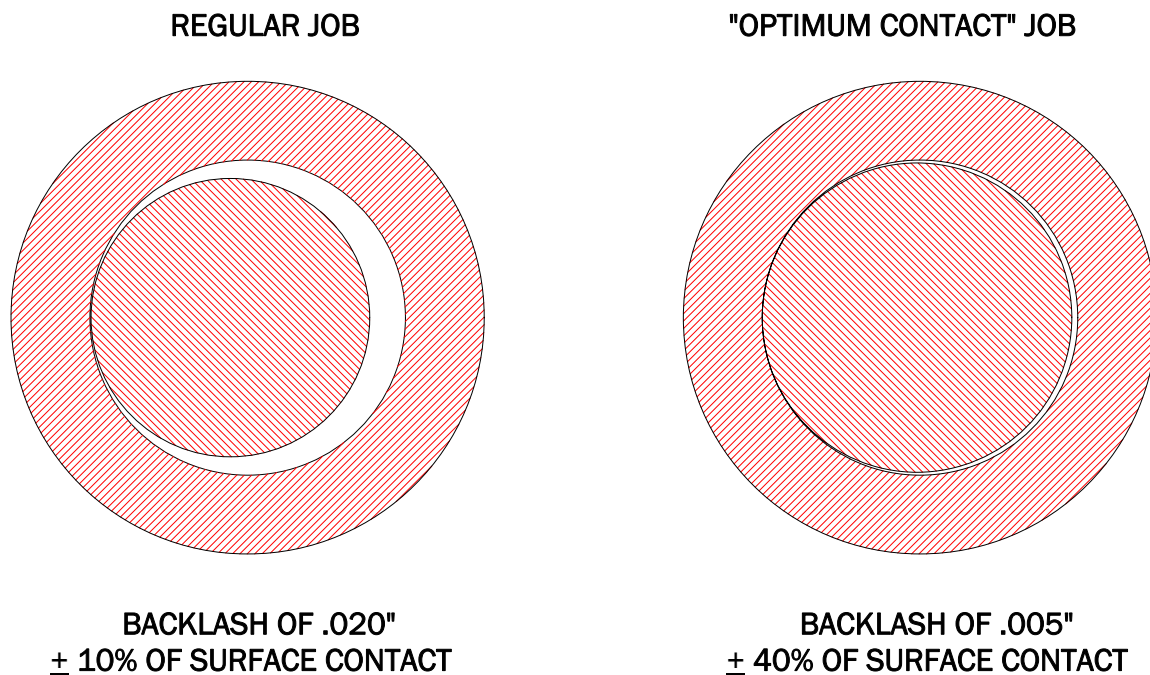


Fig. 3

We have reduced the inside diameter of the cam-bushings, making them smaller than the actual camshaft size. This allows us to align-bore them after they are installed in their respective places. This excess material permits a perfect align-bore between the two cam-bushings enabling us to fit the camshaft with a very tight tolerance. (See fig. 3).

After extensive testing we have come to the conclusion that a .005" clearance is ideal to prevent seizure at very low temperatures and to remove all side-play in the s-cam assembly.

**HERE IS WHAT WE GAIN BY USING SUCH TIGHT  
CLEARANCE IN THE CAM-BUSHING ASSEMBLY**



**Fig. 4**

- Four (4) times more contact surface between the camshaft and bushing.
- Four (4) times more surface to distribute the friction pressure of the camshaft thus dividing the friction pressure by four (4).
- Four (4) times more material to wear out before any slack can be added.
- The grease filling the assembly acts as cushion between the camshaft and bushing and reduces friction in the assembly, and isolates the shaft from the bushing.
- This grease cushion eliminates all side-play of the camshaft in the bushing.
- Once side play is removed, dust seals can perform properly and keep the grease "in" and the contaminants "out" of the cam-bushing assembly.
- Automatic slack adjuster performance is optimized (no play in the cam-bushings).
- Bottom shoe will wear equally to top shoe adding 25% brake life to the brake shoes.
- Complete system runs cooler due to the absence of drag from the shoes.
- **" Optimum-Contact "** bushings are made of a special bronze alloy. This material is 10 times more durable than the nylon actually used on the market.
- **With " Optimum-Contact " the camshafts and bushings will last up to 20 times longer than conventional parts !!!**

# Installation procedure

The following section explains the installation procedure for the “Optimum-Contact” cam-bushing system for **trailer axles only**.

Installation procedures for other types of applications are available in other manuals or service bulletins.

## STEP 1: PREPARATION






# IMPORTANT

At this point we assume that all old brake components have been removed, including cam-bushings and grease fittings. Center support plates and spiders have been properly cleaned and dried off if needed.

**It is very important to keep in mind that you must work in a clean and orderly fashion to ensure the success of this repair.**

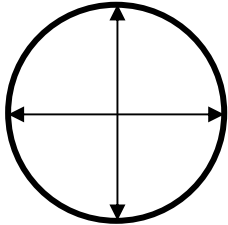
We now have to check the integrity of the cam-bushing bore of the spiders. If there is no damage, we can proceed. If damage is present we must either repair the spider or replace it. A loose cam bushing in the spider will not be tolerable for this method.

The center holding brackets also need to be rust free and properly inspected.

	<p>Clean the spider bracket and remove any rust from the bushing channel. Remove the grease fitting to allow proper cleaning of the grease channel and the bushing channel.</p> <p><a href="#">See SBCO-118 for complete inspection procedures and standard bushing channel dimensions for all makes.</a></p>
	<p>Inspect the brake spider for external damage as well as internal bushing channel integrity. Any damage in the bushing channel is unacceptable for this type of repair. If there is any damage you must rebuild the unit or replace it.</p> <p><b>For an easy rebuilding procedure use the SPIDER + system</b> <a href="#">Contact us on the tech support line 1-877-765-9629</a></p>
	<p>All rust must be removed from each side of the center support brackets. Using a 4-1/2" inch hard disk grinder, remove the rust from the center brackets.</p>
	<p>Visually inspect the center brackets for cracks or defects. Replace if necessary.</p>
	<p>Apply primer and paint for better protection against rust over the years. Provide enough time for drying before reassembly. You may want to apply primer and paint to all other steel part that need rust protection. Remember this job is intended to last many years to come.</p>

## Measurements for cam-bushing channels

Size of camshafts used on axles	Dimensions of bushing channels
1-1/2" inch diameter	1.875" +/- .001"
1-5/8" inch diameter + Old Intraax 1-1/2"	2.000" +/- .001"



Be sure to take measurements both horizontally and vertically when checking bushing channels integrity.

Figure 4.1

### STEP 2: BUSHING INSTALLATION

" **OPTIMUM-CONTACT** " bushings need to be installed in their respective places using the necessary tools supplied with the system. A puller set is used to press the spider bushings in place for certain models.

**Spider bracket thickness will vary with each different axle model and make.**

There are three sizes of puller plungers to accommodate bushing installation for most popular models of 1-1/2" cams and another three for 1-5/8" cams. Here is a brief description of the six models supplied with the BDK-200 puller kit.

### Bushing installation tool description

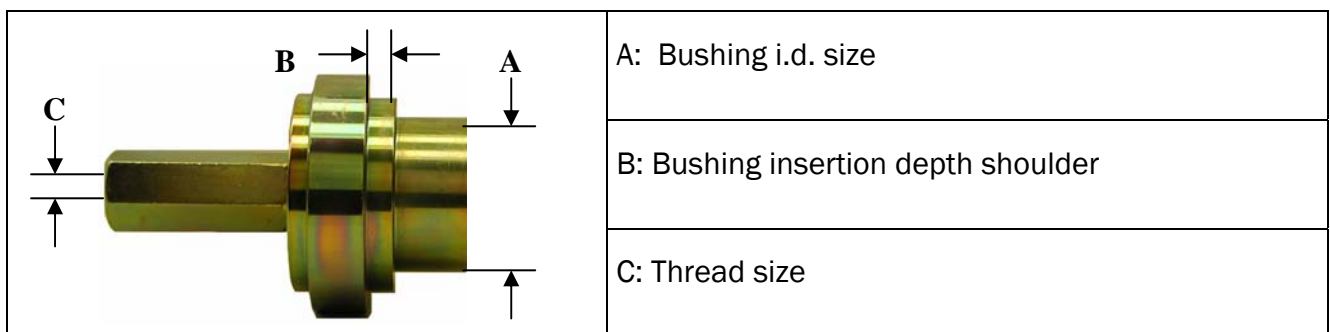


Fig.5

Tool part #	Dimension A	Dimension B	Dimension C	In kit
RT-1500-250	1-1/2"	1/4"	5/8" X 11 UNC	1
RT-1500-313	1-1/2"	5/16"	5/8" X 11 UNC	1
RT-1500-375	1-1/2"	3/8"	5/8" X 11 UNC	1
RT-1500-570	1-1/2"	9/16"	5/8" X 11 UNC	Special order
RT-1625-188	1-5/8"	3/16"	5/8" X 11 UNC	1
RT-1625-250	1-5/8"	1/4"	5/8" X 11 UNC	1
RT-1625-313	1-5/8"	5/16"	5/8" X 11 UNC	1
RT-1500-250	1-1/2"	1/4"	Acme threads	Special order
RT-1500-313	1-1/2"	5/16"	Acme threads	Special order
RT-1500-375	1-1/2"	3/8"	Acme threads	Special order
RT-1625-188	1-5/8"	3/16"	Acme threads	Special order
RT-1625-250	1-5/8"	1/4"	Acme threads	Special order
RT-1625-313	1-5/8"	5/16"	Acme threads	Special order

Fig.5a

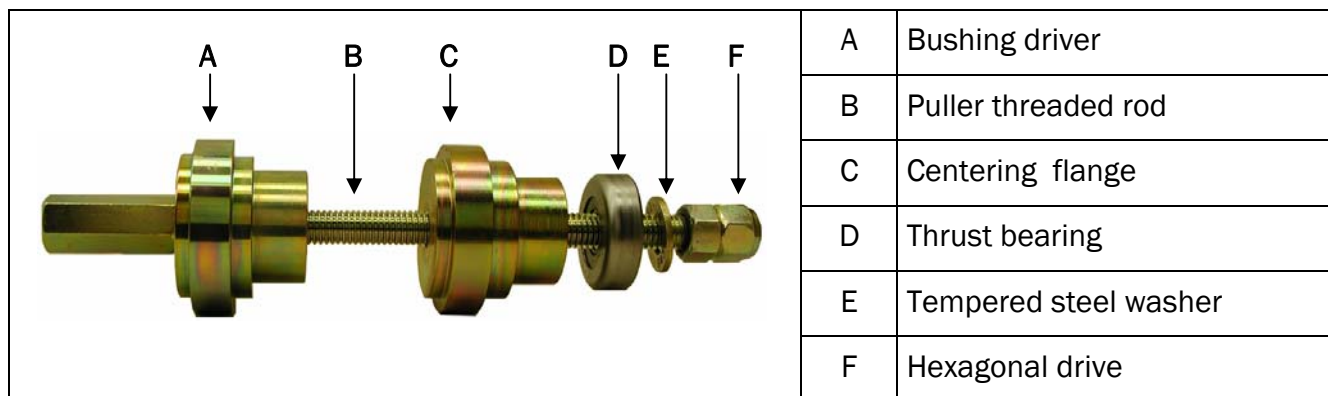

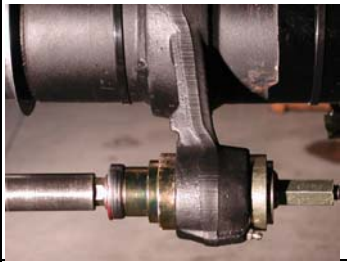





Fig.6

Take the following steps to install the spider cam bushings in their respective places.  
**N.B. the pullers used in this procedure require proper maintenance like periodical cleaning and recommended lubrication intervals (see tool maintenance on p.34 ).**

### Step-by-step installation of the spider bushing

	<p><b>2a:</b> Using a 6" precision caliper, measure the thickness of the spider bracket at the bushing channel. Choose the correct bushing driver according to this formula; <b>Spider thickness - bushing length / 2</b> Ex: thickness 2.00" - Bushing length 1.500" = .500 / 2 = .250" you will need the bushing driver with .250" (1/4") shoulder. Refer to fig. 5 and 5a on page 10, to select proper installation flange.</p>
	<p><b>2b:</b> Using a marker, make a recognition mark on the side of the bushing to indicate grease hole location in the bushing. This will facilitate grease hole alignment when installing the bushing in the spider.</p>
	<p><b>2c:</b> Select the appropriate bushing driver according to formula explained above in step 2a, or start by the bushing driver with the smallest shoulder thickness. Insert bushing onto the driver.</p>
	<p><b>2d:</b> Apply the bushing on either side of the spider-bushing channel with the bushing driver. Look inside the channel to align the grease hole to the lube channel.</p>

	<p><b>2e:</b> Insert the puller's threaded rod through the centering flange and then through the spider bushing channel and finally into the bushing driver's threaded hole. Apply the centering face of the flange onto the spider's bushing channel and rotate the puller's threaded rod clockwise until it's thrust bearing flattens out on the centering flange. Refer to fig. 6 on page 10, for correct assembled view of installation puller.</p>
	<p><b>2f:</b> Using a 1/2" square drive impact driver wrench along with a 6 point hexagonal 3/4" impact socket, drive the 3/4" hexagonal drive of the puller's threaded rod clockwise until the bushing driver flattens out on the spider bracket.</p>
	<p><b>2g:</b> Remove puller from the spider assembly.</p>
	<p><b>2h:</b> Verify the result of the installation for proper grease hole alignment and good centering of the bushing inside the channel. If all is O.K. the installation procedure of the spider bushing is complete. If bushing is not properly centered, go to next step 2i.</p>
	<p><b>2i:</b> Select proper bushing driver in order to drive the bushing toward the center of the spider-bushing channel.</p>
	<p><b>2j:</b> Repeat steps 2d through 2h until proper centering of the bushing is achieved.</p>

## Installation of the spider bushing is complete.

Repeat steps of the above procedure until all spider bushings are in place, and then proceed to install all grease fittings.


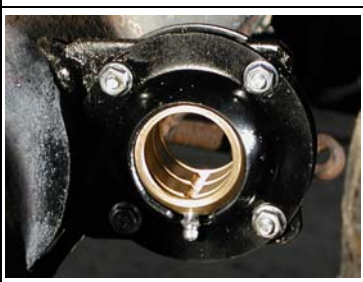



**Check all bushings for proper centering and grease hole alignment.**






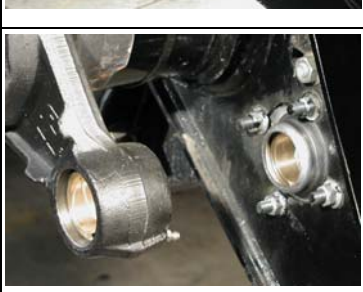
Correct any defect in installation before moving to step 2k on the next page.

## Installing the center bracket cam-bushing

Trailer axles are often equipped with spherical bushings at the splined end of the camshafts, near the slack adjusters. These spherical bushings can pivot in their holding plates, and so, need to be properly aligned with the spider bushing before they can be permanently secured in their holding brackets.





### Step-by-step installation of the center bracket bushing

	<p><b>2k:</b> Make sure all parts are primed and painted. Gather all the necessary bolts and brackets to install all center cam bushings on all wheels. Gather all necessary tooling as well.</p>
	<p><b>2l:</b> Align the mounting plates and the brackets as well as the other devices required, insert the bolts while holding the center cam bushing in place between the mounting plates.</p>
	<p><b>2m:</b> Hand tighten all bolts.</p>
	<p><b>2n:</b> Insert alignment sleeve (tool# BAC-1500) into the center bushing.</p>
	<p><b>2o:</b> Assemble sliding cone (tool# CO-1500) onto the pre-selected pilot shaft. The pilot shaft should be selected to be of equal length to the cam or longer.</p>

	<p><b>2p:</b> Insert pilot through the spider bushing and continue forward until insertion through the alignment sleeve is complete. Then drive the sliding cone forward on the pilot until it centers itself out in the spider bushing. Always position the sliding cone from the outside of the spider, pointing to the inside.</p>
	 <p><b>2q:</b> Verify the alignment of the center bushing by making sure that both the alignment sleeve and the sliding cone are well positioned in their respective places.</p>
	<p><b>2r:</b> Tighten all mounting plates bolts to specified torque. Alignment is correct when the sleeve ( tool # BAC-1500) can slide freely in the center bushing, while the cone is well centered in the spider bushing. If the sleeve cannot move freely through the center bushing, some distortion has occurred while tightening the bolts. The next step (2s) explains how to relieve distortion from the mounting plates.</p>
	<p><b>2s:</b> Using a 2-pound plastic hammer, hit the centering sleeve in order to vibrate the assembly to relieve any distortion from the mounting plates. <b>HIT THE BRACKET IF NECESSARY.</b> REMEMBER- Alignment is correct when the sleeve ( tool # BAC-1500) can slide freely in the center bushing, while the cone is well centered in the spider bushing. <b>KEEP TRYING UNTIL YOU FIND THE RIGHT SPOT TO HIT THE SLEEVE IN ORDER TO RELIEVE THE DISTORTION.</b></p>
	<p><b>2t:</b> Remove all alignment tools</p>
	<p><b>2u:</b> Center bushing installation is complete.</p>
	<p><b>2v:</b> Repeat complete procedure for all wheels.</p>

**Special note:** Some bushing models require special installation.

Here are some special installation specifics:

	PM 1625-FRU-A	This model is only used in Fruehauf axles. This two-piece bushing is pressed in the spider bushing channel with the bushing driver # RT 1625-188 and the puller alignment flange # RA 1625, both inserts are installed at once. This bushing has a special ridge to install the dust seal in each insert. <b>See service bulletin # SBCO-106.</b>
	PM 1932-ST	This model is installed in the same way the PM 2500-Z, although using a different alignment sleeve (tool # BAC 1932). This bushing is already cut to final size, it requires no align boring. <b>See service bulletin # SBCO-107.</b>
	PM 2125-P	This model is very popular and is used on many types of trailer axles. It is shipped as 3 components attached with wire ties. Proper installation requires the application of a light coat of "RTV silicone" on the inner faces of the mounting plates. <b>See service bulletin # SBCO-103.</b>
	PM 4158	This model is bolted onto the spider bracket by 4 fasteners and therefore doesn't require the use of any puller to press it into place.

Service bulletins are made available to all POLYMAX 2000 industries customers upon request and are sent with each bushing ordered when the bulletins are relatively new. Also, this training manual has been updated with all previous and the latest service bulletins (located at the end of this manual). The perforated features of this manual allow you to add new service bulletins to your personal manual so it is always updated.

**Special note :** Steps 2a through 2v describe the installation procedure for trailer axles only. For information on bushing installation on drive axles please refer to the appropriate service bulletin at the end of this manual.

**Special note :** Steps 2a through 2v describe the installation procedure for normal highway duty applications of trailer axles. For heavy duty, off-road, mining and forestry applications of trailer axles please refer to the appropriate service bulletin at the end of this manual.

## important

**Special note:** All bushings must be greased to prevent contaminating the lube pathways with metal debris produced while cutting the bushing.





## **STEP 3: MEASURING THE CAMSHAFTS**

Every camshaft used in this method of repair must be measured precisely for its diameter at the bearing journals, and each marked with its own measurements. This will allow us to select the proper cutting tool to fit each camshaft perfectly into its respective cam-bushings. It is also very important that each be attributed to one set of wheels (it will help recognize which cam goes where if their sizes are different). Please note that quality camshafts have little variation in size and so , the same reamer is usually used throughout the job.

The required clearance between camshafts and bushings is **.004" to .006"** (thousandth of an inch).

For reamer selection charts refer to page 31 of this manual.

### **Step-by-step measurement of the camshafts**

	<p>3a: Clean and inspect camshafts visually for any apparent defects. One can use a degreaser or brake parts cleaner and a clean rag to achieve good results. In some cases one might need to blow dry, using compressed air.</p>
	<p>3b: Clean and inspect your digital micrometer, and calibrate it if necessary.</p>
	<p>3c: Using your digital micrometer, measure both bearing journals of the camshaft. During each journal measurement, rotate the cam 90 degrees to check for variations in size. Take the greater measurement of the two for each journal.</p>
	<p>3d: Using an ink marker, write the corresponding measurements of each journal on the camshaft. If both journals are of the same size, write only one measurement (e.g. if both journals are 1.492").</p>

## STEP 4: Cutter selection according to cam size

Please refer to the cutter selection chart on page 31 of this manual. This chart was designed to help you select the right cutter for each job.

Once the cutter is selected, the align-boring procedure begins

### DESCRIPTION OF ALIGN-BORING TOOL COMPONENTS




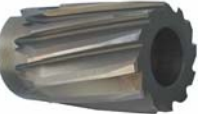
	Item A	Arbor
	Item B	Pilot shaft
	Item C	Sliding cone
	Item D	Reamer (cutter)

Fig.7

### ASSEMBLED VIEW OF THE COMPONENTS

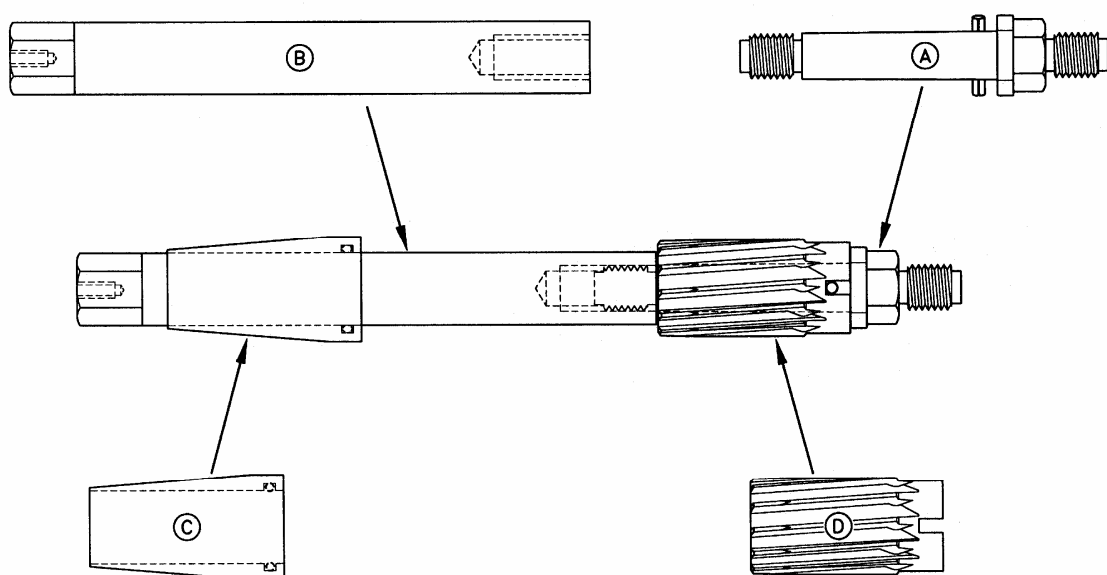






Fig.8

## **STEP 5: ALIGN-BORING THE SPIDER BUSHING ON TRAILER AXLES**

### **Assembling the tool to cut the spider bushing**

Make sure that all components are perfectly clean. The presence of metal particles or dirt can cause a misalignment of the reamer and may result in a tapered cut of the bushings. Also any dirt or metal particles in the bore of the shell reamer may result in breaking the shell reamer as it is tightened onto the arbor.

	<p>Insert the shell reamer (D) you have selected according to shaft size onto the arbor (A) and slide it on the tapered shank of the arbor toward the drive pin. Apply pressure to engage the reamer's slot onto the drive pin to assemble both components snugly together.</p>
	<p>Then screw the arbor (A) into threaded hole of the pilot shaft (B) and rotate the arbor clockwise until the frontal face of the reamer is fully seated on the corresponding face of the pilot shaft.</p>
	<p>Using two (2) 1" combined wrenches tighten this assembly to 10-15 ft. lbs. Torque. Refer to fig.8 for assembled view of tool.</p>
	<p>Apply light oil or grease to the o-ring inside the sliding cone (C).</p>

### **The tool is now ready to cut the spider bushing.**

Align-boring of the spider bushing begins by entering the pilot shaft of the tool through the spider bushing and sliding the cone onto the pilot pointing forward. Now, slide both into the inner bushing, centering the pilot in it as the whole tool assembly is forced forward through both bushings until the reamer is fully seated in the spider bushing. The reamer centers automatically as it enters the bushing (see fig. 9 on page 19). A firm thrust forward along with a slow clockwise rotation is needed to align-bore the bushing.

The technician must make sure that the sliding cone remains snugly applied to the bushing at all times during these operations, if not, the centering of the pilot will be compromised.

## DRIVING THE ALIGN-BORING TOOL :- Recommended tool configuration

We recommend the use of an 18-inch ratchet wrench with 1/2" square drive along with a 12-inch extension, at the end of which a universal joint is most important, and a 1" inch deep socket.

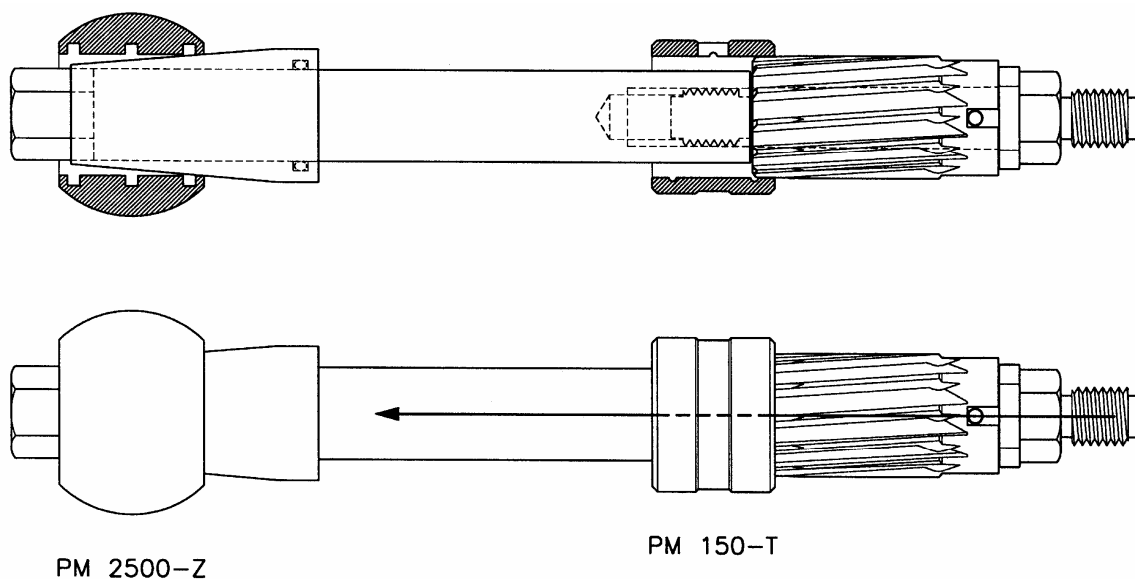


Fig.9

Apply a firm forward thrust to the wrench and start rotating the tool clockwise, while keeping the extension and wrench as well aligned as possible with the align-boring tool. Continue this motion until align-bore is completed, then remove the tool. Using compressed air clean the align-bored bushing and its grease hole. Clean all debris from the tool.

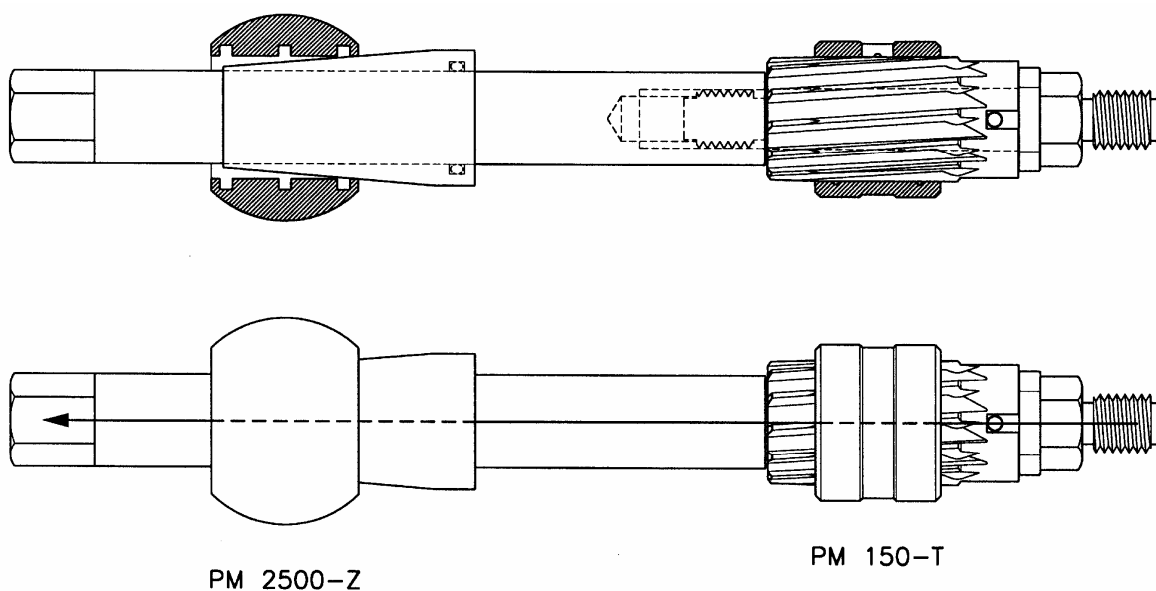









Fig. 10

For a better description of this process please refer to the next page for a step-by-step guide.

## Step-by-step align-boring of the spider bushing on trailer axles.

	<p>5a: Grease all bushings and remove all excess lube from the bushings' inner bores.</p>
	<p>5b: Insert pilot shaft of the tool through the spider bushing.</p>
	<p>5c: Slide cone onto the pilot shaft pointing it forward and stop as it clears the tip of the pilot shaft.</p>
	<p>5d: Insert the front part of the tool into the inner bushing until the cone is fully seated inside the bushing.</p>
	<p>5e: Apply forward thrust on the hexagonal drive of the tool to move it forward until the reamer is fully seated into the spider bushing.</p>
	<p>5f: Using the appropriate wrench (described earlier on page 18), apply firm forward thrust and slow clockwise rotation on the tool until the cut is completed.</p>
	<p>5g: Remove tool.</p>

**Important:** If you must back out the tool through the bushing you have just cut, **DO NOT** rotate tool counterclockwise. Rotate tool clockwise while backing out slowly and making sure that the sliding cone remains seated in the inner bushing during extraction.

**Common sense:** It is more efficient to cut all spider bushings first and then cut all inner bushings after, because a lot of time can be wasted on flipping the cutter from forward to rear position at each wheel.

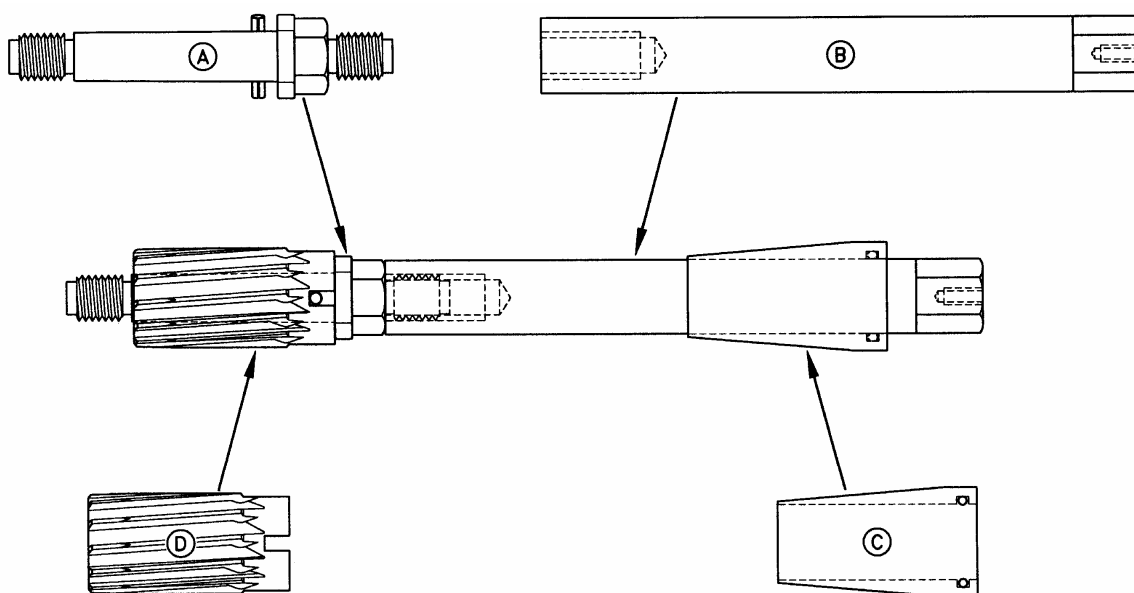
After all spider bushings are cut, it becomes necessary to clean all debris from the bushings.

## **STEP 6: ALIGN-BORING THE CENTER BRACKET BUSHING ON TRAILER AXLES**

### **Assembling the tool to cut the center bracket bushing**

Make sure that all components are perfectly clean. The presence of metal particles or dirt can cause a misalignment of the reamer and may result in a tapered cut of the bushings. Also any dirt or metal particles in the shell reamer may result in breaking the shell reamer as it is tightened onto the arbor.

Invert the arbor in the pilot shaft to proceed to the next step. This is done by unscrewing the arbor from the pilot, and screwing it back in by the other threaded end. See fig.11.











**Fig. 11**

If you are using the same cutter for the center bracket bushings and the spider bushings, just reverse the arbor in the pilot shaft and re-torque to 10-15 Ft.lbs, and proceed to pages 24 to 26. See fig. 11.

If you need to cut some of the bushings with a different cutter refer to the instructions on page 22 to change the cutter as often as needed.

## Step-by-step reversing of the cutter and changing the cutter if needed.

	<p>Step 1: Unscrew and remove the arbor (A) from the pilot shaft (B).</p> <p>If you are cutting the center bracket bushing to the same size as the spider bushing, go directly to step 7.</p> <p>If you are cutting to a different size follow all of the next steps.</p>
	<p>Step 2: Remove the cutter (D) from the arbor (A) by inserting the arbor loosely into a vise with the back of the cutter lying against the top the jaws of the vise, and with the forward stem of the arbor pointing upward.</p>
	<p>Step 3: Using a center punch and a 2 lbs hammer, Knock down the arbor through the cutter. To avoid any damage to the arbor and cutter insert the pointy edge of the center punch into the center point machined at the forward tip of the arbor. Hit with the hammer gently until arbor slides out from the cutter.</p>
	<p>Step 4: assemble new cutter onto arbor. Refer to page 18 for procedure.</p>
	<p>Step 5: Screw the forward threaded stem of the arbor (A) into pilot shaft (B) and torque to 10-15 ft. lbs. This operation will install the reamer onto the arbor before reversing the arbor's position.</p>
	<p>Step 6: Unscrew and remove the arbor from the pilot shaft.</p>
	<p>Step 7: Reverse the arbor and screw its back end threaded stem back into the pilot shaft.</p>
	<p>Step 8: Torque to 10-15 ft. lbs.</p>

## The tool is now ready to cut the center bracket bushing.

Align-boring of the center bracket bushing begins by inserting the pilot shaft through the back of the spider bushing and slide the cone onto the pilot and into the outer bushing, centering the pilot in the bushing. Then insert the edge of the reamer in the inner bushing and begin cutting the bushing by driving the tool by the hexagonal drive at the end of the pilot shaft. Apply the same motion as you did while Align-boring the first bushing.

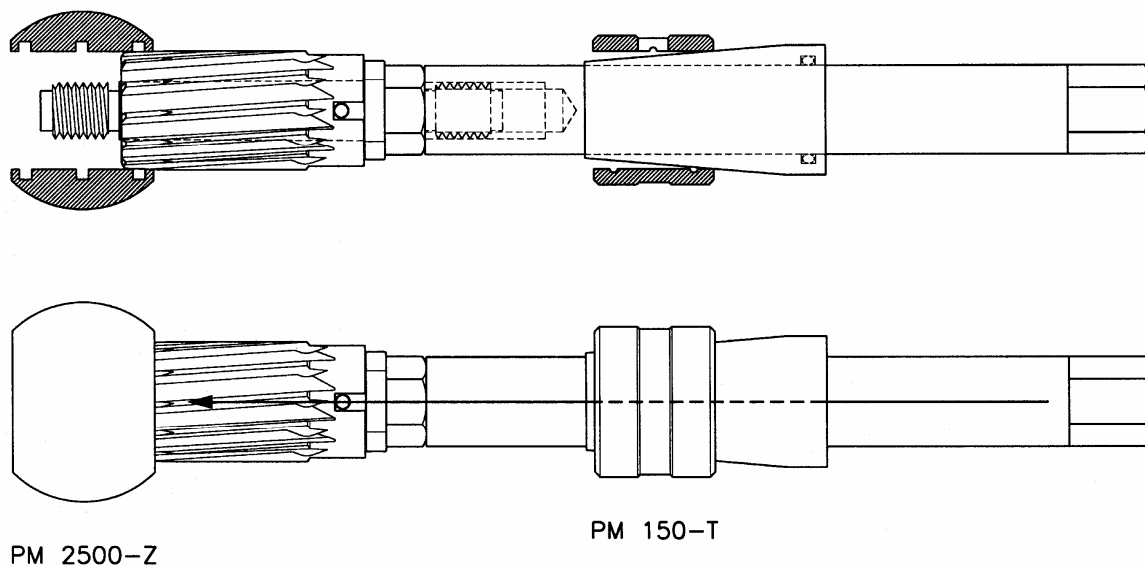


Fig. 12

The sliding cone must remain snugly applied to the bushing at all times during these operations, if not, the centering of the pilot will be compromised.

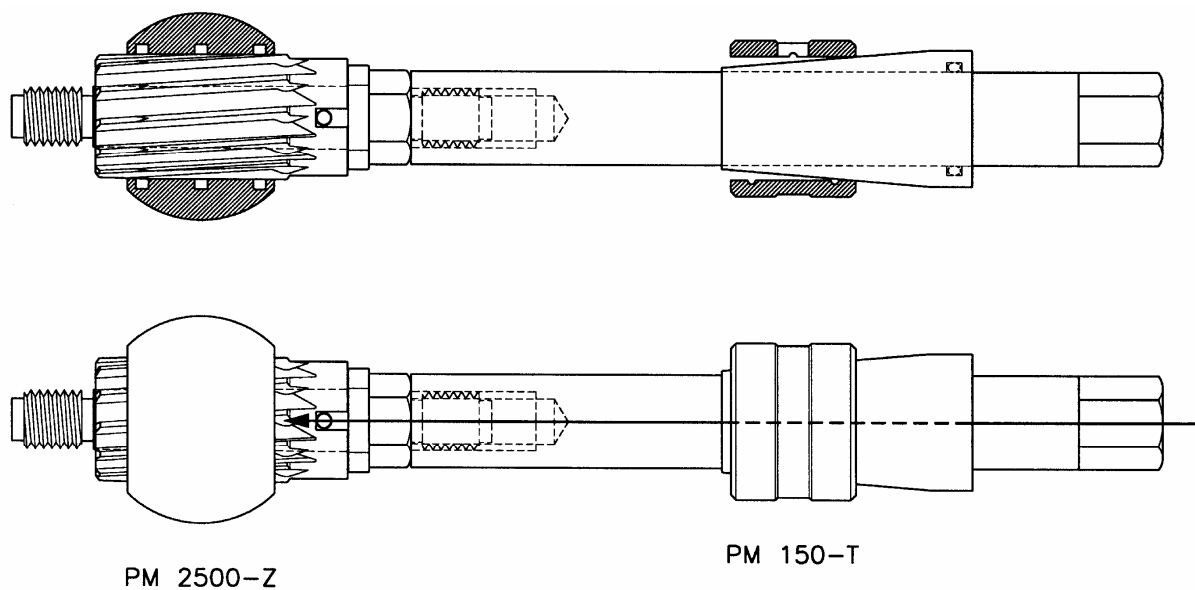



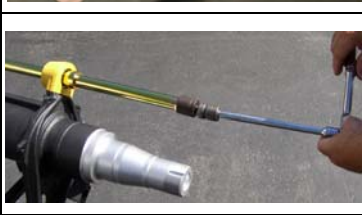



Fig. 13

Continue this motion until the align-bore is completed see fig. 13, then remove the tool. Using compressed air, clean the bushing from all metal deposits, and clean the tool.

Here is the step-by-step procedure to align-bore the center bracket bushing.

	<p>Step 6a: Insert pilot shaft through the back of the spider bushing and drive a good portion of it through (at least 10 inches).</p>
	<p>Step 6b: Assemble the sliding cone onto the pilot shaft and push it forward to get it as close as possible to the spider bushing.</p>
	<p>Step 6c: Take the tool by the pilot shaft and driver it forward until the cone is well seated in the spider bushing, and then continue pushing forward until the tapered end of the cutter sits in the center bracket bushing, perfectly centered. See fig. 12.</p>
	<p>Step 6d: Using the same wrench as before, apply affirm forward thrust and turn the tool clockwise slowly. Keep going slowly until bushing is completely reamed. See fig. 13</p>
	<p>Step 6e: Remove cone from pilot shaft and keep moving tool forward until you can remove tool completely.</p>

In order to save time, we suggest you position all bushings in their respective places, and then proceed with Align-boring all the outer (spider) bushings at first, then reverse the cutting tool and proceed to align-bore all inner center bracket bushings. You will save the time needed to reverse the cutter every time you align-bore an outer bushing then an inner bushing etc. If you encounter a camshaft of a different size than the others, align-bore the other bushings first and keep this one for last.

**It is very important that all debris be removed from the bushings and that they be kept clean. Pump a small amount of grease in the cam-bushings to expel the metal debris left there from the align-boring procedure. Camshafts must also be clean. Any dirt or contamination will reduce durability.**

## **STEP 7: CHECKING THE SIDE-PLAY OF THE CAMSHAFT**

Insert a shim plate or spacer at the "S" end of the camshaft. Install the camshaft on the axle **without any lubricant on either cams or bushings** to be able to measure real slack of the cam-bushing assembly. **Make sure this is done while seals and O-rings are NOT installed.** Take extra care to handle the installation of the camshaft delicately to prevent damaging the inner bore of the bushings.

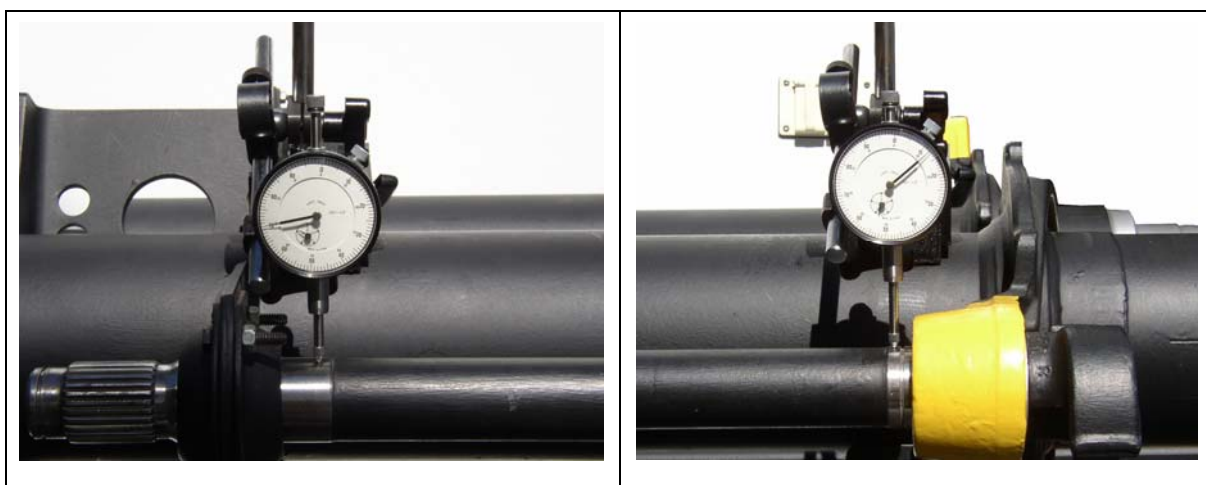
Once the cam is in place, check for proper seating of the spacer on the spider and then spin the cam rapidly by hand. **Make sure that the cam spins freely through both bushings.** If the camshaft does not spin freely double-check for cleanliness.

If the camshaft is bent or distorted, it may be hard to spin it freely.

If the camshaft is hard to insert through the inner bracket bushing, do not force it in because it may be bent or distorted. Try another cam of the same o.d. measurement and compare the fit.

We recommend that you verify the precision of your work, especially the first few jobs !

**This procedure must be performed while O-rings and dust seals are not yet installed and without grease.**



**Fig. 14**

**Using a magnetic based dial indicator gauge,** measure the side-play of the camshaft inside the cam-bushings. See fig.14

The reading you will get will differ from the clearance you initially fitted the bushing with. This is normal, since no hole can be perfectly round and no camshaft can be perfectly round either.

This needs to be done before o-rings and seal installation or this will take up some of the slack.

A reading slightly inferior to the clearance you gave the assembly is to be expected.

**FOR EXAMPLE :**

- If the camshaft measures 1.492", and you selected the 1.497" reamer to cut the corresponding bushing, this will fit the camshaft with .005" clearance inside that bushing.
- Once you have measured the side-play with the dial gauge, you will see that the reading obtained is approximately .003" to .004".
- It is very rare to have .005" or .006" side play.
- If you get a reading higher than that of the clearance you fitted the bushing with, then you probably misplaced a camshaft and some other assembly will be too tight.
- If the assembly is too loose or too tight, restart align-boring procedure as needed to correct the situation until you set the right results.

The point in this double-check is to avoid giving too much clearance to an assembly, because this will allow dirt and contaminants to enter the cam-bushing assembly and waste the efforts we just made. If the assembly is too tight, the lack of space for lubricant will cause it to grip (seize-up).

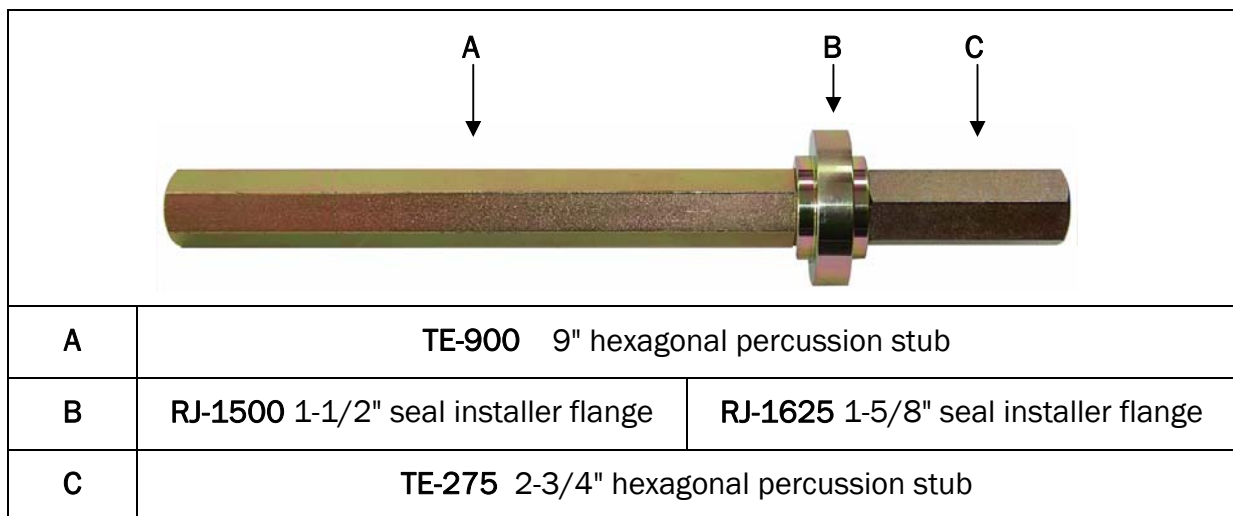
**If the assembly is too tight or too loose, it is more cost-efficient to start over now, as you won't need to remove all the wheels and brakes to repair that mistake.**

We would like to remind you that the success of our method lies in the tight fit we give to the cam-bushing assembly. Clearance must remain between .004" and .006" to ensure that success.

**Step 8: Installation of the seals and the O-Rings**

Seals and O-Rings are installed the same way they are regularly installed in a normal procedure. The one difference being that the "OPTIMUM-CONTACT" system comes with a special seal installing tool that will enable the technician to install these ordinarily "hard to install" seals in a snap, every time.

**Seal installer tool description**



**Fig. 15**

# Spider dust seal installation

Install the spider dust seals in a way that they will allow grease to purge easily from the cam-bushing assembly.

The outer seal must be installed with its sealing lip pointing toward the cam-bushing (**positive installation**), in order to keep the grease from entering the brake shoes and drum assembly, during lubrication, thus contaminating the brake shoes and drum.

The inner seal must be installed with its sealing lip pointing outward from the cam-bushing (**negative installation**), in order to let the grease escape from the cam-bushing assembly during lubrication.

Figure 16 shows proper seal installation.

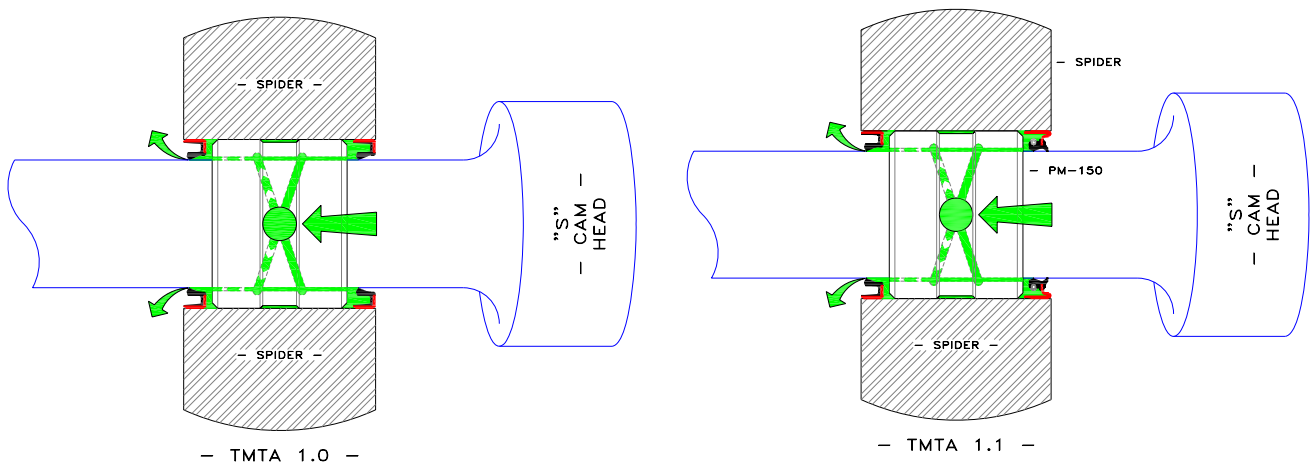


Fig. 16

Single lip seal design

Double lip seal design

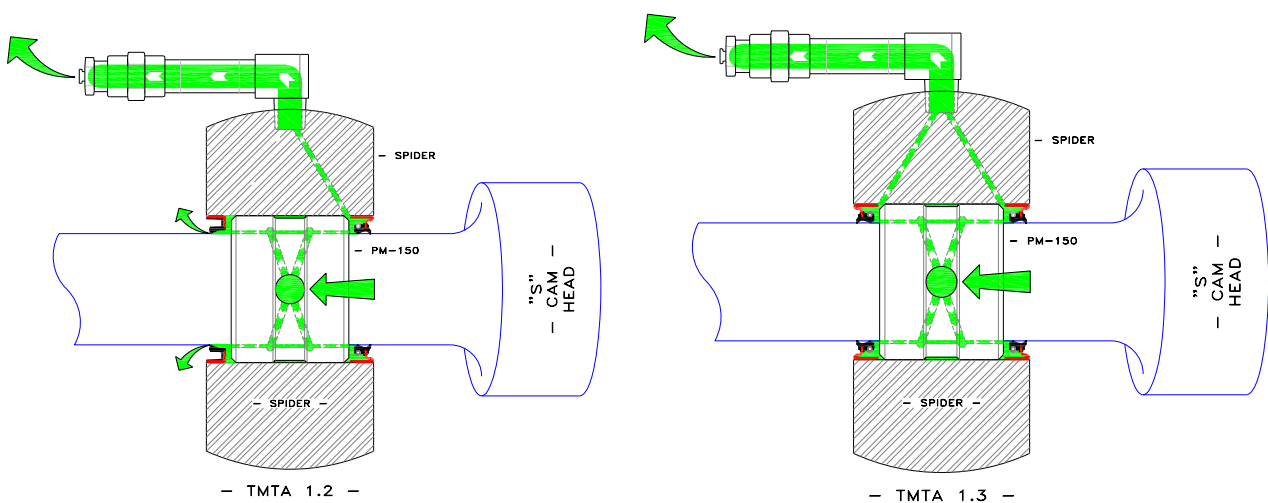


Fig 16.1






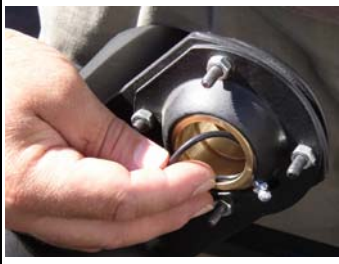
Heavy-Duty highway use

Heavy-Duty Off road use

For Heavy-Duty applications see service bulletin # SBOC-104 for complete procedures.

## Step-by step installation of the seals and O-Rings

Make sure that the spider is free of metal debris and other dirt.

	<p>Step 1: Insert the dust seal onto the 2-3/4" stub side of the installer flange making sure that the seal's lip is pointing outward (toward the 2-3/4" stub). Refer to fig.15 for tool description.</p>
	<p>Step 2: Insert the dust seal onto the other side of the installer flange making sure that the seal's lip is pointing inward on the flange (same direction as the other seal, toward the 2-3/4" stub).</p>
	<p>Step 3: Insert the seal installer tool's short stub through the outer face of the spider to apply the seal evenly on the bushing channel, and then tap the seal in with a small hammer using the edge of the long extension to hold and drive the tool. Drive the seal in until the wide face the installer flange flattens evenly on the spider. Back out the tool.</p>
	<p>Step 4: insert the long extension of the tool through the back side of the spider channel and apply the seal evenly on the bushing channel, then hold the tool in position by the long extension, tap the short stub with the hammer to drive the seal in position while holding the tool by the long extension. Remove tool once the seal installation is completed.</p>
	<p>Step 5: Check for proper installation of inner and outer seals. <b>Make sure that the outer seal is installed with the lip pointing toward the cam-bushing, and that it does not touch the bushing. Make sure that the inner seal lip is pointing away from the cam-bushing and that the outer shell of the seal is pushed all the way in.</b></p>
	<p>Step 6: Check for cleanliness of the whole assembly and apply a thin coating of good quality grease to all parts.</p>
	<p>Step 7: insert the O-rings in both grooves of the PM-2500-Z bushing and coat inner bore and O-rings with good quality grease. <b>Refer to service bulletin # SBOC-111.1 at the end of this training manual, for proper procedure.</b></p> <p><b>For heavy-Duty applications see service bulletins:</b>      PM 2500-Z = SBOC-105      PM 2380 = SBOC-109</p>

Installation of the "Optimum-contact" cam-bushing system is complete.

### Step 9: Re- assembly of brake components.

Re-assemble the camshaft and all other brake components **EXCEPT FOR THE SLACK ADJUSTERS** according the normal procedure and specifications of the axle manufacturer. **Refer to service bulletin # SBOC-113 for slack adjuster installation procedure.**

Lubricate the cam-bushing assembly thoroughly and wipe any excess lube. Install a CP-5-100 cap plug on each grease fitting after lubricating, to protect from damage and dirt.

## **RECOMMENDATIONS**

We recommend the use of a thread-locking agent to seal the splines of the camshaft and the slack adjuster to prevent the infiltration of contaminants in the splines. This could lead to early wear of the splines and cause the brake stroke to extend. **PLEASE REFER TO SERVICE BULLETIN # SBOC-113 FOR PROPER PROCEDURE IN THIS MATTER.**

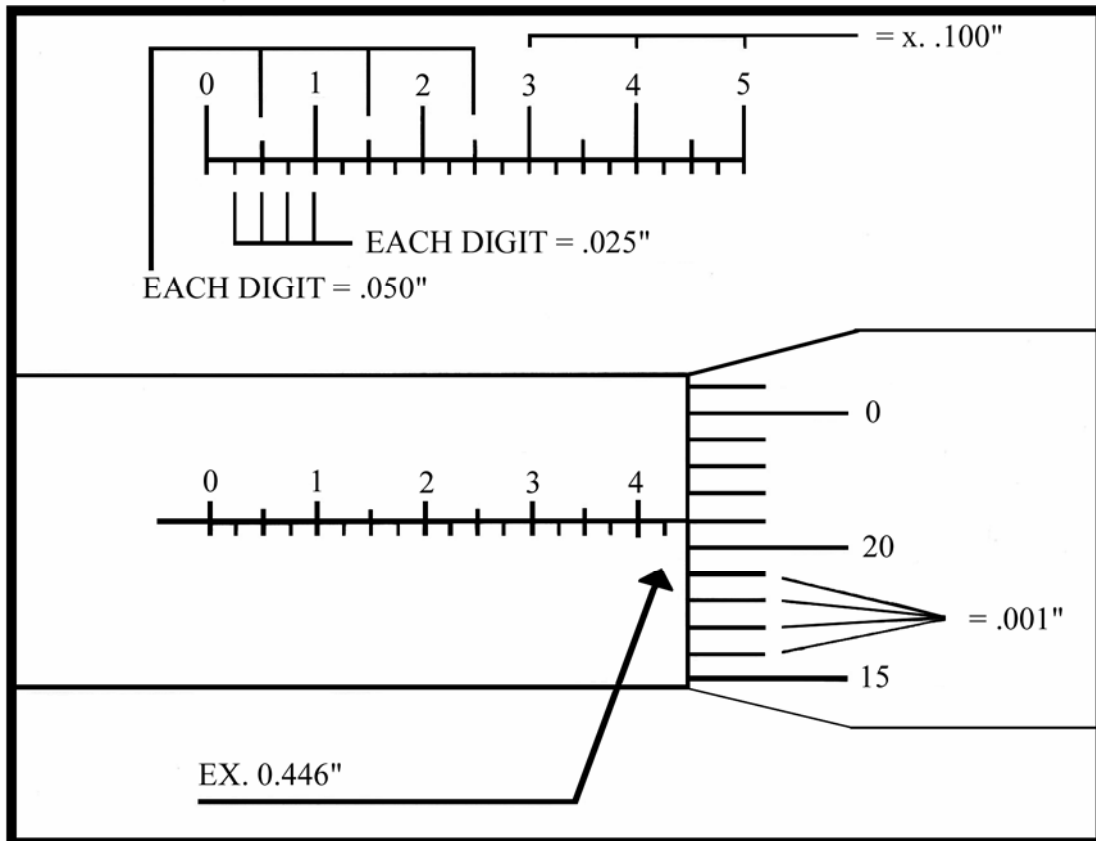
It is important to ensure the cleanliness of the grease fittings when lubricating the cam-bushing assemblies (any dirt or contaminants inserted in the assembly will contribute to reduce their durability. The tip of your grease gun coupler also needs to be clean to prevent introduction of contaminants in the cam-bushing assemblies.

### **Lubrication requirements:**

We recommend that all "Optimum-Contact" cam-bushings be greased at least once per 120 days for normal high way use. For city and heavy high way use; at least once per 90 days.

For off-road use and other severe applications; at least once every 2 weeks.

## Reading a micrometer



**This micrometer readout scale is precise to 1 thousandth of an inch**

## REAMER SELECTION CHART

### FOR 1 ½" CAMSHAFT JOURNALS

For shaft 1.488 }	
For shaft 1.489 }	Use 1.494 reamer (supplied in tool kit)
For shaft 1.490 }	
For shaft 1.491 }	
For shaft 1.492 }	Use 1.497 reamer (supplied in tool kit)
For shaft 1.493 }	
For shaft 1.494 }	
For shaft 1.495 }	Use 1.500 reamer (supplied in tool kit)
For shaft 1.496 }	
For shaft 1.497 }	
For shaft 1.498 }	Use 1.503 reamer (optional)
For shaft 1.499 }	

### FOR 1 5/8" CAMSHAFT JOURNALS

For shaft 1.613 }	
For shaft 1.614 }	Use 1.619 Reamer (optional )
For shaft 1.615 }	
For shaft 1.616 }	
For shaft 1.617 }	Use 1.622 Reamer (supplied in tool kit)
For shaft 1.618 }	
For shaft 1.619 }	
For shaft 1.620 }	Use 1.625 Reamer (supplied in tool kit)
For shaft 1.621 }	

Cleanliness is essential to precise measurement. Please make sure that the parts you are measuring and your measuring tools are free of dirt or any other contaminants.



## Tool maintenance

### Pullers:

Must be kept clean by avoiding the threaded rod and the other components to touch dirty surfaces. If contact with dirt and contaminants is inevitable, clean the tools as soon as possible.

Keep bearings and threaded rods well lubricated at all times

If you notice that tools run excessively hot, check for proper lubrication. Cool down the tools with water if necessary.

### Boring tools:

All cutters (reamers) must never come in contact with any abrasive substance and have to be kept clean at all times (Do not allow the tools to lay on a concrete floor).

**Special note:** Any metal debris on the inner surface of the cutters' tapered mounting journals will render the assembly of the cutter on the arbor very difficult, and if cutter is forced onto the arbor, it will break.

## Tooling and shop supplies checklist

- " OPTIMUM-CONTACT " CO-1500 / 1625 CK reamer tool kit
- " OPTIMUM-CONTACT " BDK-100 Bushing installation puller kit
- 1" - 2" Digital Micrometer
- Magnetic based dial indicator gauge
- Hard disc 4 ½" Grinder
- ¼" shank high-speed die grinder ( 20,000 + r.p.m. )
- 1 ½" diameter with ¼" shank flap wheel ( 80 - 100 grit )
- 3/8" square drive impact wrench
- 3/8" square drive hexagonal 7/16" deep socket
- 3/8" square drive hexagonal ½" deep socket
- ½" square drive impact wrench
- ½" square drive extension ( 12" + long )
- ½" square drive universal joint ( impact )
- ½" square drive hexagonal 1" deep socket
- ½" square drive hexagonal ¾" deep socket (BDK-100 / 200 before June 2006)
- ½" square drive hexagonal 15/16" deep socket (BDK-100 / 200 after June 2006)
- ½" square drive hand ratchet wrench ( long handle 16" + )
- (2) 1" open and closed combined wrenches
- 7/16" open and closed combined wrench
- ½" open and closed combined wrench
- Blow drying air gun
- Wire brush
- 6" precision calliper ( digital if possible )
- 2lbs plastic hammer

## Other necessary shop supplies

- Primer Spray tin
- Paint Spray tin
- Small quantity of good quality clean grease
- Brake cleaner
- Shop rags
- Low strength thread locking compound ( yellow or purple "Loctite" )
- Ink marker (large)

## Service bulletins

Service bulletins supplied with this training manual :

<b>SBOC - 104</b>	PM 150-T bushing installation for heavy-duty applications
<b>SBOC - 105</b>	PM 2500-Z bushing installation for heavy-duty applications
<b>SBOC - 106</b>	PM 1625-FRU-A bushing installation
<b>SBOC - 107</b>	PM 1932-ST bushing installation
<b>SBOC - 108</b>	Conversion from "Cam-tube enclosures to regular PM 150-T and PM 2500-Z bushings
<b>SBOC - 110</b>	PM 151-STD and PM 152-std bushing installation
<b>SBOC - 111.1</b>	New seal design installation for the PM 2500-Z & PM 2380 bushing
<b>SBOC - 112</b>	Greasing the bushings before align-boring them
<b>SBOC - 113</b>	Thread locking agent for cam splines and slack adjusters
<b>SBOC - 114</b>	Using the proper seals for "Optimum-Contact" bushings.
<b>SBOC - 116</b>	PM 2380 Bushing installation
<b>SBOC - 117</b>	Lubrication

**FOR ANY INFORMATION  
DIAL TOLL FREE**

**1-877-765-9629**

**THE INSTRUCTOR WHO GAVE YOUR TRAINING IS :**

**CLAUDE DROUIN**

**This training manual was revised last: March 27, 2007**