SKF

Wheel End Maintenance

Complete Guide to Trouble-Free Handling of Bearings, Seals, Hubcaps, Lubricants and More.

A systems approach to total wheel-end maintenance

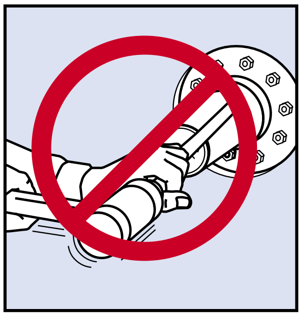
SKF's Trouble-Free Operation (TFO®) Program is a proven systems approach to heavy duty maintenance. By providing fleets with detailed instructional materials, and making hands-on training available to your technicians, this program has made a significant contribution to many fleets' overall productivity.

This Wheel-End Maintenance Guide, central to the TFO program, is based on our core experience with bearings and seals over several decades and literally billions of over-the-road truck miles.

Through our investigation of thousands of premature seal leaks and/or bearing failures, we've learned that improper removal and installation are by far the leading causes of these premature failures. Armed with the right information and tools, and using the step-by-step procedures in this manual, you can extend the service life of bearings and seals, protect your trucks from costly damage, and make your fleet safer in the process.

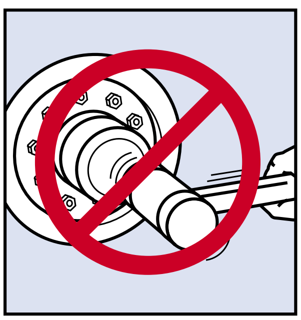
Why a systems approach?

Improper procedures during the removal, disassembly, and replacement of wheel end components

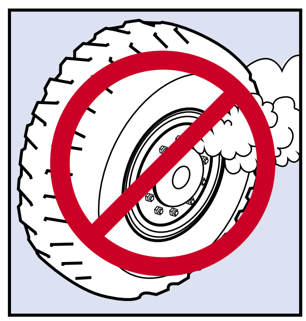


Removal of bearings and seals with incorrect tools causes damage to spindle or hub which can be undetected and lead to future problems.

Personal lack of cleanliness in handling components allows particles and dirt to cause bearing and seal damage.

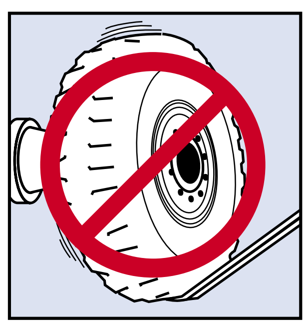


Use of improper or damaged installation tools can damage new components.



Lack of understanding the important role of lubricants can lead to future problems.

Lack of knowledge about critical end-play adjustment can cause premature or even catastrophic wheel end failure.



Improper mounting procedures can damage new components.

Lack of knowledge concerning bearing and seal failures prevents corrective action.

Lack of training or unskilled personnel can lead to any of these causes of failure.

Warranties under the TFO® Program

In addition to helping your fleet reduce wheel-end maintenance and its associated costs, you can also benefit from special extended warranties on selected products when certain requirements are met. The following warranties are provided for the SKF line of Scotseals purchased under the TFO program.

	Scotseal Classic	Scotseal Longlife	Scotseal PlusXL
Tractor	1 year or 100,000 miles	2 years or 150,000 miles	3 years or 300,000 miles
Trailer	1 year Unlimited	2 years Unlimited	3 years Unlimited
Severe Service	1 year or 50,000 miles	1 year or 100,000 miles	1 year or 150,000 miles

The following conditions are required for warranty coverage under the TFO program:

- **SKF hubcaps must be used**
- **Coverage applies to genuine SKF Scotseals and Hubcaps only**
- **User must follow current TMC maintenance procedures**
- **SKF representative to conduct training at each fleet maintenance facility**
- **Wheel end maintenance records are to be monitored by SKF and fleet**

Note: For further details on the warranty program, contact your local SKF representative.

Caution: Beware of counterfeit seals.

Unscrupulous manufacturers are flooding the global market with poorly engineered and cheaply manufactured seals that have deliberately been made to resemble premium quality SKF Scotseals. Most obvious is the use of green paint (not Bore-Tite®) that can flake off and enter the hub, actually causing bearing damage. The warranties detailed above apply only to genuine SKF brand Scotseals. A few words of caution:

- A seal's running surfaces are critical to performance. Historically, the running surfaces of counterfeit seals have been demonstrated to be well below SAE standards.
- Testing has shown these counterfeit seals to be of substantially inferior quality and highly questionable reliability.
- Premature seal failure can lead to unexpected wheel end failures that can cause vehicle downtime and damage, serious personal injury and even fatalities.

The TFO® Wheel End Solution
Overview

Subject	Situation/Problem
 SEALS	Just as the equipment needs of long haul commercial fleets vary from those of heavy duty construction fleets, so does the matchup of the right seal for the driving environment. A "good" seal can fail prematurely if used in the wrong application.
 BEARINGS	Handling wheel bearings correctly at every stage is critical to trouble-free operation. A bearing that fails unexpectedly can be not just inconvenient, but costly and dangerous.
 HUBCAPS	Hubcaps work through the constant exposure of the environment, including hot, cold, wet, dry and road salt conditions. Some of the hubcap's roughest treatment comes from inside due to lack of lube or an over-tight bearing adjustment, causing a cooked hub and permanent damage.
 FAILURE ANALYSIS	You can tell a lot about why a bearing or seal has failed prematurely by examining the failed component. This guide provides photographs of failed bearings, hubcaps and seals, along with explanations for the failures.
 TOOLING	Tools for removal and installation of wheel end seals are as critical to seal performance as they are to other tooling issues (imagine how wrong it would be to install a new piston with a sledge hammer). Related tools such as wheel dollies and end-play calibrators also play a role in the correct or incorrect installation process.
 TRAINING	Professional training of the shop personnel is the "silver bullet" to improved maintenance efficiency and the reduction of premature seal and bearing failure. To put training in its proper perspective, as much as 90% of all wheel end seal failures are a result of improper installations.

TFO® Solution

SKF recognizes the need for more than one type of seal for every purpose.
The TFO Program analyzes seal matchup to your fleet's needs and recommends the optimum seal selection for your operation.

The TFO Program details the proper removal and installation of bearings, including procedures for cleaning, lubricating and assuring correct end-play adjustment.

SKF offers replacement hubcaps that are approved by all major OE truck and most trailer builders, and are compatible with all popular oils and greases. The TFO program outlines the importance of proper hubcap installation, and details the process of matching the correct hubcap with the lubricant being used on a specific application.

Over the years, SKF has examined thousands of damaged seals (from all manufacturers) and has analyzed the major causes of the damage. This knowledge has been distilled into our documentation called Failure Analysis. Part of the TFO Program includes inspection and analysis of your fleet's wheel-end failures and a recommendation of steps needed to avoid similar failures in the future.

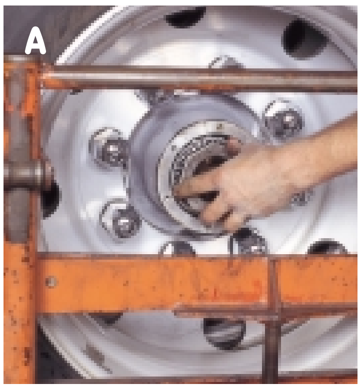
SKF's specialized tooling is designed for errorless, damage-free removal and installation of seals, with procedures that can be easily understood. These tools, and the training on how to use them properly, are part of the TFO Program's implementation process.

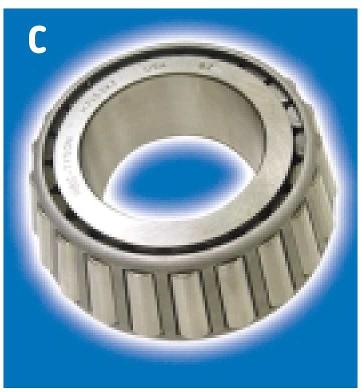
The TFO Program puts appropriate emphasis on training, with the goal of issuing "TFO® Qualified" certificates to participating shop maintenance personnel. Training is conducted by knowledgeable and experienced SKF personnel, with hands-on learning, tooling demonstrations, videos and User Manuals. Education on the importance of wheel end systems and their critical role in the safety and productivity of the vehicle is an important part of the TFO Program implementation.

General Procedure Overview

Basic guidelines of the TFO procedures for removal.
For more detailed information, see pages 21 and 22

REMOVAL PROCEDURES





A **Removal of the wheel assembly should always be done with a wheel dolly.**

B **Grease or oil seals should be removed with a special seal removal tool to avoid damage to the hub. New seals must always be used in replacement.**

C **Bearings and seals should be inspected for wear or signs of probable failure. These signs, and the likely causes of failure, are described in the Failure Analysis section of this manual.**

Basic guidelines of the TFO procedures for installation.
For more detailed information, see pages 24 thru 29

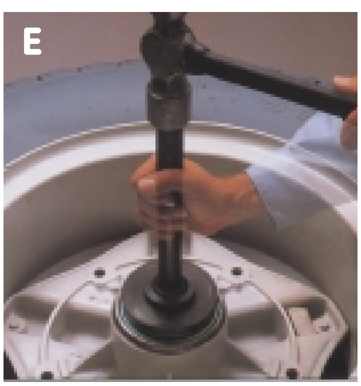
INSTALLATION PROCEDURES

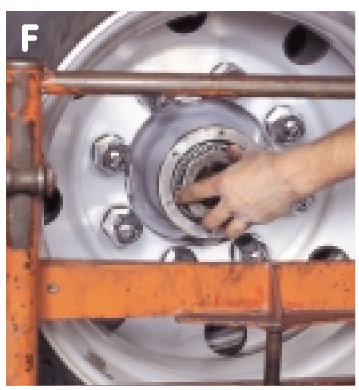
D **Bearing cups should be installed using a special bearing installation tool. A hammer should never be used directly to drive bearing cups into position!**

E **Scotseals should be seated in the bore using a special installation tool with centering plug. Never use direct hammer blows on the seal – it will destroy the seal's ability to contain lubricants and protect the bearings.**

F **Re-mounting of the wheel assembly on the spindle should always be done using a wheel dolly. Be careful in moving the assembly onto the spindle because it is necessary to avoid damaging the seal.**

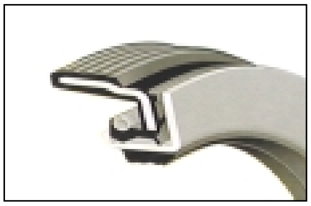
G **Spindle nut torque adjustment should follow the manufacturer's specification on TMC RP618. End-play adjustment should be verified using a portable dial indicator.**





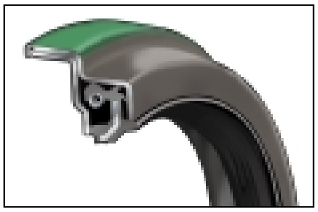
A SKF Scotseal® for Every Application

Scotseal® *PlusXL*



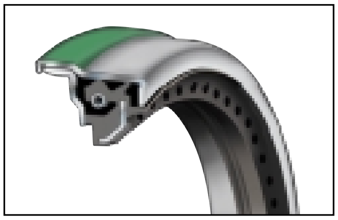
The Scotseal® PlusXL design with extended life capabilities is the SKF premium performance seal, offering maximum sealing life under virtually all driving conditions. The new high-temperature, synthetic lubricant-friendly material of the new Scotseal PlusXL, Hydrogenated Nitrile Butadiene Rubber (HNBR), is an excellent choice for frequent braking applications. HNBR elastomeric material provides heat resistance up to 300º F and broad compatibility with today's synthetic lubrication fluids. The unsurpassed exclusion properties allow the Scotseal PlusXL to perform in very harsh conditions. The new Scotseal PlusXL with the unique hand-installable design includes a fat footprint ensuring stability on the shaft. Worn hubs and spindles are not a problem for the Scotseal PlusXL.

Scotseal® *Longlife*



Building upon the success of the original Scotseal design, SKF engineers had a great start in their development of a new extended life seal. Computer aided design (CAD) of lip geometry and the addition of an axial dirt excluder lip was combined with a newly formulated material to produce Scotseal® Longlife—a premium performance seal with the characteristics required by many of today's demanding heavy duty environments.

Scotseal® *Classic*



The original Self Contained Oil Type Seal, Scotseal® Classic became the trucking industry standard—and the best value for more than 30 years. With literally trillions of road miles to its credit, Scotseal Classic has proven to be a solid choice for dependable, long lasting service. Time and time again, field studies show that when properly installed, using SKF tools and procedures, Scotseal Classic is a reliable performer for meeting the sealing requirements between brake maintenance intervals.

SKF Scotseal® Descriptions and Fitting Information

SKF Scotseal® *PlusXL* is a rubber unitized, one piece design. The Scotseal PlusXL consists of four sealing lips; a spring loaded primary sealing lip with patented Waveseal® design that is factory pre-lubed, a radial and axial dirt lip, plus an outer bumper lip that acts as a preliminary dirt excluder. Scotseal PlusXL requires no special installation tools and maintains a rubber-to-metal contact between the seal O.D. and the hub bore surface as well as a rubber-to-metal contact between the packing I.D. and spindle. (See Figure 1)

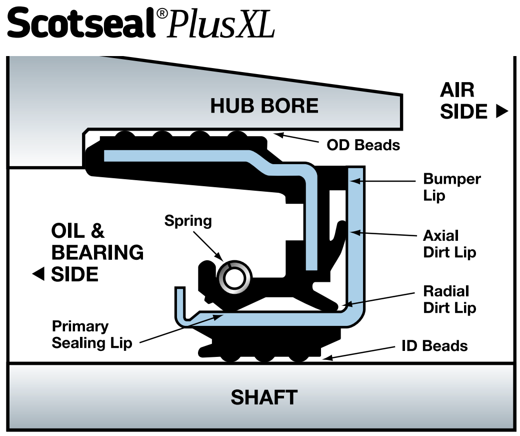


Figure 1

SKF Scotseal® *Longlife* is a unitized, one piece design consisting of a sealing element (packing) that is assembled between a metal outer and inner case. The Scotseal Longlife's packing consists of four sealing lips; a spring-loaded primary sealing lip that is factory pre-lubed, a radial and axial dirt lip, plus an outer bumper lip that acts as a preliminary dirt excluder. The Scotseal Longlife is pressfit into the hub bore using Scotseal Installation Tools. The Scotseal Longlife maintains a metal-to-metal contact between the seal O.D. and the hub bore surface as well as a metal-to-metal contact between the packing I.D. and the spindle. (See Figure 2).

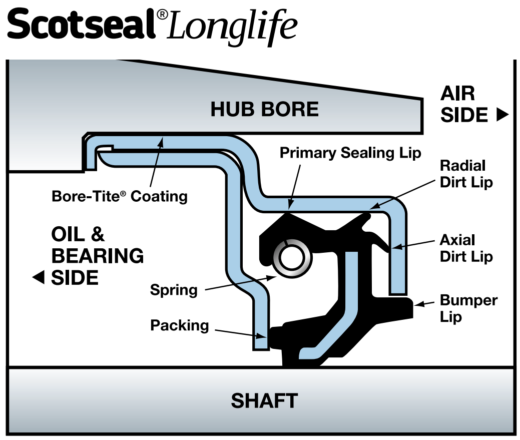


Figure 2

SKF Scotseal® *Classic* is a unitized, one piece design consisting of a sealing element (packing) that is assembled between a metal outer and inner case. The packing consists of three sealing lips; a spring-loaded primary sealing lip that is factory pre-lubed, a dirt exclusion lip, and an outer bumper lip that acts as a preliminary dirt excluder. The seal is pressfit into the hub bore using Scotseal Installation Tools. The Scotseal Classic maintains a metal-to-metal contact between the seal O.D. and the hub bore surface as well as a metal-to-metal contact between the packing I.D. and the spindle. (See Figure 3).

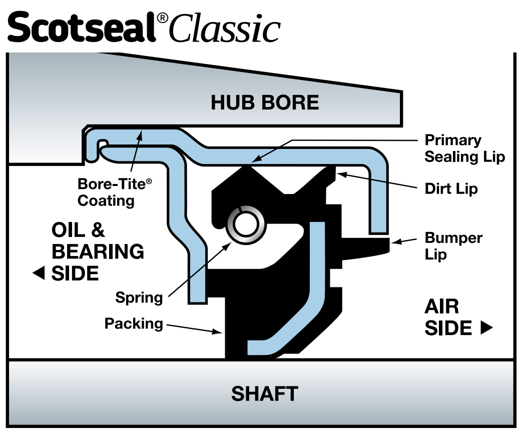


Figure 3

TFO® "Good Practice" Tips

To prevent wheel end leakage problems, be a good detective ... look for clues.

Our experience has shown that there are many causes of wheel end leakage beyond the oil seal. If you look, you will find that leaking wheel ends leave clues pointing to which component or components are the culprits. Follow the guidelines of the checklist below as you service the wheel end. You may find that just changing the seal may not be your permanent solution.

Inspect for indications of leakage:

Under vehicle inspection

- Oil present past the seal
- Oil contaminated hub, brake hardware, brake shoes

External leakage

- Oil present around hubcap, in wheel cavity
- Oil present around axle flange (drive axle)
- Smells burnt indicates overheating

Check condition of fastening system

- Verify end-play measurement before removing fastener
- Examine outer nut, washer (dowel, tang or 'D' type), inner nut, cotter pin

Disassembling the wheel end

(Caution: Block wheels, support vehicle on stands)

- Check condition of hubcap. Check flange, window and centerfill plug
- Check bolts and axle flange area on drive axle

Remove hubcap

(Axle flange on drive axle)

Check condition of lube

- Cloudy or milky indicates water
- Shiny indicates bearing wear
- Metal flakes present could indicate loose shavings from an axle component
- Grit and sand indicates lube contamination

Remove outer bearing

- Inspect for signs of damage

Remove wheel or hub assembly, using a wheel dolly

Check spindle

- Threads damaged
- Chamfer damaged

Set bearings aside for inspection

Remove seal

- Check hub
- Condition of chamfer
- Nicks, burrs, damage
- Consult the Failure Analysis section of the User's Manual

The Quality of SKF Bearings

Bearing Sets

SKF Tapered Bearing Sets are engineered and manufactured to the highest quality standards. Their design and superior materials provide a significant increase in operational reliability under heavy loads and misaligned conditions.

Precision engineering enables SKF tapered bearings to be easily adjusted on clearance or fit between the cup and cone assembly.

SKF Tapered Bearing Sets greatly reduce friction and increase load carrying capabilities. Each set contains a precision matched cup and cone that are specifically designed to maximize bearing performance and life.

SKF Bearing Sets:

- Help the installer do the job right
- Ensure longer bearing life
- Help prevent premature failure
- Available for all popular applications

Taper roller bearing – TRB

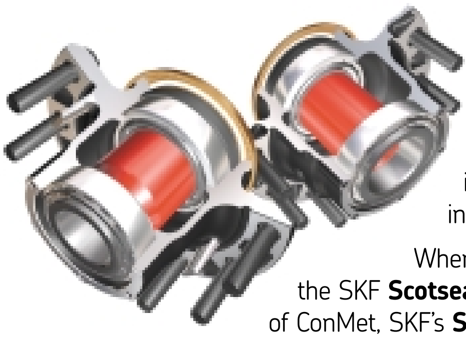
Though unitized hubs are more and more common with each new generation of vehicles, taper roller bearings without integrated seals are still prevalent in the aftermarket.

SKF offers a wide range of tapers with pressed steel cages, manufactured to rigorous quality standards in both metric and inch sizes.

With low cross sections and precise contact angles, these wheel bearings are designed to accommodate axial and radial loads when mounted with proper clearance.

Each wheel end contains an inner and outer bearing assembly; a cup that is pressed into the hub and a cone with precisely matched rollers.

ConMet PreSet™ Wheel Ends



ConMet manufactures PreSet Hub Assemblies that combine lightweight material, easy installation, low maintenance and long life. When installed in OEM equipment, ConMet PreSet assemblies include Scotseal PlusXL and are designed to be maintenance free for 500,000 miles. As with all long life safety critical components, these units still require regular inspection. Refer to the truck or trailer manufacturer for specific inspection intervals and procedures.

When PreSet wheel end maintenance is needed, ConMet recommends the use of the SKF **Scotseal***PlusXL*. As the preferred original equipment and aftermarket wheel seal of ConMet, SKF's **Scotseal***PlusXL* allows fleets to maintain the warranty and the long life associated with ConMet PreSet Assemblies.

ConMet PreSet Assemblies contain specially toleranced bearings designed within the spacer system to provide long service life. Additionally, ConMet engineers its PreSet Assemblies with a precision metal spacer, which ensures optimum bearing adjustment.

In emergency break-down situations where the special bearings are not available, it is possible to use standard bearings as a replacement, by removing the spacer and manually adjusting the bearings. In this case, standard SKF Tapered Sets could be used. Be sure to follow maintenance guidelines as found on ConMet's website www.conmet.com. It is always preferred to use the specially toleranced bearings when they are available to eliminate the possibility of bearing problems related to improper adjustment.

Spacer provides a fixed, dimensional bearing adjustment.

Precision-ground spacer ensures proper bearing adjustment. PreSet Hub Assemblies never need adjustment.

Tapered roller bearings deliver exceptional life.

Specially toleranced inner and outer tapered roller bearings are designed and selected for extended life.

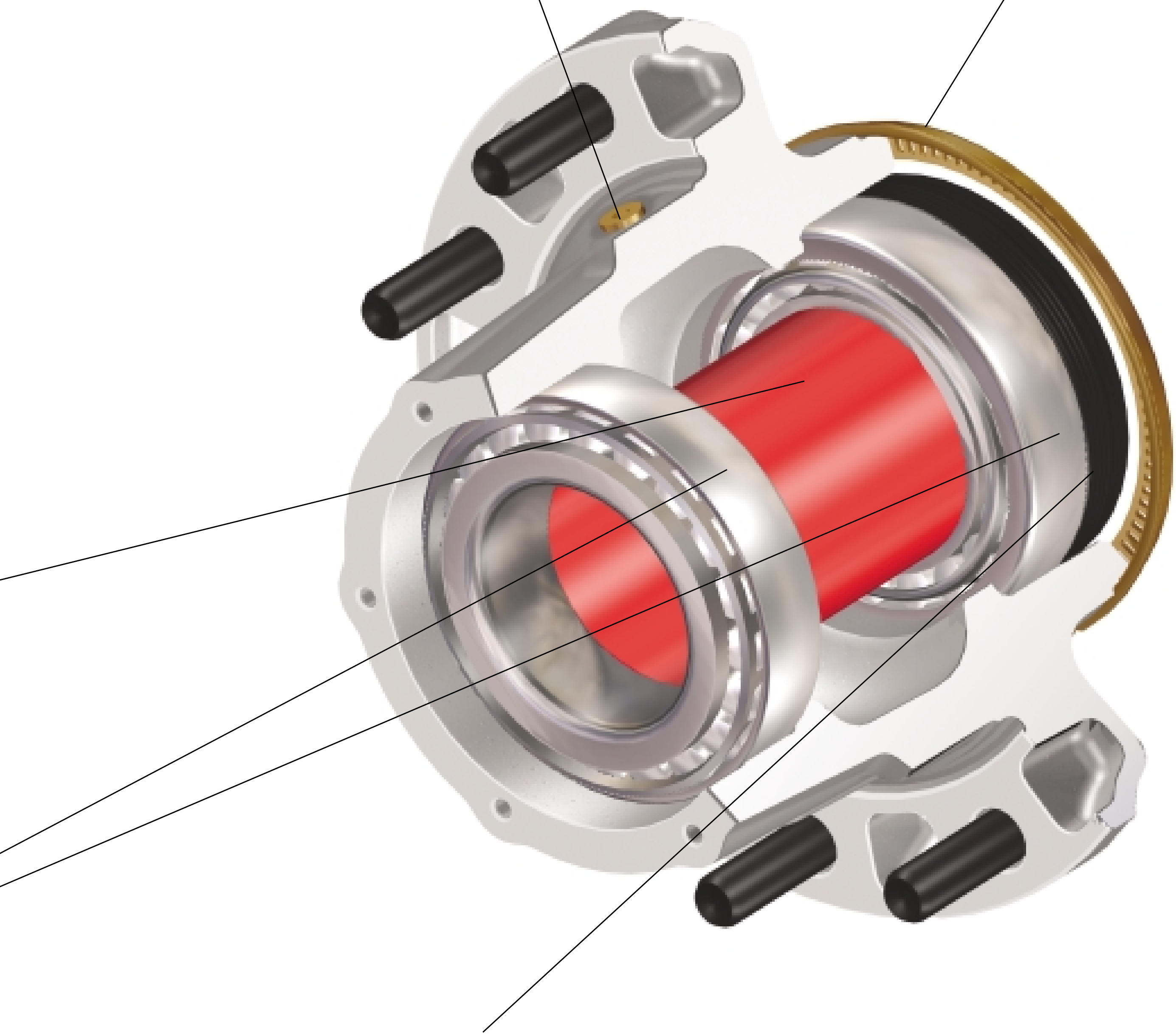
ConMet and PreSet are registered trademarks of Consolidated Metco, Inc.

Fill hole simplifies installation of lubricant.

Standard fill hole in trailer hubs makes it easier to install the correct amount of semi-fluid lubricant.

Integral tone ring for ABS-equipped vehicles.

Optional precision-stamped one-piece ring is installed as an integral part of the PreSet assembly.



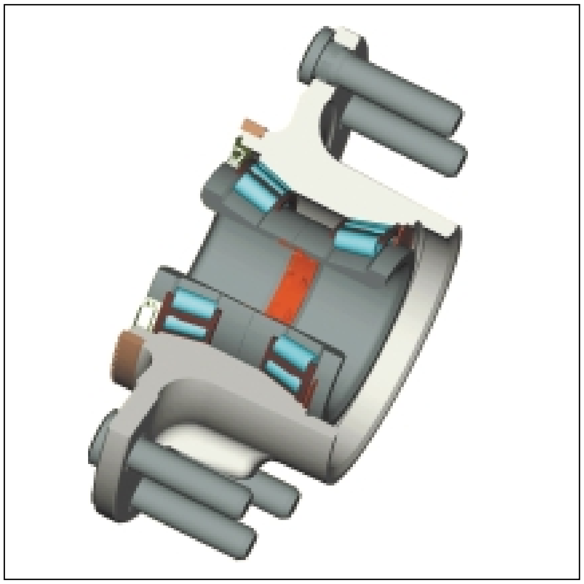
Extended-life wheel seal protects internal components.

Premium seals are installed at the factory to a controlled depth, providing maximum sealing efficiency and protecting against leaks and contamination.

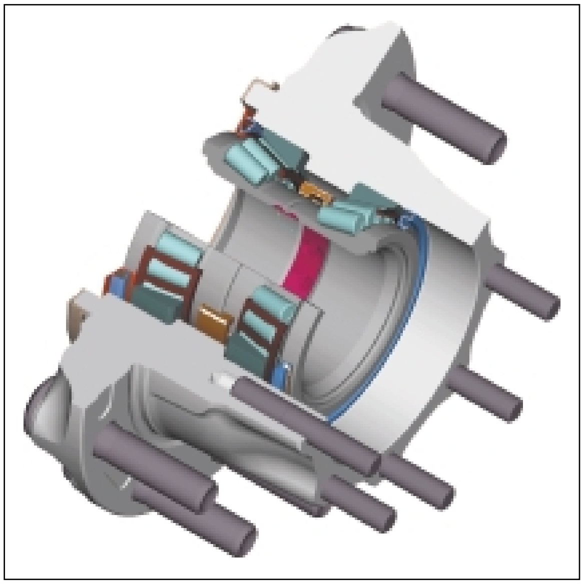
SKF LUNAR Truck Hubs

Unlike conventional wheel ends, with separately installed, replaced and adjusted components, SKF LUNAR hubs, (for Longlife Unitized No Assembly Required), are fully integrated, factory-assembled units that are designed for extended trouble-free operation. Because they require virtually no maintenance for the life of the hub, these units have become a popular original equipment choice on new steer, drive and trailer axles.

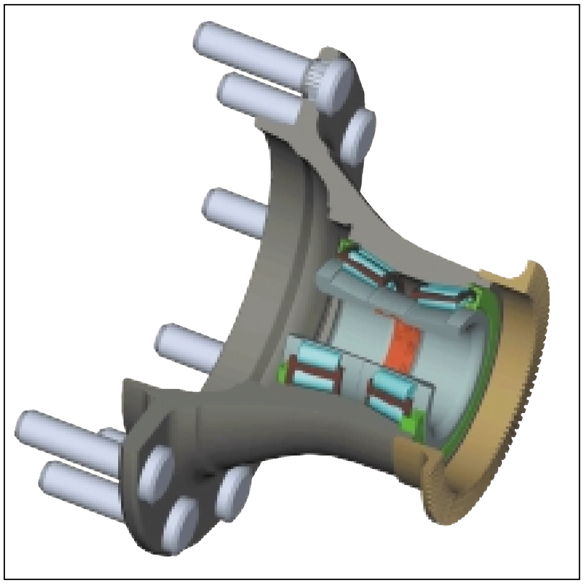
As with all long life safety critical components, these units still require regular inspection. Refer to the truck or trailer manufacturer for specific inspection intervals and procedures.



LUNAR Trailer Axle Hub



LUNAR Drive Axle Hub



LUNAR Steer Axle Hub

Greater wheel-end stability

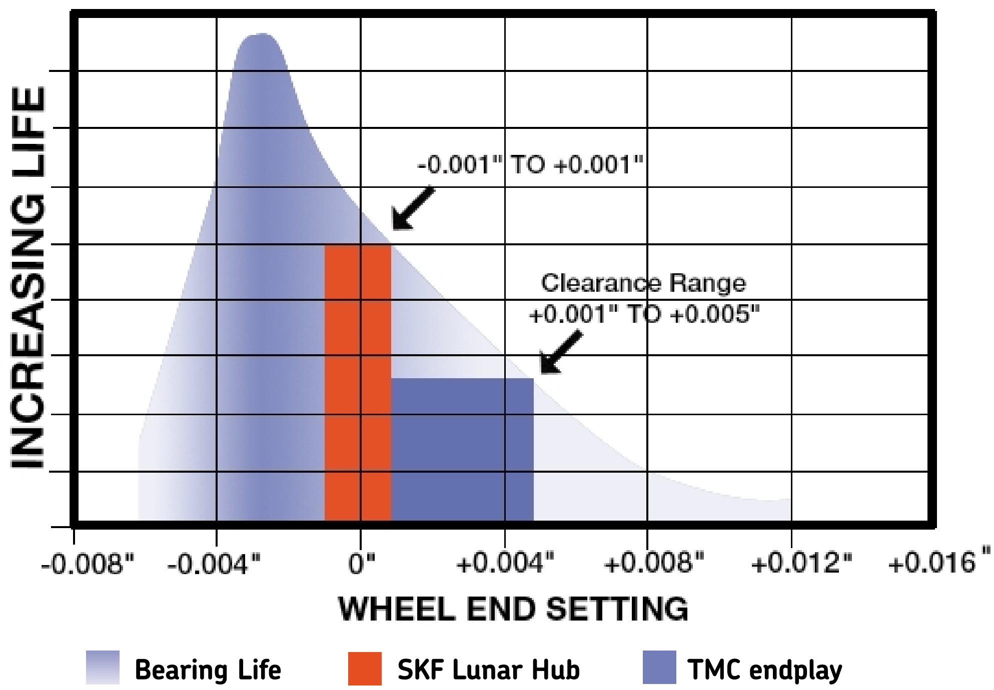
Under aggressive cornering, today's vehicles exert lateral separation forces on the bearings in excess of 6 tons. In a conventional hub, with its typical bearing clearance, these turning forces cause movement in the bearing arrangement.

In an SKF LUNAR hub, designed for a spindle that is straight, rather than tapered, an 8 ton clamping load is placed across the inner rings. This creates a rigid system that keeps the bearings and seal stable during excessive load conditions. The result? Higher safety, reduced maintenance.

The clearance problem—solved.

The biggest obstacle to effective wheel-end maintenance is setting the correct bearing clearance. In fact, most wheel-end bearing failures are the result of incorrect clearance adjustment. While in general practice, the wheel is rotated only 3 times during adjustment, it can take as many as 18 revolutions for bearings to become fully seated.

How important is clearance to bearing life? Immense. As this graph illustrates, too much or too little pre-load—even a few thousandths of an inch—can dramatically effect fatigue life.



An experienced technician working with the right tools typically achieves settings ranging from 1 to 5 thousandths of an inch, but that doesn't take into account what happens to clearance when the bearings become fully seated. So even if a technician sets the bearings as accurately as possible in the shop, bearing clearance can be highly inaccurate a mere forty yards down the road.

The SKF LUNAR Hub solves adjustment problems by precisely match-grinding all the components to achieve a +/- 0.001" clearance control. Correct clearance adjustments produce increased bearing and seal life, ultimately increasing the wheel-end's lifetime and a fleet's profitability.

Bearing adjustments below zero enter preload stage and cannot be measured in the shop. Over tightened bearings, as you can see, lead to bearing failure. On the other hand, too loose bearing adjustment will also lead to bearing failure.

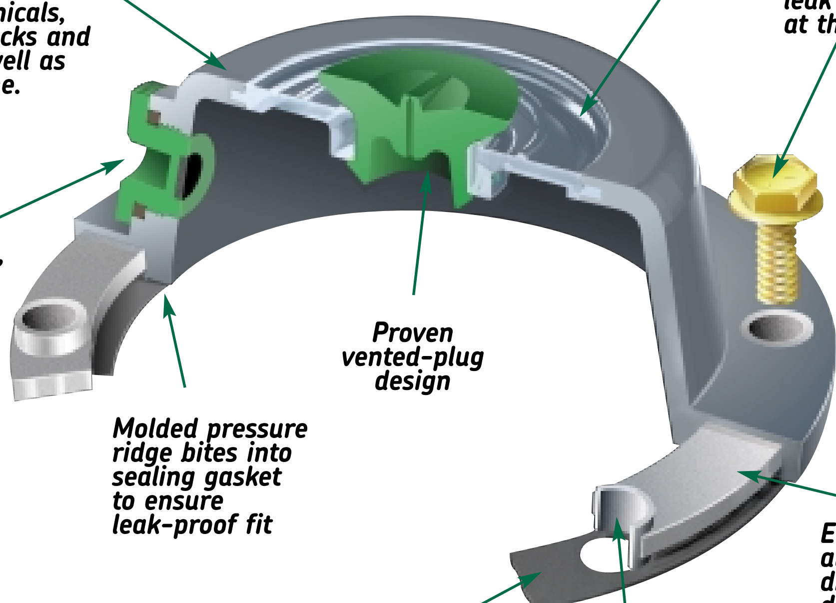
SKF TF Replacement Hubcaps

Approved by all major OE truck and trailer builders, SKF TF Hubcaps are compatible with all popular oils and greases.

Oil Bath Type

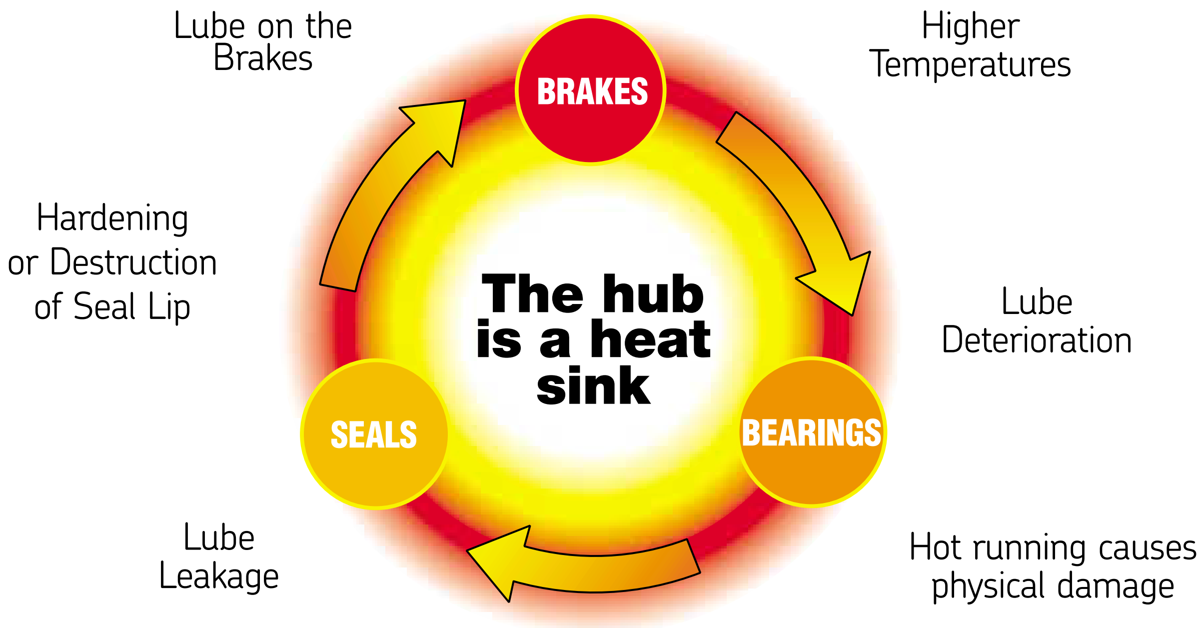
Grease Packed Type

Oil Bath Type



The importance of proper lubricants

Running conditions (Road surface, weather, terrain, speed and load)



Inspection of lubricant

Inspection of grease or oil can provide a clue to other problems. Remove a sample from the wheel end and check for the following:

- Presence of contaminants
- Burnt aroma
- Presence of water

Prior to re-installing bearings, always check for the proper lubricant.

Wheel end lubricants are formulated to match the requirements of the truck and bearing manufacturer.

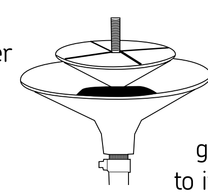
- Always use specified lubricant
- Do not mix lubricants
- Chemical interaction between lubricants and seal materials can damage the seal
- Whenever possible, use a grease packer

Always use lubricants as recommended by the manufacturer.

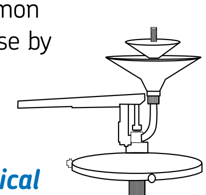
Grease and oil lubricants

The truck or trailer manufacturer has pre-determined that the wheel-end assembly is to be lubricated by grease or oil. The importance of following the manufacturer's specifications cannot be over emphasized – never change or mix grease and oil in the same assembly!

Grease lubricated wheel-ends



For proper lubrication, the grease must be packed into the cavities between the rollers and cage of the bearing cone. A mechanical grease packer is recommended in order to improve on the common procedure of filling the grease by hand. Also apply a light film of grease to the axle spindle for corrosion protection.



Typical mechanical grease packer

Helpful Hints

- Stay organized—a messy shop is dangerous and inefficient.
- Keep loose components together
- It is important to not mix wheel-end components – bearings are “mates” that wear together. This includes new bearings.

- Do not use chisels, impact wrenches and torches
- Do not use hammers directly on seals or bearings

Do not use compressed air. After cleaning, dry with a clean paper towel or a clean rag. Air jets cause small abrasive particles to become jammed in between the bearing surfaces.

Bearings must be cleaned for inspection and re-use. Use only clean solvents—effectiveness of solvent in removing old lubricant depends on how clean the solvent is.

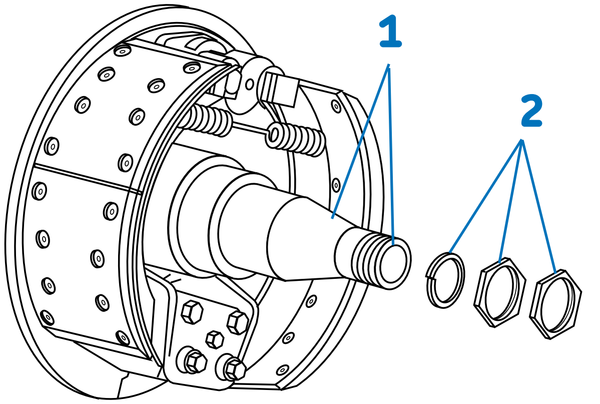
Good cleaning requires proper equipment such as:

- Solvent bath
- A filter system and regular changes of the solvent and the filters

Inspection of the Spindle and Hub

1. Inspect the spindle and spindle threads for damage, and remove light frett. Also check for the following:
   - Spalling
   - Corrosion pits
   - Discoloration from overheating
   - Punch marks / chisel marks
   - Weld beads
   - Upset metal

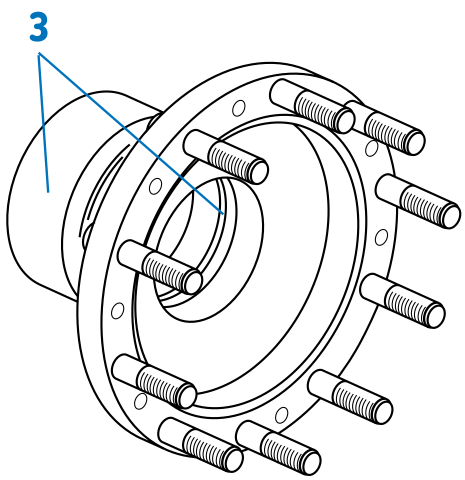
   Note: Damaged threads can be repaired using a pitch thread file or die nut.



2. Inspect the Fastener / Locknut / Bearing adjustment nut / Washer

   (The use of these spindle end components varies by truck or trailer manufacturer)

   Look for chisel marks or other deformation as a sign of improper installation, or an attempt to make temporary repairs.

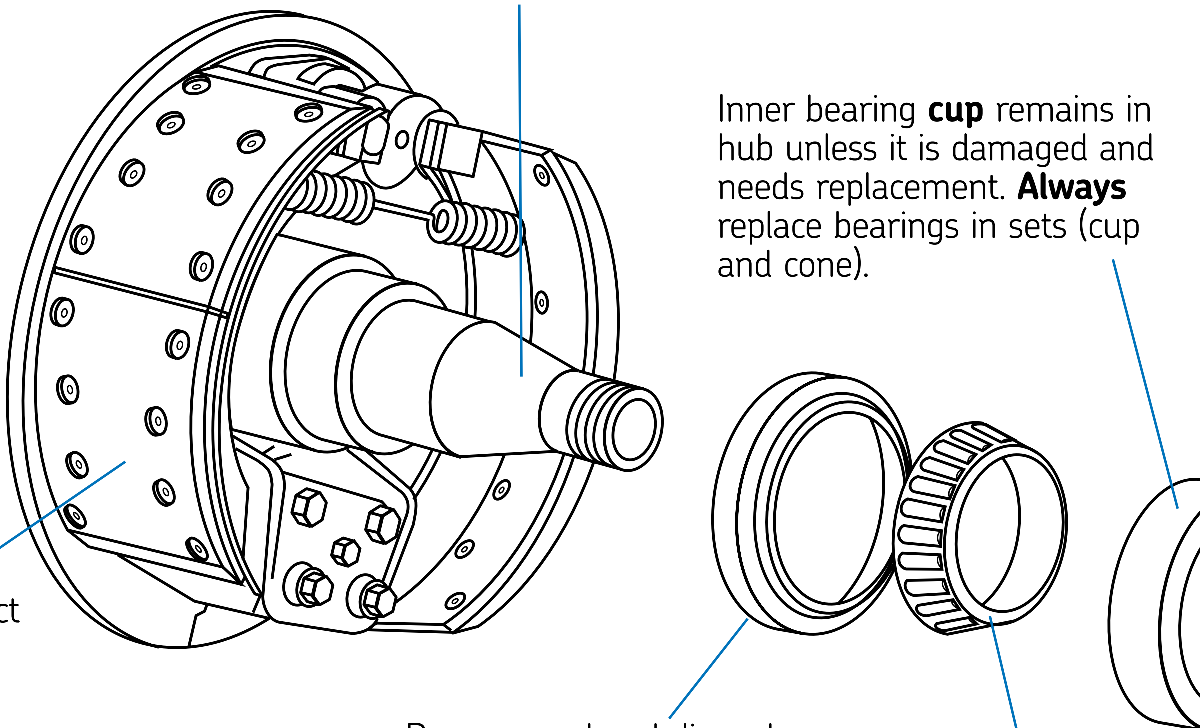


3. Inspect the inside and the outside of the hub. Look for the following:
   - Broken fasteners / bolts
   - Cracks in the housing
   - Damage to the hub and bore

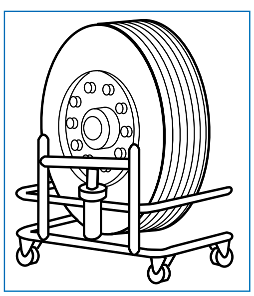
   Note: If the bearing cup is loose in the hub, this indicates a serious condition and the hub must be replaced.

WARNING: Never work under a unit supported by only a jack. Always support the vehicle with stands. Block the wheels and make sure the unit will not roll before releasing brakes. Always wear eye protection.

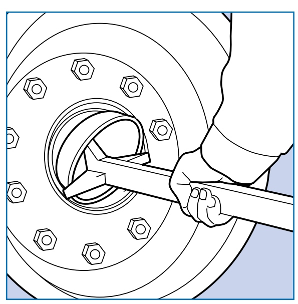
Wheel-end disassembly



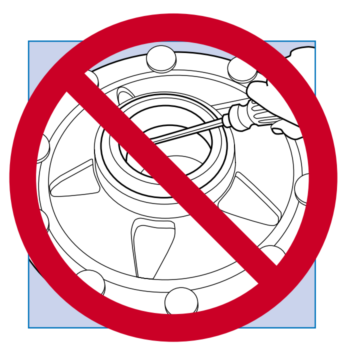
RECORD ANYTHING ABNORMAL ON WORK ORDER.



Always use a wheel dolly to remove the wheel assembly. Drain oil if hub is oil lubricated. When the wheel is removed, make a visual inspection for signs of damage, leaks, or wear on undercarriage components.



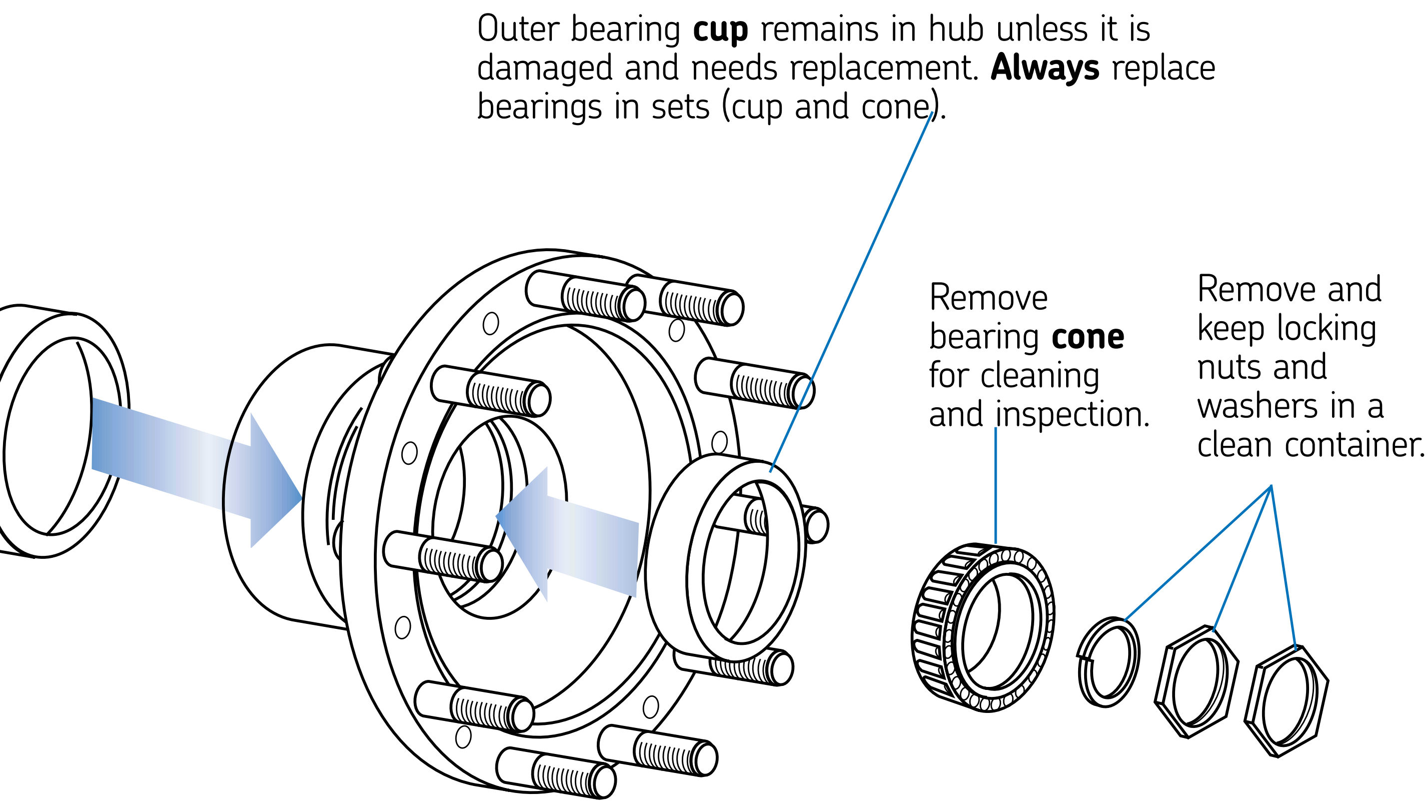
Removal of the **seal** is best done with a tool specifically designed. Pry the seal loose without damaging the bearing or the hub bore.

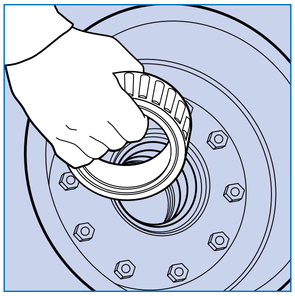


Hammers, chisels and improper prying tools cause damage to bearings and hubs and can lead to catastrophic results. **USE ONLY SPECIFIED TOOLS.**

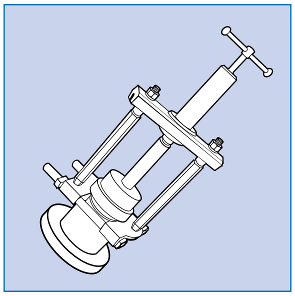
Wheel-end component inspection

Because most of the components can only be inspected when they are removed from the assembly, it is also important to use the proper removal tools to avoid damage, or to alter signs of existing damage.

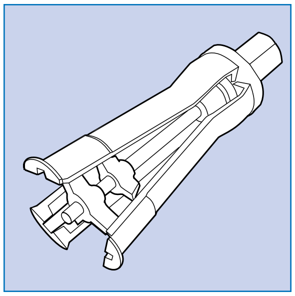




The **bearing cone** can usually be removed from the hub by hand. When removed, place the bearing in the clean containers with the other components.



If **bearing cone** is seated too firmly for hand removal, use a special removal tool of the type shown above.



Bearing cups are too tightly fitted in the hub bore to be removed by hand. If removal is required, use a special tool of the type shown above.

The SRT-1 Seal Removal Tool

U.S. Patent No. 5,617,621

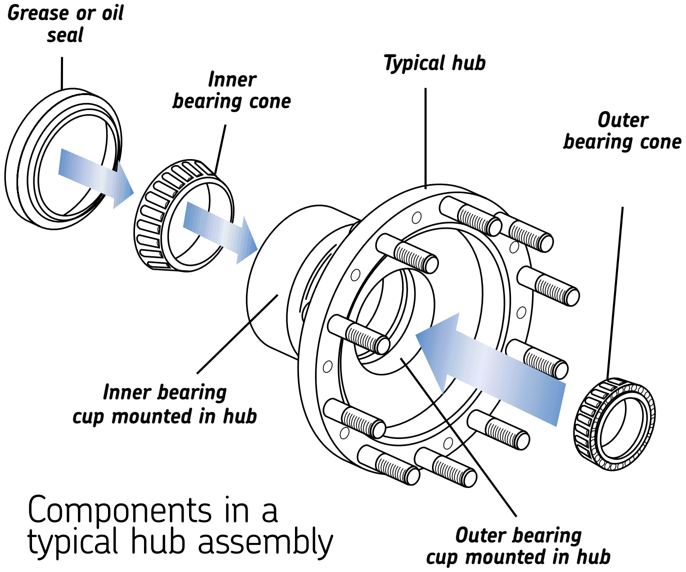
The SKF SRT-1 Seal Removal Tool is recommended for removal of most tractor, truck, dolly or trailer wheel seals. With the wheel hub assembly removed from the axle, simply insert the hook tip of the tool between the seal and bearing. The unique design of the tool allows you to use leverage to easily and safely remove the seal, without damaging the spindle.

Simple design, rugged construction and ergonomic features increase your productivity and eliminate costly bearing damage.

- Saves time — no more laborious prying against bearings or driving out seals.
- Saves bearings — tool grabs seal only and bearings go undamaged.
- Easy to use — wedges and long handle provide exceptional leverage.
- Rubber grip for security in handling.
- Heavy duty construction for long life and dependability.
- Works with steer, drive, and trailer wheel seals.
- Seal is removed intact allowing for proper seal inspection, and failure analysis if required.

WARNING: Do not add a handle extension to the tool. This tool is to be used for seal removal only.

Bearing and Seal Installation



Components in a typical hub assembly

General instructions

Wheel hub designs differ from one manufacturer to another. However, the correct procedures for installing bearings and seals remain basically the same. Care in handling components and proper tooling are always the critical factors in all procedures which lead to Trouble-Free Operation.

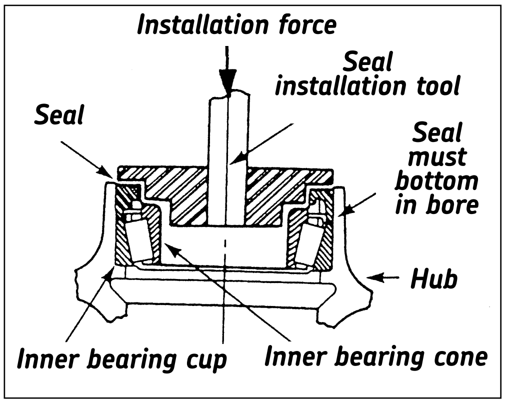
Oil lubricated wheel-ends

Coat the bearing cones with a light oil film before inserting them into the bearing cups. Always use the specified oil for replacement and do not mix lubricants.

Installing bearing cup and seal

Avoid any direct hammering on the bearing or the seal – this will cause deformation or damage, which will result in premature failure. Use a simple vertical press to push the bearing cup into correct position in the hub.

Use a recommended seal installation tool to set the seal correctly in the hub. When hammering on the tool, be sure to stop when the seal is "bottomed." Do not add extra blows or it will cause immediate damage to the seal.



Note: if the tire is mounted on the hub, place the entire assembly against a solid surface at a 45° angle before final setting.

Installation Procedures: **Scotseal®***PlusXL*

This seal is hand installable. No special tools are required.

Caution: Do not install the **Scotseal®***PlusXL* directly onto the spindle.

Place the hub (wheel) assembly flat or at least a 45° angle for seal installation.

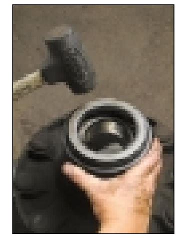
1. Pre-lube the inner bearing cone with the lubricant that is being retained and place it into the hub.

2. Lightly lubricate the seal O.D. and I.D. evenly with the fluid that is being retained. Also apply a thin layer of oil on the hub bore that the seal is being pressed into. NEVER INSTALL DRY.

3. Press the seal by hand evenly into the bore. A rubber mallet or other soft-faced tool may be used to gently tap the seal into place. Be sure that the seal is evenly seated and bottomed in the bore. As in any seal installation, apply an even driving force to avoid cocking the seal or damaging the flange surface.

4. Allow seal to set for about 5 minutes prior to installing hub assembly onto spindle.

Lightly lubricate the OD and ID with the fluid being retained.



A rubber mallet may be used to tap into place.

Press the seal into the bore evenly by hand.

Caution: **Install a new seal if the seal is cocked or damaged during or after installation.**

Installation Procedures:

Scotseal® *Classic* **/ Scotseal®** *Longlife*

Caution: Do not install the Scotseal® directly onto the spindle.

Place the hub (wheel) assembly against a solid surface or bench at a 45° angle for seal installation. This aids in centering the bearing and seal in the hub bore. Clean bore of any particles, rust or grease.

1. Pre-lube the inner bearing cone with the lubricant that is being retained and place it into the hub.

2. Place the **Scotseal®** *Classic* or **Scotseal®** *Longlife* into the hub bore and insert the tool assembly with centering plug into the seal. Note: Be sure to wear proper eye protection.

3. Hold the tool handle firmly and straight, and drive the seal with firm hammer strokes until the seal is squarely seated. Continue driving the seal into the hub until the sound of impact changes.

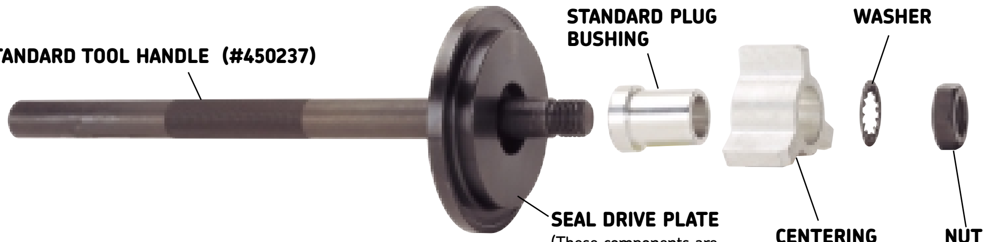
4. After the seal is bottomed in the bore, check for freedom of movement by manually moving the packing of the seal up and down. Ensure that the inner bearing rotates freely.

Caution: **Install a new seal if the seal is cocked or damaged during or after installation.**

The Scotseal® Toolboard

- Keeps tools orderly and lessens chances of tools being misplaced or damaged
- Sturdy metal construction — mounts easily on shop wall
- Fitting chart included
- Just order Part No. TB-1

Installation Tooling:
Scotseal® *Classic* / **Scotseal®** *Longlife*



Tool Selection

SKF **Scotseal®** *Classic* and **Scotseal®** *Longlife* are to be installed using only SKF Scotseal® installation tools. (See Chart A on opposite page)

Centering the Seal

Precisely matched centering plugs are engineered to fit within the inside diameter of the inner bearing cone and allow accurate centering of the Scotseal in the bore of the hub, as well as preventing cocking of the seal. Chart B below provides correct matchup of bearing cone and centering plug.

Chart B
MATCHUP OF BEARING CONES & CENTERING PLUGS

BEARING CONE NO.	CENTERING PLUG NO.	BEARING CONE NO.	CENTERING PLUG NO.	BEARING CONE NO.	CENTERING PLUG NO.
495AX	708	749	719	39585	704
497	711	749A	710	42688	708
539	701	749S	719	45284	700
555S	702	756A	709	45285	700
557A	703	758	711	47678	708
559	704	759	712	47685	710
560	706	760	717	47686	710
567	707	776	715	47687	710
568	731	780	718	52400	718
575	708	3778	730	52401	718
580	710	3982	704	JH217249	719
582	710	3984	706	JM205149 A	722
593	712	4595	701	JM207049 A	723
594	715	5557	721	JM511946	724
594A	715	5760	708	JM716649	719
595	710	6379	705	JM718149	713
596	711	6386	706	JM719149	733
598	714	6386A	706	HM212044	703
598A	714	6389	706	HM212046	704
639	704	6461	708	HM212047	704
641	706	6461A	708	HM212049 X	706
659	708	6559	710	HM212049	706
663	710	6580	712	HM215249	707
663A	710	28995	703	HM218248	713
664	732	33281	716	HM516449	710
665	711	33287	707	HM518445	712
665A	711	33895	701	H715345	716
68lA	714	39578	701		
683	715	39580	702		
687	718	39581	702		

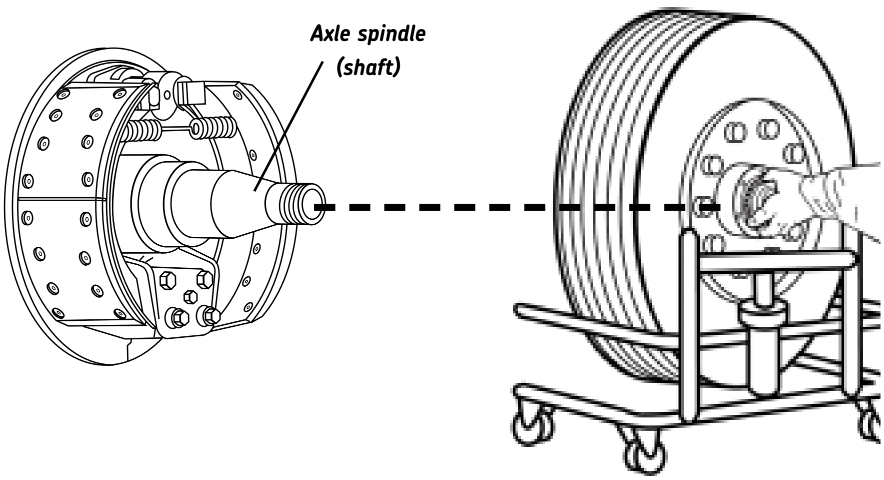
Chart A
DRIVE PLATES & SEAL MATCHUPS
(Drive plates in bold numbers with matching seal numbers)

427	34387, 36274, 36285, 36358, 36365
428	31175, 31244, 31264, 31266, 31281, 31307, 32470
435	47690, 47691, 47693, 47696, 47697, 47698, 48000
436	34975, 35000, 35001, 35060, 35066, 35072, 35075, 35102, 35103
441	40086, 40090
445	39380, 39420, 39425, 42550, 42672, 42800
446	43860, 43865, 43875, 46390, 47483, 48297, 48298, 48690, 48792, 48794, 48796, 48884, 50124
448	38709, 39988, 39990
449	47686
451	46305, 46306, 46308
452	42623, 42624, 42630, 42631
453	50190, 52660, 52664
457	40040, 40136, 40139, 40146, 40147
461	45152, 45160, 45162, 45163
462	38747, 38750, 38780, 38782, 38783
463	27438, 28758, 28820, 28832
465	43752, 43764, 43765, 43800
472	39380 (w/disc brks.)
474	52658
484	44922, 44964, 45010, 45099, 45100, 45103, 45108, 450737, 42625

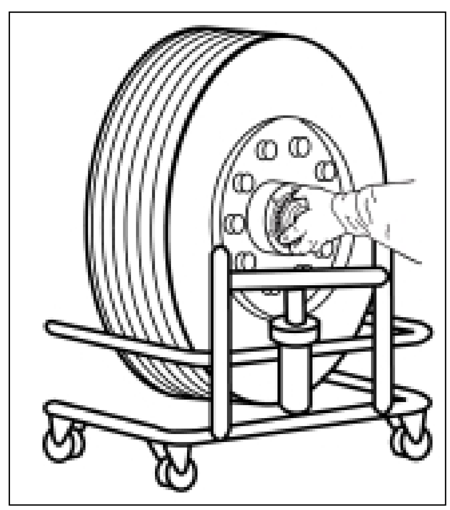
Installing Hub Assembly

DO NOT ATTEMPT TO INSTALL THE HUB ASSEMBLY BY HAND!

Whether the hub is with or without the tire, do not install it without mechanical support.



1. **When installing the hub assembly** over the axle spindle be sure to align the hub bore to the center of the spindle. Mechanical supports will allow you to do this without scraping or otherwise damaging the spindle, the threads, and in particular the seal.
2. **Install the outer bearing cone and adjusting nut.** Tighten nut only until it is snug against the bearing cone. DO NOT USE A PNEUMATIC TOOL during this part of the procedure. Be sure to maintain support of the hub assembly until the adjusting nut is secure. Failure to do so may cause damage to the seal and subsequent leakage of lubricant.
3. **Remove the hub support** so that the hub is resting on the bearings. Check for free rotation of the bearings. Never allow hub to rest on seal.
4. **Follow wheal bearing adjustment** as instructed on following page.



Wheel Bearing and End Play Adjustment Procedures

WHEEL BEARING ADJUSTMENT PROCEDURE

<table>
<tr><td>STEP 1:</td><td colspan="8">Lubricate the wheel bearing with clean axle lubricant of the same type used in the axle sump or hub assembly.
Note: Never use an impact wrench when tightening or loosening lug nuts or bolts during the procedure.</td></tr>
<tr><td rowspan="2">INITIAL ADJUSTING NUT TORQUE</td><td rowspan="2">INITIAL BACK OFF</td><td rowspan="2">FINAL ADJUSTING NUT TORQUE</td><td colspan="3">BACK OFF</td><td colspan="2">JAM NUT TORQUE</td><td rowspan="2">ACCEPTABLE END PLAY</td></tr>
<tr><td>AXLE TYPE</td><td>THREADS PER INCH</td><td>FINAL BACK OFF</td><td>NUT SIZE</td><td>TORQUE SPECIFICATIONS</td></tr>
<tr><td>STEP 2</td><td>STEP 3</td><td>STEP 4</td><td></td><td>STEP 5</td><td>STEP 6</td><td colspan="2">STEP 7</td><td>STEP 8</td></tr>
<tr><td rowspan="8">200 lb•ft (271 N•m) WHILE ROTATING WHEELS</td><td rowspan="8">ONE FULL TURN</td><td rowspan="8">50 lb•ft (68 N•m) WHILE ROTATING WHEELS</td><td rowspan="4">STEER (FRONT) NON-DRIVE</td><td>12</td><td>1/6 TURN *</td><td colspan="2" rowspan="2">INSTALL COTTER PIN TO LOCK AXLE NUT IN POSITION</td><td rowspan="4">.001"-.005" (.025mm-.127mm)</td></tr>
<tr><td>18</td><td>1/4 TURN *</td></tr>
<tr><td>14</td><td rowspan="2">1/2 TURN</td><td rowspan="2">LESS THAN 2 5/8" (66.7mm)</td><td rowspan="2">200-300 lb•ft (271-407 N•m)</td></tr>
<tr><td>18</td></tr>
<tr><td rowspan="2">DRIVE</td><td>12</td><td rowspan="2">1/4 TURN</td><td>DOWEL TYPE WASHER</td><td>300-400 lb•ft (407-542 N•m)</td><td rowspan="4">AS MEASURED PER PROCEDURE WITH DIAL INDICATOR</td></tr>
<tr><td>16</td><td>TANG TYPE WASHER**</td><td>200-275 lb•ft (271-373 N•m)</td></tr>
<tr><td rowspan="2">TRAILER</td><td>12</td><td rowspan="2">1/4 TURN</td><td rowspan="2">2 5/8" (66.7mm) and over</td><td rowspan="2">300-400 lb•ft (407-542 N•m)</td></tr>
<tr><td>16</td></tr>
</table>

* If dowel pin and washer (or washer tang and nut flat) are not aligned, remove the washer, turn it over, and reinstall. If required, loosen the inner (adjusting) nut just enough for alignment.

** Bendable type washer lock only: Secure nuts by bending one wheel nut washer tang over the inner and outer nut. Bend the tangs over the closest flat perpendicular to the hang.

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Wheel Bearing End Play Verification

Wheel bearing end play is the free movement of the wheel assembly along the spindle axis. It is recommended, for verification purposes, that wheel bearing end play be measured with a dial indicator. (Example in photo below.)

Step 1 Make sure the brake drum to hub fasteners are tightened to the manufacturers' specifications.

Step 2 Attach a dial indicator with its magnetic base at the bottom of the hub or brake drum.

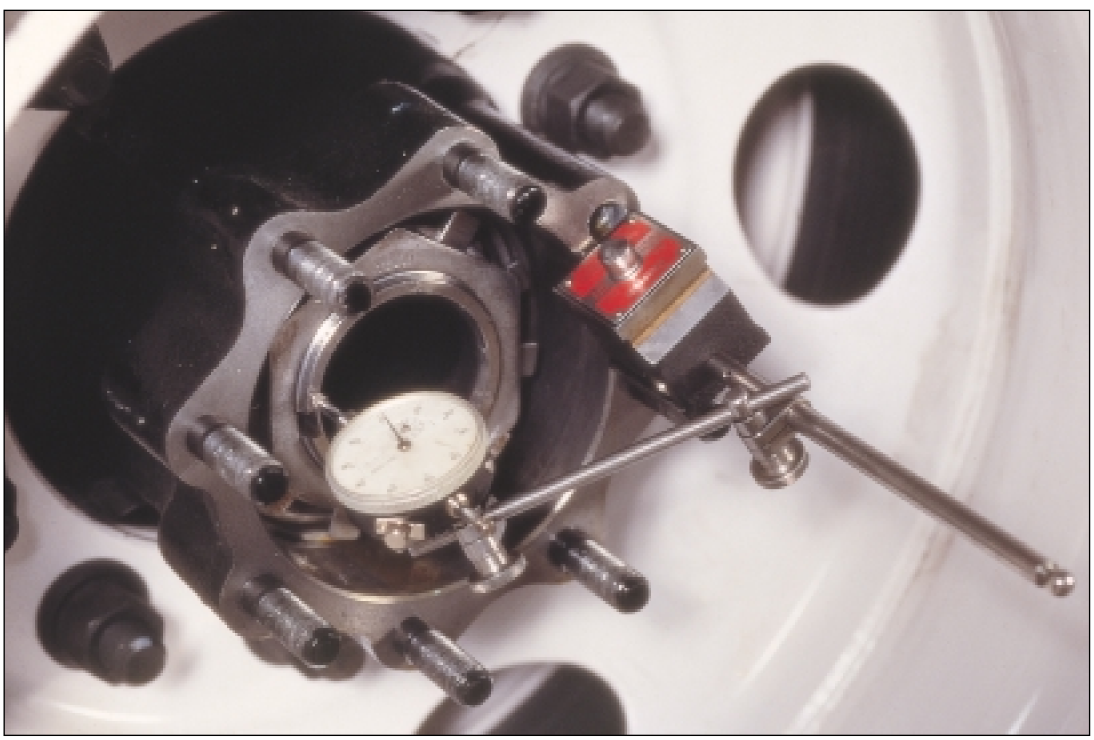
Step 3 Adjust the dial indicator so that its plunger or pointer is against the end of the spindle with its line of action approximately parallel to the axis of the spindle.

Note: For aluminum hubs, attach the magnetic base of the indicator to the end of the spindle with the plunger against the hub or brake drum.

Step 4 Set the dial indicator to zero by rotating the gauge face so the zero mark lines up with the gauge needle. For digital indicators, push the zero-out button.

Step 5 Grasp the wheel assembly at the 3 o'clock and 9 o'clock positions, while oscillating it to seat the bearings. Read bearing end play as the total indicator movement.

Note: If end play is not within specifications, refer to the readjustment procedure of SKF technical bulletin No. TBF 9301.



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Hubcap Installation Procedure

Procedure

1. Hub mating surface must be free of dirt, burrs and radial score lines.
2. Hub mating surface, hubcap flange and gasket should not be greased or oiled.
3. Always install and re-install a hubcap with a new gasket.
4. When using a Tamper Proof system with synthetic grease, never fill hubcap with grease.

Bolt on Hubcaps

- Lockwashers of the split, conical or internal toothed design may be used in conjunction with the fastening bolts. Do not use flat washers.
- Thread all bolts loosely, then tighten down bolts uniformly in a star pattern per the following recommended torque values:

TF (Zytel) Hubcap with embedded metal ring	**12-16 lbs./ft.**
Stamped Steel Hubcaps	**10-14 lbs./ft.**
Plastic Hubcap with external metal ring	**6-10 lbs./ft.**

Threaded Hubcaps

- Lightly lubricate the threads of the hubcap and the O-ring, with the lubricant that is being retained.
- Install the O-ring onto the hubcap.
- Install the hubcap assembly onto the hub.
- Using an 8-point 4 13/16" opening x 4 1/4" high socket, torque to the following recommended values:

Lexan	**60-70 lbs./ft.**

OIL FILL

Through Center Fill Port

- Fill wheel end assembly through centerfill port with the specified grade of oil. Wheel hub configurations vary, allowing different amounts of oil to be added depending on design. Allow for the oil to seep through the outer bearing and fill the hub cavity. Continue to add oil until the oil reaches the oil level fill line as indicated on the hubcap.
- Install center fill hubcap plug.

Through Side Fill Port

- Fill wheel end assembly through side fill port with the specified grade of oil. Wheel hub configurations vary, allowing different amounts of oil to be added depending on design. Allow for the oil to seep through the outer bearing and fill the hub cavity. During this fill operation, **DO NOT ALLOW THE OIL TO GO ABOVE THE CENTERLINE OR WEEP HOLE.** This may result in a weeping condition that may be perceived as a leaking hubcap. Continue to add oil until the oil reaches the oil level line as indicated on the hubcap.
- Install side fill hubcap plug per the following recommended torque values:

3/8" - 18 NPT Pipe Plug	**100-140 lbs./in.**
3/4" - 16 UNF (Zytel) Side Fill Plug	**15-25 lbs./in.**

Clean up any overspills that would give the appearance of a leaky hubcap.

Grease fill: See TMC RP631
"Recommendations for Wheel End Lubrication" and the vehicle manufacturer's recommendation for proper fill procedure.

Failure Analysis:

An important step in achieving Wheel End TFO®.

Failure analysis of prematurely failed seals is one of the best means to discover the cause of failure and to avoid a similar fate for the replacement seal.

The cross sectional drawings at right illustrate the critical components of each member of the **Scotseal**® family. The captions identify these components as described in the following pages.

For **Scotseal®***PlusXL*, failures most likely result from these common errors:

- Improper installation

  — O.D. and/or I.D. not lubed
- Lube contamination as listed above
- Spindle not fully prepped
- Use of a hammer

Note: replacing a narrow footed seal like the **Scotseal®** *Classic* and **Scotseal®** *Longlife* requires cleaning the spindle along the new area where the wider **Scotseal®***PlusXL* will sit.

Below are the key failure modes for **Scotseal®** *Classic* and **Scotseal®** *Longlife*. These account for the lion's share of premature seal failures.

- **Improper installation**

  Wrong or no tool used
- **Cocked installation**
- **Lubricant contamination**

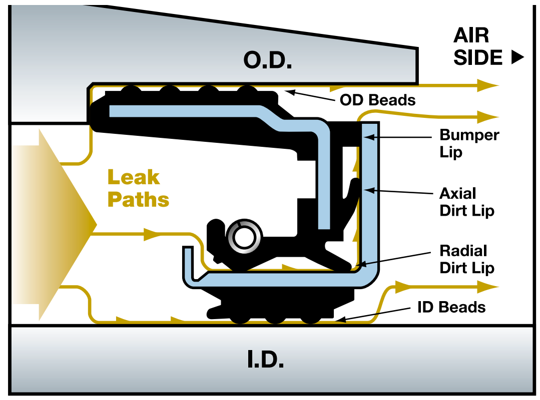
  Metal flakes

  Dirt or water

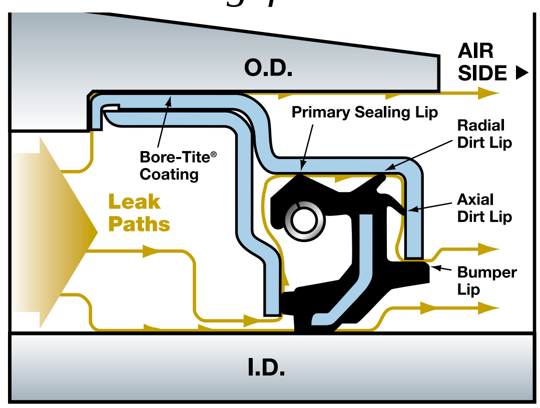
  Mixing of lube types
- **Improper bearing adjustment**
- **Seal spinning on spindle**

  Damaged spindle
- **Hub imperfections**
- **Installed over a wear ring**

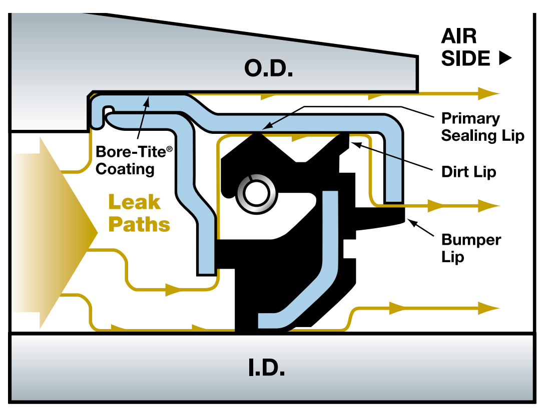
Scotseal® *PlusXL*



Scotseal® *Longlife*



Scotseal® *Classic*



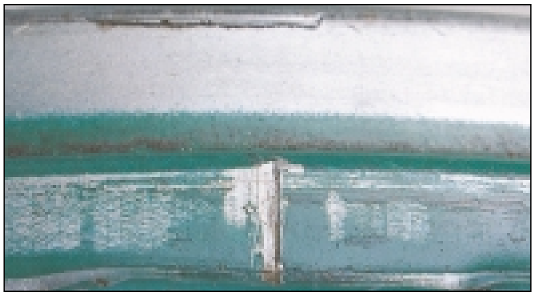
Consult the following pages for examples of Failure Analysis.

Failure Analysis:

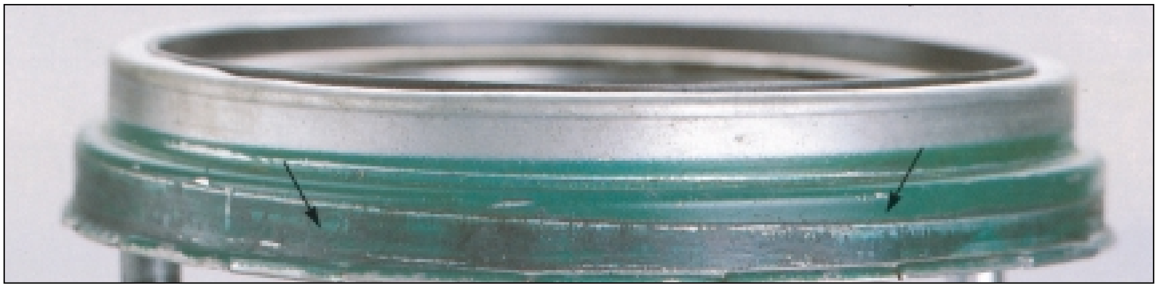
Scotseal®*Classic* / **Scotseal®***Longlife*

EXTERNAL INSPECTION – OUTER DIAMETER

Normal scuffing: The surface will show some scraped areas, that's normal. But signs of nicks, scratches metal particles, or any foreign material are warning flags that something else is amiss. Make sure the hub bore is smooth and free of burrs or nicks.

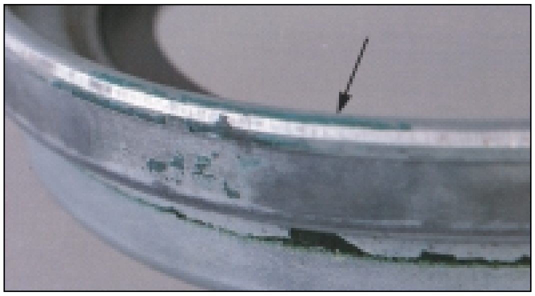


O.D. radial grooves: If the Bore-Tite® film has been scored all the way across the width of the seal, you should inspect the hub for burrs or damage. Before installation, the hub should be inspected and cleaned with emery cloth or a fine file.

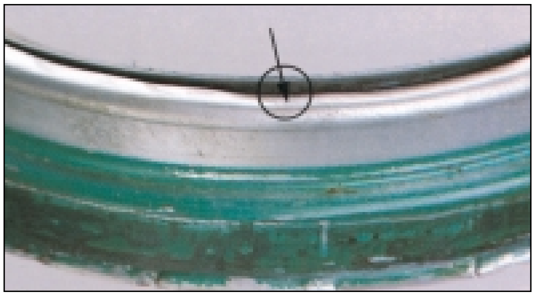


Lines in the Bore-Tite: If you see lines around the seal, several things could have happened.
If the lines are etched to the metal, the seal could have spun as a result of being the wrong application or, more likely, it was installed crooked or cocked.

As you can see in this example, the grooves run from high on the right to low on the left, indicating a cocked installation. Most likely, the seal was not properly "bottomed-out" or a centering tool was not used — common causes of premature seal failure.



Shiny leading edge: Occasionally someone will try to improve seal installation by changing the shape of the seal. They'll round off the leading edge of the outer cup on a grinder. This distorts the outer diameter and can possibly cause the seal to disassemble.

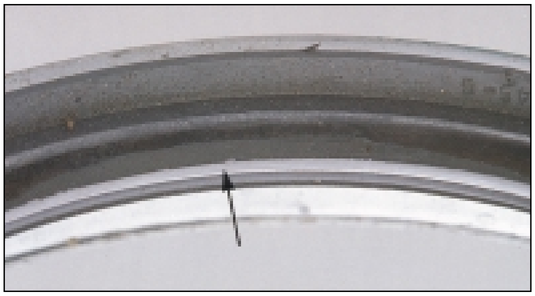


Outer cup damage: If you see dents, nicks, or a bent casing you can bet that the seal was installed without the proper tool or the tool was damaged. Gashes indicate the use of a sharp object, like a screwdriver or punch.

Failure Analysis:

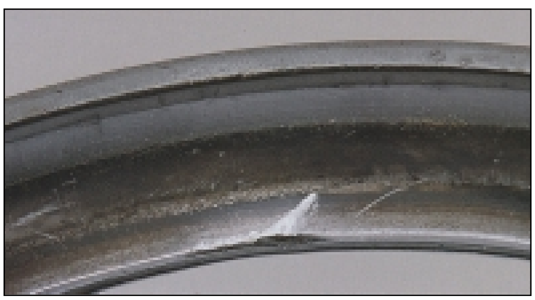
Scotseal®*Classic* / **Scotseal®***Longlife*

EXTERNAL INSPECTION – INNER DIAMETER

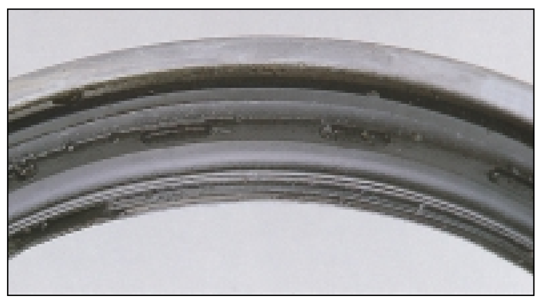


I.D. wear: If the I.D. of the packing is shiny, or has axial scratches, the seal has spun on the shaft. That can be caused by not bottoming-out the seal properly, leaving it cocked in the bore or installing the wrong part number.

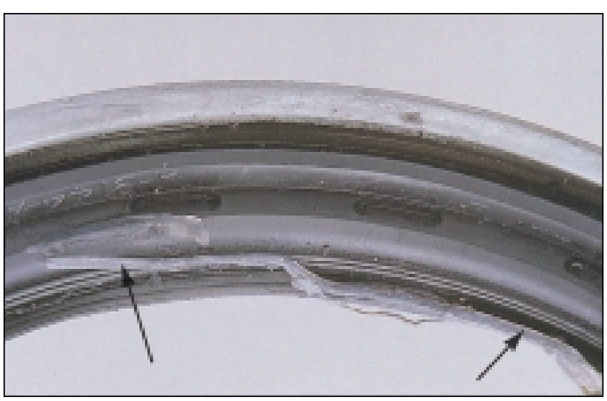
Installed backwards: The only way that the packing can be worn shiny, as shown here, is by rubbing against the bearing race.
The only way that can happen is by putting the seal in backwards. The **Scotseal**® installation poster makes a convenient guide.



Severely damaged I.D.: Scratches or dents in the I.D. are signs that the seal has struck the spindle or axle tube during installation. Rushing the installation and not lining up the wheel dolly is the usual suspect. Or a rough shop floor may be the problem.



Distorted packing: One way to damage the packing of a **Scotseal**® is to try to install it over a wear ring. The wear ring will deform the inner surface and ruin the seal. Any previously installed wear ring must be removed prior to installing a Scotseal.



Foreign matter on I.D.: Occasionally, you will come across a seal with a shaft leak that has a mysterious, tacky substance on it. Most likely someone added a silicone sealant to "improve" the seal. Old habits die hard.

Failure Analysis:

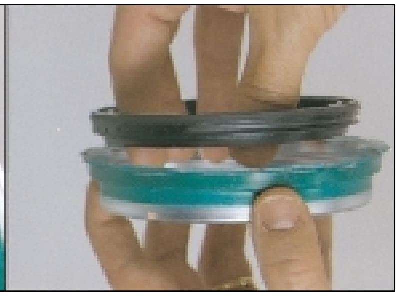
Scotseal® *Classic* / **Scotseal®** *Longlife*

EXTERNAL INSPECTION – OUTER DIAMETER

Opening a Scotseal

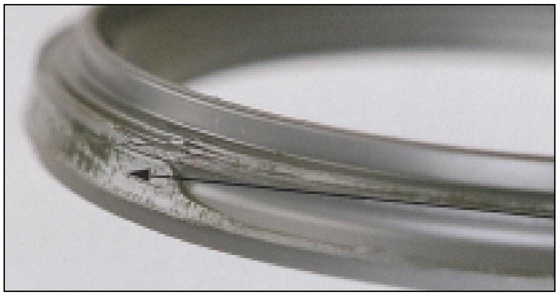
Use pliers or end cutters and work your way all the way around the seal, straightening the outer cup flange.

Remove the inner cup. Be sure to wear gloves or use a shop rag to protect your hands, the open flange edges are sharp.



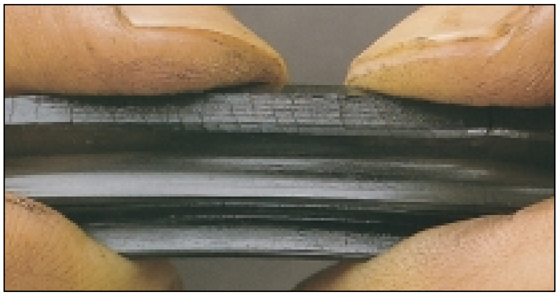
Remove the packing without disturbing the lip surfaces, as shown.

Internal Inspection – The Major Clues



Factory Applied Grease

Lip grease: Every **Scotseal®** comes with grease between the primary and dirt lip. If it's not there, it's very likely oil has washed it away. Suspects are excessive end-play, a cocked seal or improper ventilation of the wheel end (dirt, corrosion or paint-plugged vent).



Brittle primary seal lip: After cleaning the entire seal, use your fingers to curl the primary seal lip back. Run your finger completely around the circumference. The oil lip should be smooth and pliable. If not, the seal has overheated; lack of lubrication could be the cause.

Broken dirt lip: Using the same technique, check the dirt lip. If it's dry and brittle, most likely it's been baked. It will probably split away from the seal at some point around the circumference.

Lack of lubrication may have fried the bearings as well.

Failure Analysis:

Scotseal® *Classic* / **Scotseal®** *Longlife*

INTERNAL INSPECTION – WEAR TRACKS

Good pattern: What you will see in a good **Scotseal®** are the two parallel lines that look like they've been drawn with a sharp pencil. They're approximately the same size and equidistant from the edge all the way around the inside of the outer cup.

Wide, wide: If both lines are wider than pencil lines, it means that the primary lip and dirt lip have been allowed to move in and out on the outer cup. The cause of this is excessive endplay, indicating that the bearing adjustment is greater than .001" and .005".

Metal Shavings in Lip Area: Before cleaning the seal, inspect the seal area for traces of metal particles. A magnet can attract metal particles. Sharp edges of metal may have cut the seal primary lip causing the seal to leak.

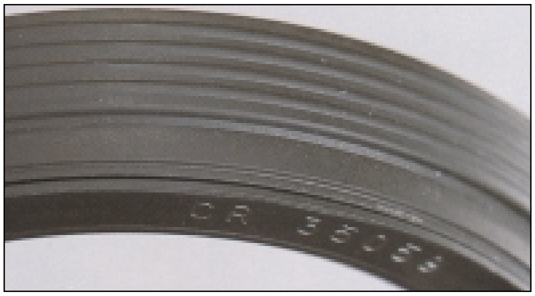
Cocked Seal—Inner Markings: Holding the outer cup just below eye level and flat, like a bowl, rotate your wrist through 360°. If the seal has run cocked, the two lines will be parallel to each other, but they appear to move closer and then farther from the outer cup flange.

Failure Analysis:

Scotseal® *PlusXL*

EXTERNAL INSPECTION – CHECKING THE BEADS

Normal exterior: The tough nitrile covering on the **Scotseal®** *PlusXL* doesn't supply clues as readily as Bore-Tite does. But it can still reveal problems and lead to corrective measures. There should be lubrication in each of the O.D., I.D. beads.



Dry exterior: If, in good illumination, you cannot see any residual lubrication between the beads of the outer sleeve, the seal may have been installed dry. A **Scotseal®** *PlusXL* does not need special tools, but it does need lubrication for proper installation.

Damaged O.D. beads: If the external ridges appear damaged, most likely someone has tried to force the seal in place without proper lubrication. Burrs or dirt in the bore can also cause problems, but they're not as visible with the thick nitrile rubber protection.

Worn I.D. beads: A worn I.D. indicates the seal has been slipping on the spindle. Look for three main causes: a cocked seal, a bent seal section, or poor spindle preparation in changing from another seal to the **Scotseal®** *PlusXL*.

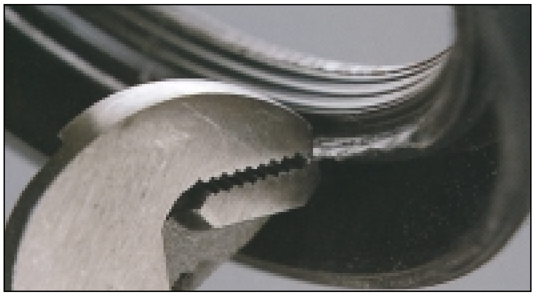
Damaged I.D. beads: Cuts or scarring in the I.D. is caused by jamming the seal into the spindle or axle tube. Misaligning the wheel dolly is usually the result of haste, however the work area should be checked to make sure the floor is smooth and free of clutter.

Dented, scarred sleeve assembly: A dimpled or dented surface indicates damage caused by a problem during installation. Lack of lubrication would be a prime suspect, but a poorly prepared hub or the use of hard-faced tools or seal driver could be the culprit.

Failure Analysis:

Scotseal®*PlusXL*

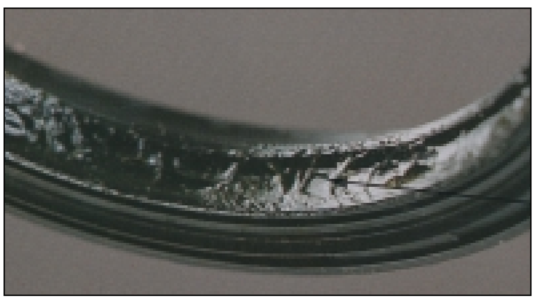
OPENING A **Scotseal**®*PlusXL*



Use pliers to straighten the flange on the sleeve section. Be sure to wear gloves or use a shop rag to protect your hands. The opened flange is extremely sharp.

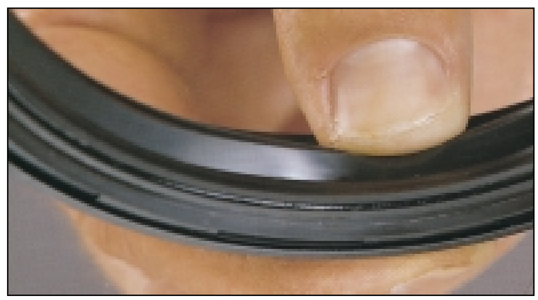
Pull the two components apart. Then set the sleeve assembly aside (the top component shown above). Place it carefully where it is out of the way, but won't be disturbed.

Internal Inspection – Sealing Lip Condition



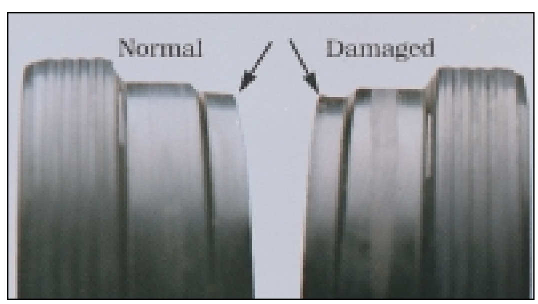
Factory Applied Grease

Check for grease: Locate the primary sealing lip and radial dirt lip. If the area between them is dry, something has allowed oil to wash away the grease. The cause could be excessive end-play or a cocked seal. Or internal pressure from a blocked vent.



Normal lip flexibility: Check the primary sealing lip and dirt lips by pressing downward on them with your thumbs, sliding them around the entire circumference. The rubber should remain soft and flexible in normal use.

Cracked lips: If, when you check the primary and dirt lips the nitrile feels rough and dry, it has probably been subjected to excessive heat. Loss of lubrication is one of the prime suspects.



Flattened bumper lip: Scale or rust on the spindle will prevent the wider **Scotseal**®*PlusXL* from sealing properly. This creates extra pressure on the bumper and axial dirt lips. The spindle must be fully cleaned and all wear rings removed before installing a **Scotseal**®*PlusXL*.

Failure Analysis:

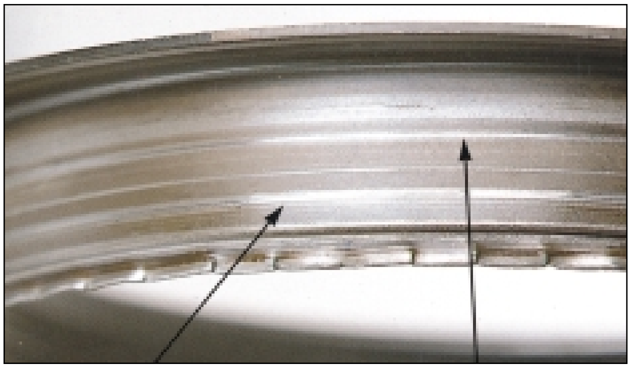
Scotseal® *PlusXL*

EXTERNAL INSPECTION –
Primary And Radial Dirt Lip Wear Patterns

Good primary lip pattern: You should see two parallel lines. The primary lip line is slightly wider than the radial lip marking, because it's a SKF Waveseal® design.

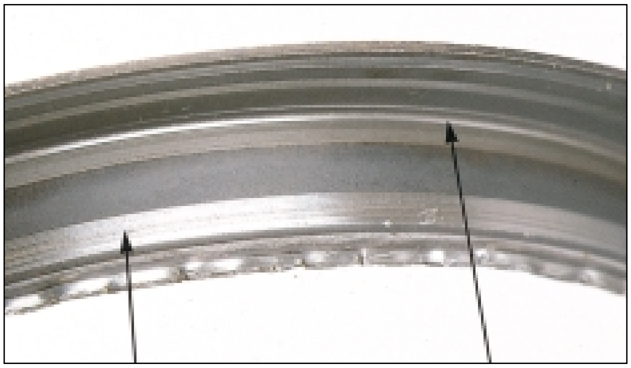
Primary Lip Wear Pattern *Radial Dirt Lip Wear Pattern*

Wide, wide: If both of the tracks formed by the primary and dirt lips are wide, chances are the whole wheel assembly is moving in and out at an excessive rate. End-play like this causes leaks as well as increased tire wear. The solution, of course, is proper bearing adjustment.



Primary Lip Wear Pattern *Radial Dirt Lip Wear Pattern*

Wide, thin: If the primary seal lip line (bottom) is extra wide, while the radial dirt lip line (top) is light, there is excessive pressure on the primary lip. For steer and trailer axles that can be a plugged vent, on drive axles the tube vent may be locked.

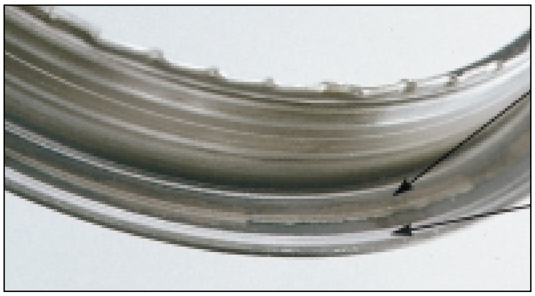


Primary Lip Wear Pattern *Radial Dirt Lip Wear Pattern*

Failure Analysis:

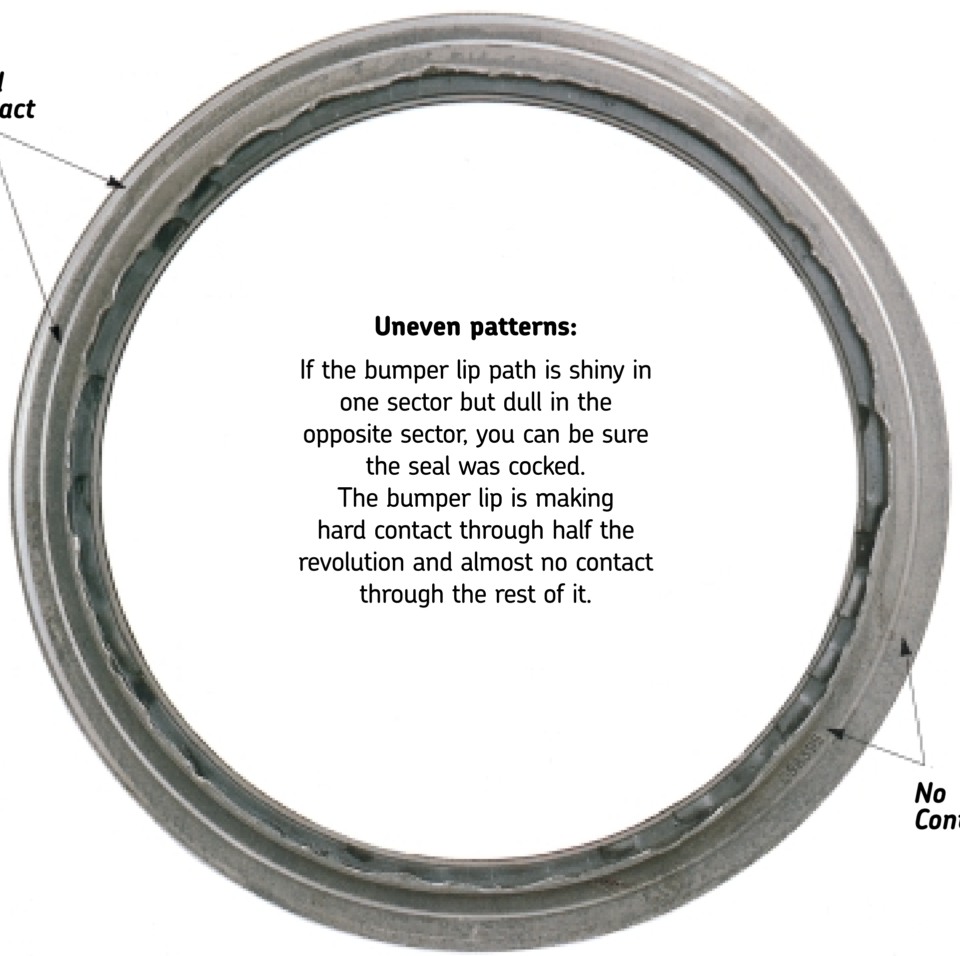
Scotseal® *PlusXL*

INTERNAL INSPECTION –
Axial Dirt Lip And Bumper Lip Wear Patterns



Good axial and bumper lip patterns: When you examine the axial face, you have two more wear patterns to learn from. About half way up on the face you should see a pencil line track from the axial lip, and at the top edge a gently scuffed pattern from the bumper lip.

Wide, shiny: If both lines are wide or polished clean, then you should suspect that the seal has been compressed. This will happen if the I.D. of the seal isn't lubricated before installation, if the sleeve wasn't sealed fully on the spindle, or if the bearing adjustment is too tight.



Uneven patterns:

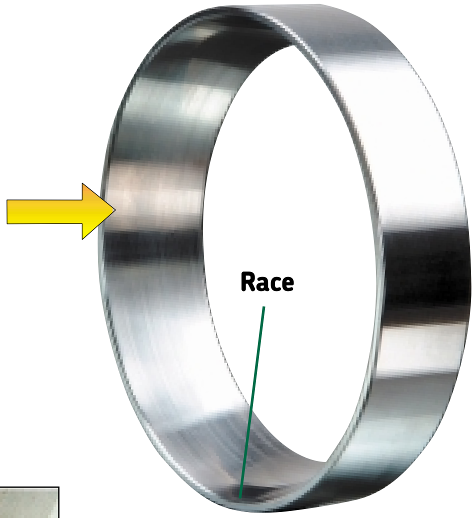
If the bumper lip path is shiny in one sector but dull in the opposite sector, you can be sure the seal was cocked. The bumper lip is making hard contact through half the revolution and almost no contact through the rest of it.

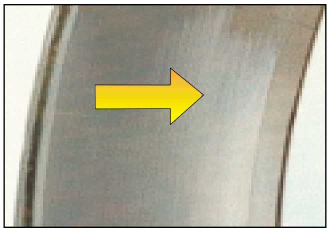
Inspection:

BEARING CUP

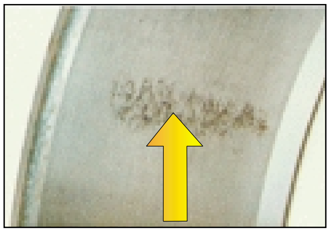
The most commonly damaged portion of the bearing cup is the tapered raceway surface inside the cup. Make a careful inspection and look for the following:

- Evidence of corrosion
- Metallic debris
- Pitting of the surface
- Metallic flakes
- Any other signs of damage or foreign matter



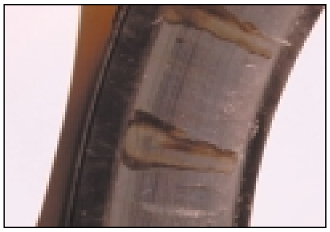


Severe sliding wear due to presence of hard abrasives.



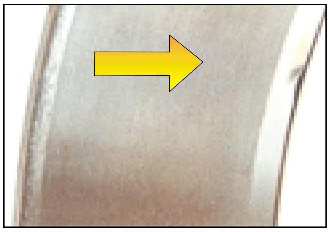
Etching of metal generally indicates water contamination, allowing oxidation to attack the surface.

Dent across the race indicates a sharp high impact.

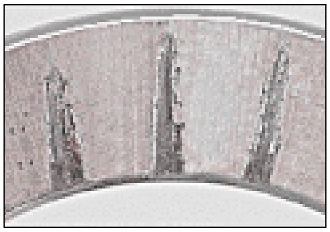


Cup shows considerable corrosion. This will develop in spalling.

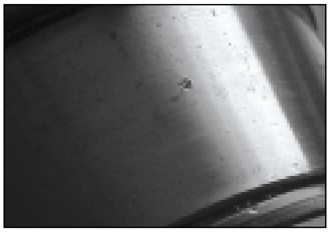
Heavy grooving by large hard particles in the lubricant.



Dings and dents in the bearing surfaces indicates a drift was used during installation.



Typical surface appearance with repeated effects of vibration (called “false brinelling”).



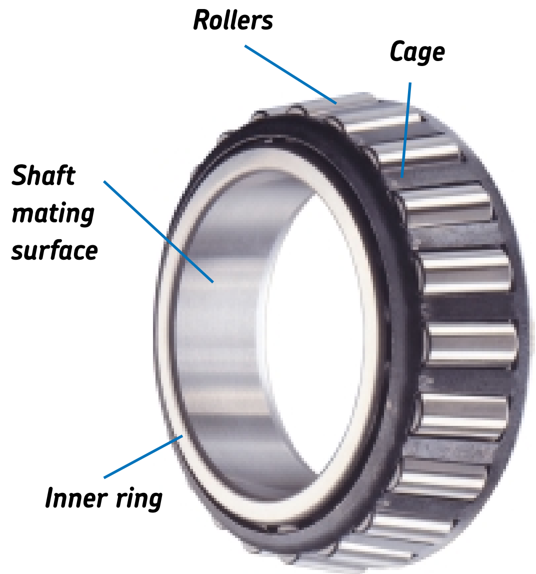
Surface appearance caused by electrical arcing during welding.

Inspection:

BEARING CONE

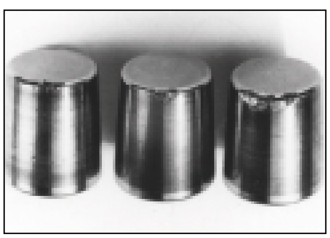
The cone of the bearing is a composite assembly consisting of taper rollers and a metal or polymer cage. This cage contains the rollers and an inner ring which is the interface surface with the shaft or spindle.

Since there are many moving parts on the cone, you should slowly rotate the cone assembly for proper inspection of all surfaces of the components.

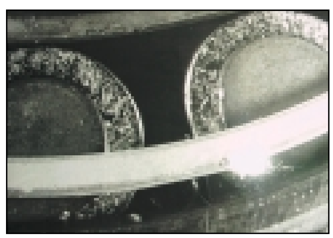


Make a careful inspection and look for the following:

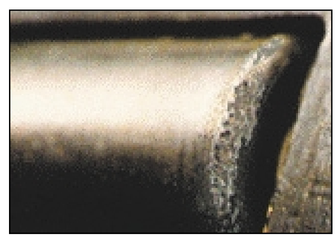
- Corrosion
- Metallic debris
- Pitting
- Metallic flakes
- Other signs of damage or wear



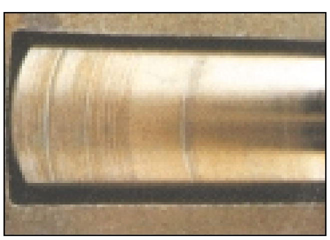
Roller end fracture due to heavy stress peaks caused by slackness of too loose bearing adjustment.



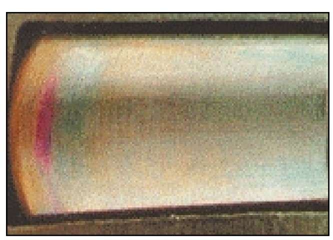
Roller end wear caused by over tightening, lubrication degradation, or lack of lubricant.



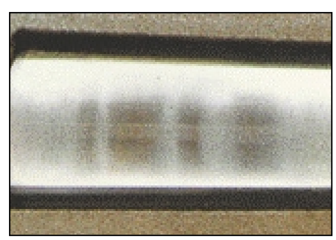
Roller end cracks indicate excessive loading or excessive misalignment.



Scoring indicates contamination by dirt, grit or metallic particles.



Coloration indicates an overheated bearing - from straw brown to deep purple. Causes are lack of lubricant, misadjustment or excessive loading.



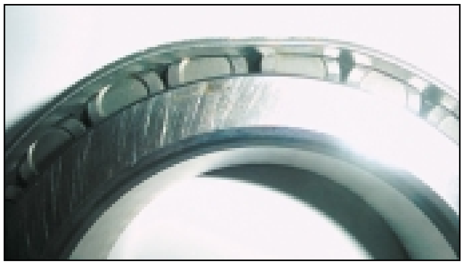
Wear marks in bands are due to foreign particles causing mild abrasive wear.

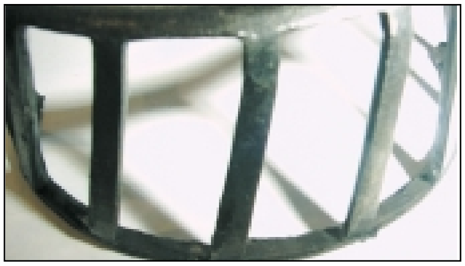
Inspection:

BEARING CAGE AND INNER RING

The bearing cage is made of either pressed steel or polymer and is therefore subject to various forms of damage.

These cages are deformed due to rough handling (dropping on the floor, being thrown in a box with other hard components, etc.) or poor installation with shock loads caused by hammering during removal or installation.





Inspection of the inner ring often requires a sharp eye because the damage can be very subtle. The most common types of fatigue damage are shown below.

Examine the inner ring raceway by holding the bearing against a light and turning the cage slowly. Look for pitting flaking, discoloration and corrosion.

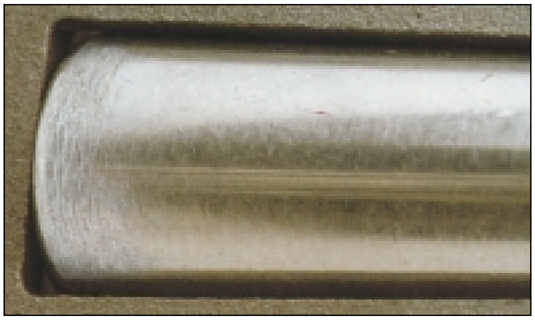
Dirt

Misalignment

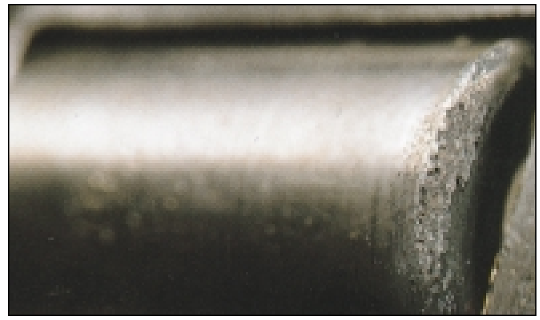
Insufficient lubricant

Failure Analysis for Bearings

IMPROPER BEARING ADJUSTMENT

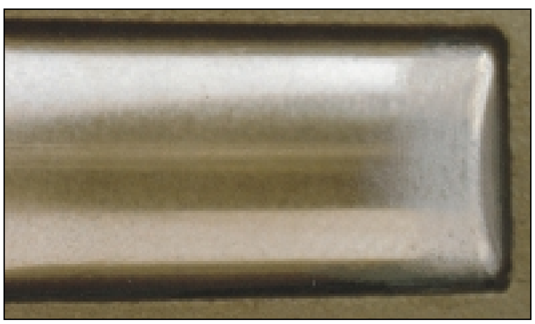


Large end of roller shows scoring, the result of excessive preload.



Large end of the roller shows spalling, the result of insufficient lubrication and/or excessive preload.

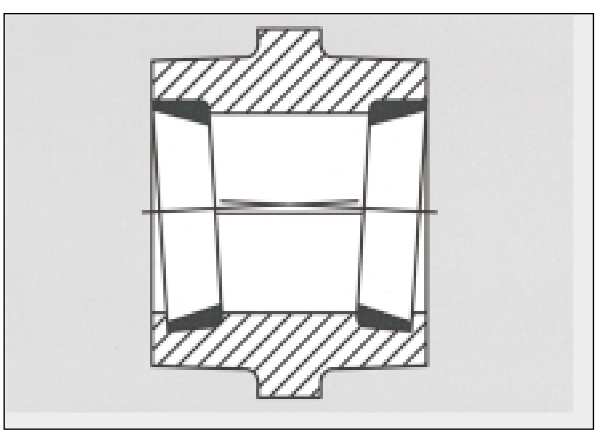
PITTING



Small end of the roller shows excessive wear, the result of loose bearing adjustment.

Pitting of the race, as a result of debris in the lube causing surface deformation.

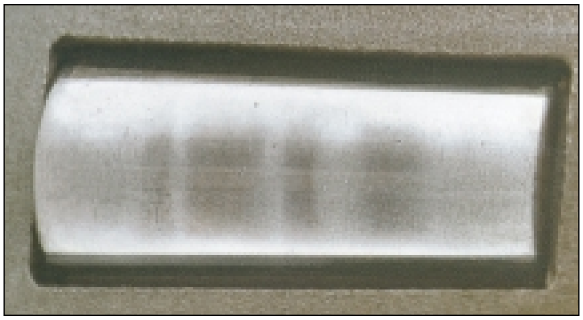
MISALIGNMENT



Misalignment occurs when the center lines of the two bearings are not parallel to each other. The causes can be an improperly seated bearing, where dirt or burrs prevent a flush mount; an outer cup installed without the proper tool; a warped shaft; or nut faces that are out of line.

Failure Analysis for Bearings

MISALIGNMENT

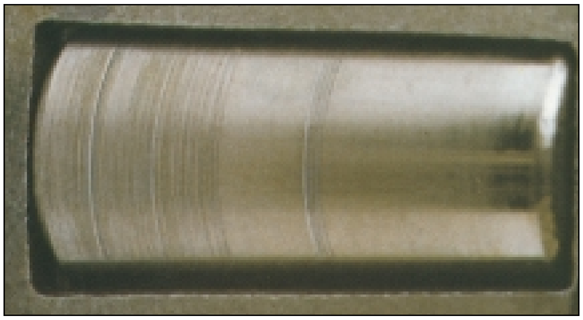


Uneven wear on the roller, the result of improper installation.

CONTAMINATION

Circular wear in the race, the result of hard particle contamination in the lube.

Vertical etching on the race, the result of moisture contamination within the lube.



Circular wear on the roller, the result of hard particle contamination in the lube.

Failure Analysis for Bearings

Peeling, the tearing away of metal from the race, the result of the breakdown of lubrication.

Discoloration indicates high levels of heat, the result of improper lubrication or improper bearing adjustment.

INSTALLATION DAMAGE

Deformation of the cage, the result of improper installation or mishandling prior to installation.

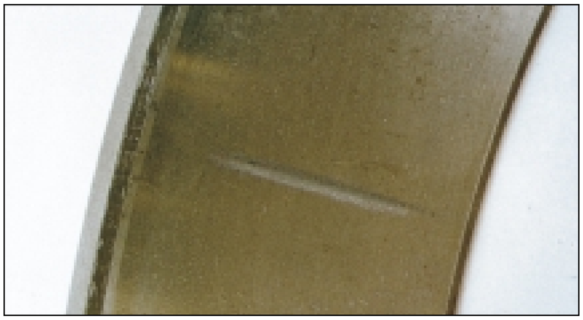
Cage damage, the result of abuse prior to or during installation.

Cracked cone, the result of misapplication or cocking the cone at installation.

Damage to the cup front face, the result of installation damage through use of a hardened driver.

Failure Analysis for Bearings

BRINELLING



Brinelling, the result of severe impact to the bearing, causing one or more of the roller bodies to deform the surface of the race.

OTHER DAMAGE

Fretting corrosion of the outer surface is often the result of a worn hub or spindle.

Light pitting can be caused by electrical arcing. The probable cause is electrical welding grounded through the shaft.

Spalling, the wearing away of metal from the bearing surface, the result of contamination, brinelling, improper installation, improper lubrication, or the normal end of bearing life.

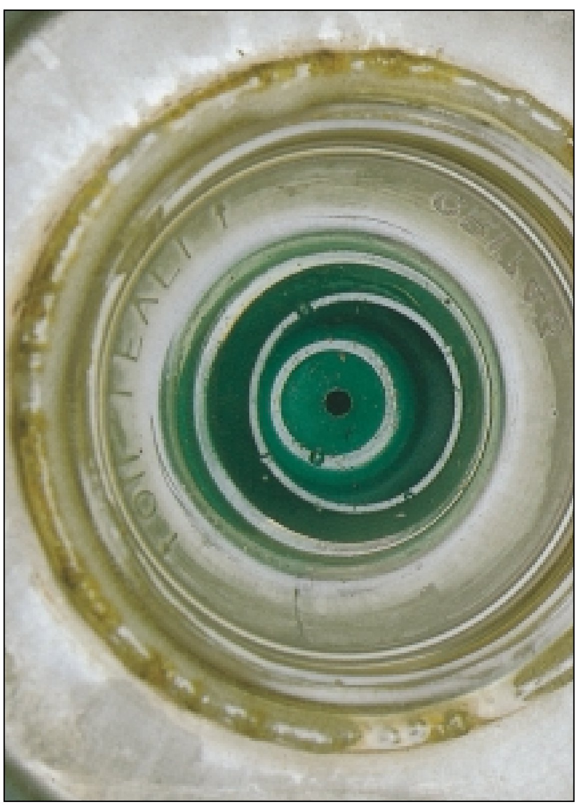
Failure Analysis for Hubcaps

INSPECTION OF LUBRICANT AND HUB CAP

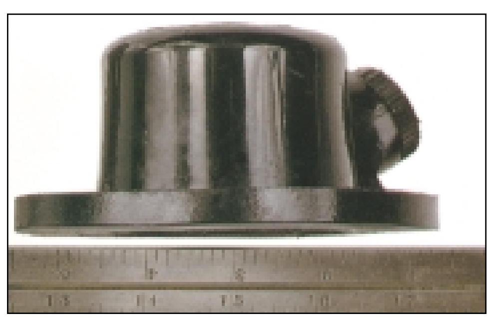
The hub cap is constantly exposed to the environment. That means hot, cold, wet, dry and road salt conditions. But some of it's roughest treatment can come from inside. A lack of lube or an over-tight bearing adjustment can cook the hub cap and permanently damage it. Here are a few of the clues to indicate why a hub cap has failed.

Distorted bolt hole: Bolt hole, or flange distortion, may be the result of excessive bolt torque during installation. The use of an impact wrench may damage the flange at the bolt hole area during assembly.

Milky window: The view window in the hub cap will become nearly opaque white when subject to heat. The heat comes from inside and spells trouble. You'll want to pull the wheel and check the bearing adjust-ment, check for low lube or a change to an incompatible lubricant.



Melted window: With the hub cap removed, inspect the edges of the view window for damage or discoloration. If the edge has a rippled look, chances are it has started to melt from excessive heat. Heat build-up could be from running low on lube, excessive pre-load on bearing or a recent switch to an incompatible lubricant.



Warped Flange: Place hubcap on a flat surface. When flange is distorted it will not hold contact all the way around. Proper torque specifications may not have been followed.

NOTES

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