

# LOCTITE®

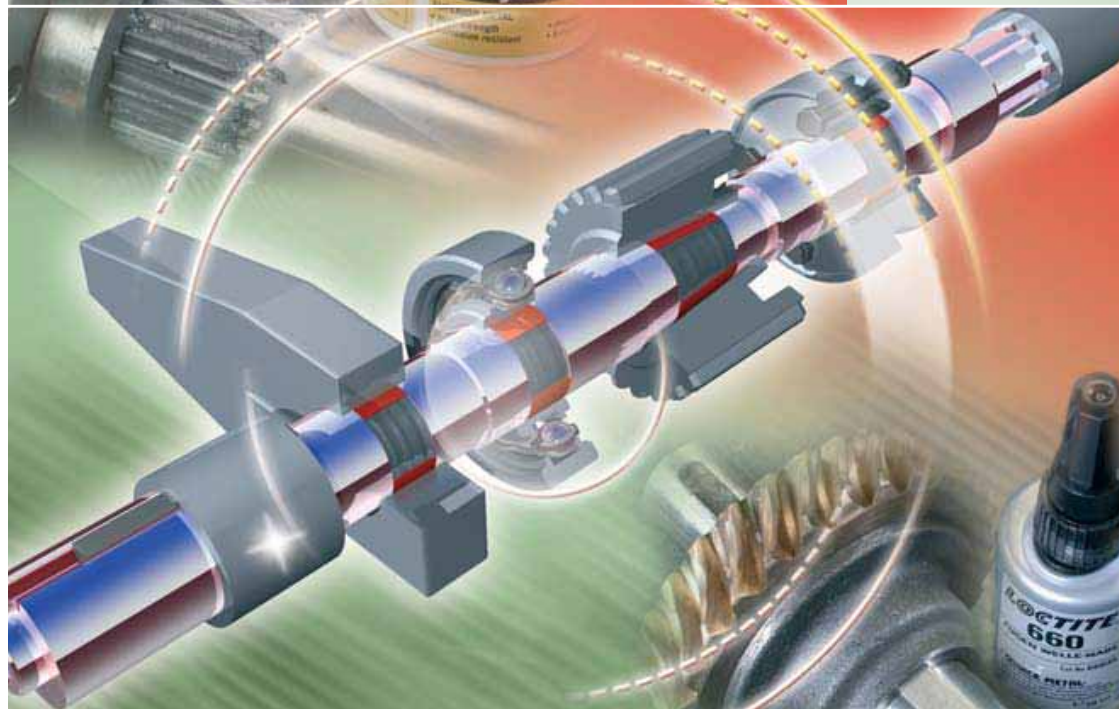


## Shaft Repair

### Rebuild and Maintenance Guide



Henkel





## Introduction

**This guide has been designed to provide quick and easy assistance to the professionals responsible for the maintenance and repair of shaft assemblies. With the help of this guide, you can:**

- Easily select the right way to repair the wide variety of shaft assemblies
- Pinpoint the most suitable repair method for worn parts, or prevent wear proactively
- Determine the best product for your particular maintenance or repair problem

Most shaft assemblies are incorporated into systems carrying a significant capital equipment value. It is therefore vital to maximise their useful lives and ensure reliable performance. Proactive maintenance can minimise expensive downtime, enhance reliability and dramatically cut costs.

**A comprehensive range of Loctite® products provides the busy maintenance engineer with all the technologies required to**

- Prevent common failures and extend end-product life
- Allow for the recycling of parts to avoid scrap and replacement costs
- Assist in disassembly
- Help ensure reliability and smooth running by restoring performance to "as new" condition.

## SHAFT DESIGN AND FUNCTIONS

The Shaft Repair Guide deals with typical shaft-mounted assemblies as well as roller and idler shaft configurations. The sections cover key assemblies, spline and toothed shafts, cylindrical and cone joints. They include tensioning element and clamp connections as well as key, pin or bolt connections used to attach parts and align components along a shaft.

## SHAFT REPAIR AND PROACTIVE MAINTENANCE

Harsh environments and operating parameters may result in wear, erosion, corrosion, etc. The Guide describes how to repair worn components or prevent wear proactively.

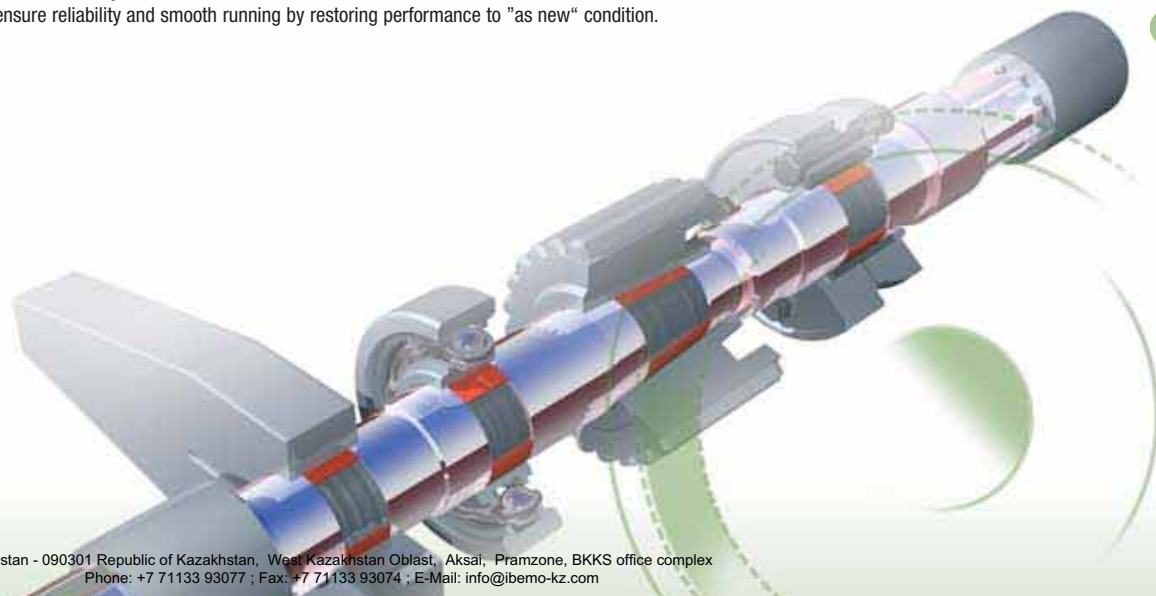
Different repair methods, colour-coded in the Shaft Repair Guide for easier reference, are available depending on the type and degree of wear:

- **Sleeving** to instantly restore a worn or damaged shaft or create a high quality seal surface
- **Bonding** to fill the gap with repair adhesive without compromising load-bearing capacity
- **Rebuilding** of badly worn shafts with metal filled epoxy

## PROFIT FROM RELIABILITY

Reliability and maintenance is a growing concern for companies. At Henkel, we understand the problems you face in ensuring reliability, safety and durability. We provide products for cost-efficient, easy and effective shaft maintenance and repair.

Contact your local Henkel representative for help to meet your specific product application needs.





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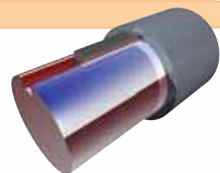
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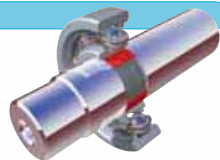
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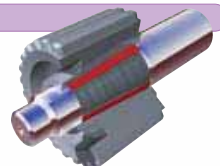
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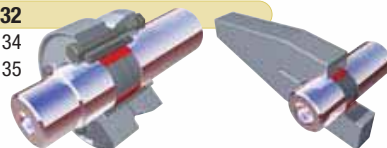
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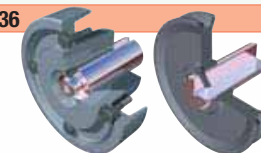
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# Shaft Repair Program

## Additional Products:

### Loctite® 7063 Cleaner & Degreaser:

- Use for all repair methods, for cleaning parts prior to adhesive bonding

### Loctite® 7649 Activator:

- Use in combination with Retaining Compound
- Increases cure speed on passive surfaces such as stainless steel, aluminium, and plated or passivated metals

### Loctite® 8192 Dry Film Lubricant Release Agent:

- Use as a release agent for the repair methods on parallel keys and splines

## Proactive Maintenance:

### Loctite® 8012 Moly Paste:

- Prevention of wear caused by friction
- Prevention of corrosion

## Proactive Maintenance:

### Loctite® 243 and 248 Threadlockers:

- Stop threads working loose
- Eliminate the micro-movement which leads to fretting
- Prevent keyway wear
- Prevent corrosion

## Sleeving:

### Loctite® 603, 648 and 668 Retaining Compounds:

- For badly worn shafts
- High load applications
- Use a sleeve material similar to the original shaft material

## Bonding:

### Loctite® 603, 648, 660 Retaining Compound and Loctite® Hysol® 9466 A&B Epoxy:

- Recover worn or incorrectly machined components by using repair adhesives
- Adhesive selection depends on depth of wear

## Rebuilding:

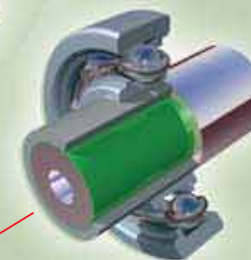
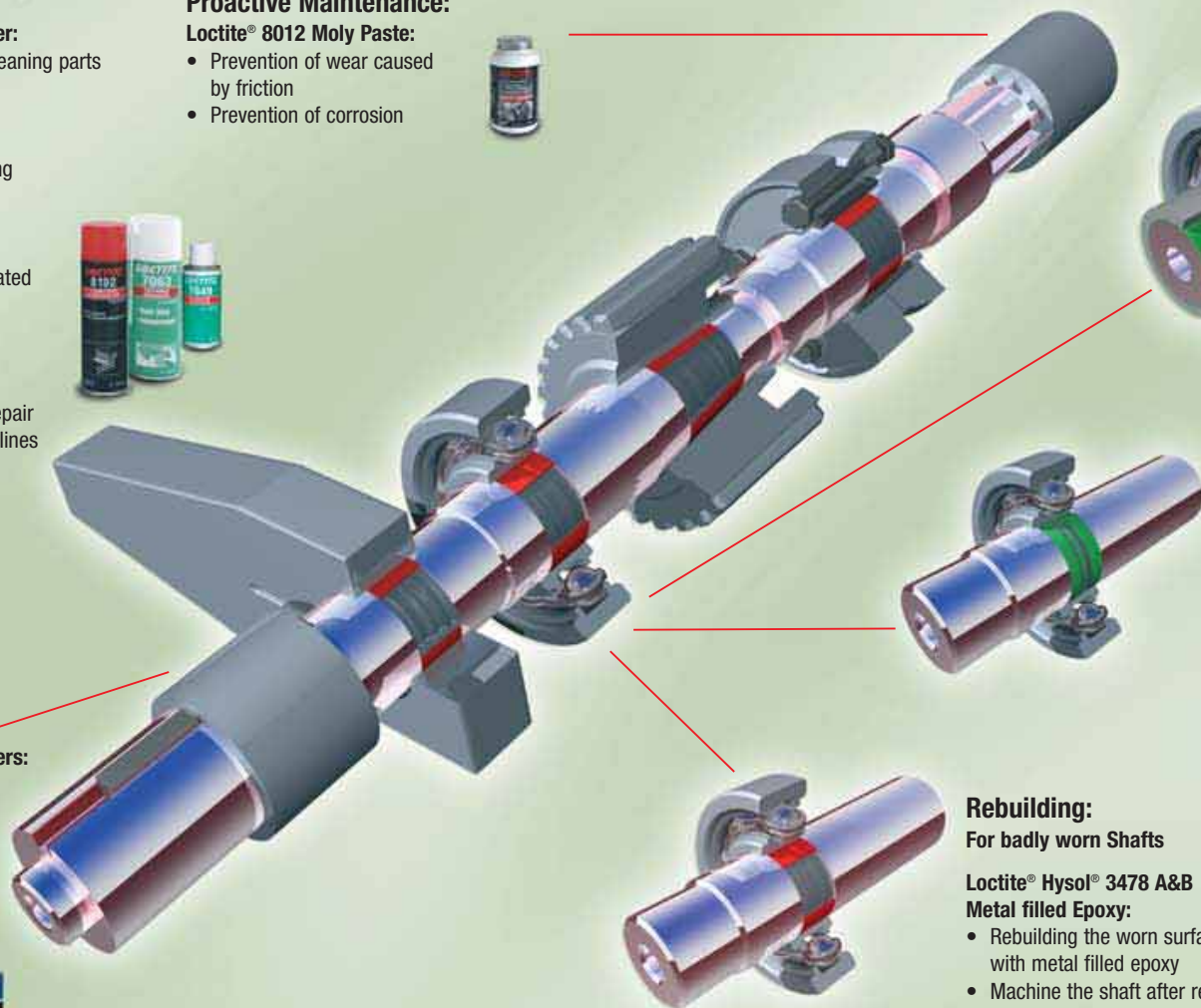
### For badly worn Shafts

### Loctite® Hysol® 3478 A&B Metal filled Epoxy:

- Rebuilding the worn surface with metal filled epoxy
- Machine the shaft after repair to the original (nominal) diameter


### Loctite® 660 Retaining Compound and Loctite® 7649 Activator:





- Bonding of the shaft mounted component onto the worn surface





## Repair Adhesive & Compounds

									
	<b>Anaerobic</b>			<b>Epoxy</b>			<b>Metal filled Epoxy</b>		
Material:	Metals			Metals; All Materials			Metals		
Repair Components:	Repair of Shaft: Parallel Key, Spline and Tooth Shaft; Cylindrical Fit; Cone Fit; Tensioning Element; Clamp Connection			Repair of Shaft: Parallel Key, Spline and Tooth Shaft; Cylindrical Fit			Repair of Shaft: Parallel Key, Spline and Tooth Shaft; Cylindrical Fit; Cone Fit; Tensioning Element; Clamp Connection		
Application	Sleeving; Bonding			Bonding			Rebuilding		
Min. – Max. Gap	<b>Press Fit – 0.25 mm gap</b>			<b>0.05 – 0.5 mm gap</b>			<b>&gt; 0.5 mm gap</b>		
Adhesive Number	Product	Application	Characteristic	Product	Application	Characteristic	Product	Application	Characteristic
	<b>Loctite® 603</b>	Oil Tolerant Retaining Adhesive	Fit: Press fit and narrow transition fit (up to 0.05 mm); temp. resistance: 150°C	<b>Loctite® Hysol® 3421 A&amp;B</b>	General Bonding	Medium viscosity extended working life; excellent humidity resistance	<b>Loctite® Hysol® 3471 A&amp;B</b>	Steel Putty	Steel putty; low shrinkage on cure (0.1%); temperature resistance: 120°C
	<b>Loctite® 620</b>	High Temperature Retaining Adhesive for large work pieces	Fit: Shrink fit up to clearance fit (0.10mm); temp. resistance: 230°C (when heat cured)	<b>Loctite® Hysol® 3430 A&amp;B</b>	Five Minute Epoxy	Medium viscosity; ultra clear; toughened	<b>Loctite® Hysol® 3472 A&amp;B</b>	Steel Pourable	Steel liquid; low shrinkage on cure (0.1%); temperature resistant (120°C)
	<b>Loctite® 638</b>	Special Retaining Adhesive for large gaps	Fit: Large clearance fit 0.05 up to 0.15 mm; temp. resistance: 150°C	<b>Loctite® Hysol® 3450 A&amp;B</b>	Five Minute Epoxy	Medium viscosity; steel filled; fast curing	<b>Loctite® Hysol® 3473 A&amp;B</b>	Steel Fast Cure	Steel putty; fast curing; temperature resistant (120°C)
	<b>Loctite® 640</b>	Special Retaining Adhesive for large diameters (slow cure)	Fit: Press fit up to clearance fit with 0.08 mm gap; temp. resistance: 175°C	<b>Loctite® Hysol® 9466 A&amp;B</b>	Toughened Epoxy	Medium viscosity; low density; high strength	<b>Loctite® Hysol® 3474 A&amp;B</b>	Self-lubricating, high wear resistant	Self lubricant; high wear resistant, temperature resistant (120°C)
	<b>Loctite® 641</b>	Possibility for disassembly	Fit: Narrow clearance fit up to 0.04 mm gap; temp. resistance: 150°C	<b>Loctite® Hysol® 9492 A&amp;B</b>	High temperature Epoxy	Medium viscosity; high strength; high temperature resistant (180°C)	<b>Loctite® Hysol® 3475 A&amp;B</b>	Aluminium Multi Purpose	Aluminium putty; low shrinkage on cure (0.1%); temperature resistant (120°C)
	<b>Loctite® 648</b>	Universal Retaining Adhesive	Fit: Press fit-transition fit – up to clearance fit with 0.08 mm gap; temp. resistance: 175°C				<b>Loctite® Hysol® 3478 A&amp;B</b>	Ferro Silicon Putty	High ferro-silicon content; Resists corrosion, abrasion and chemicals (120°C)
	<b>Loctite® 660</b>	Quick Metal for large gaps	Fit: Large clearance fit up to 0.25 mm gap; temp. resistance: 150°C				<b>Loctite® Hysol® 3479 A&amp;B</b>	Aluminium High Temperature Resistant	Aluminium putty; low shrinkage on cure (0.2%); high temperature resistant (190°C)
	<b>Loctite® 668</b>	Medium Strength Retaining Stick	Fit: Up to 0.15 mm gap; temp. resistance: 150°C; possible to dismantle for maintenance						
	<b>Loctite® 243</b>	Medium Strength Threadlocker	Parallel key: Securing the key in the key stocking						
	<b>Loctite® 248</b>	Medium Strength Threadlocker	Parallel key: Securing the key in the key stocking						

												
	<b>Wearing Compounds</b>			<b>Instant Bonding</b>			<b>Anti-Seize</b>			<b>Additional Products</b>		
Material:	Metals			Plastics and Elastomers			Metals			Metals		
Protect, rebuild and repair shafts with high wear areas of processing equipment				Shaft Repair of: Plastics and elastomers, rubbers, porous or absorbent materials			Shaft Repair: Avoid wear proactively For parts under static stress and slow turning and moving components			Shaft Repair: Avoid wear proactively For parts under static stress and slow turning and moving components		
Rebuilding of worn out surfaces Abrasion and impact resistance				Bonding			Avoid wear, corrosion and seizing, lubrication property			Avoid wear, corrosion and seizing, lubrication property		
> 0.5 mm (layer)	Product	Application	Characteristic	Product	Application	Characteristic	Product	Application	Characteristic	Product	Application	Characteristic
	<b>Loctite® Nordbak® 7221</b>	Chemical resistant coating protects equipment against corrosion caused by chemical exposure	Brushable consistency; ideal thickness: 0.5 mm, max. temp. 65°C	<b>Loctite® 401</b>	Universal Instant Adhesive	General purpose for bonding most substrates such as plastics and rubber	<b>Loctite® 8009 CS-A®</b>	Heavy Duty Anti-Seize: Long term protection at high temperatures	All metals; temp. range: short -30 to +1315°C	<b>Loctite® 7063</b>	Cleaner and Degreaser	Non CFC solvent based; general degreasing part cleaner; final pre-assembly cleaning treatment to be bonded with Loctite® adhesive
	<b>Loctite® Nordbak® 7227</b>	Brushable Ceramic Grey; Providing a smooth, protective, abrasion resistant coating	Silicon carbide filled; ultra smooth brushable consistency; ideal thickness: 0.5 mm, max. temp. 90°C	<b>Loctite® 454</b>	High-viscosity Instant Adhesive	General purpose gel for bonding metals, composite materials and ceramic	<b>Loctite® 8012</b>	Moly Paste Anti-Seize; Eliminate friction secure during assembly	All metals; temp. range: -30 to +400°C; ensures maximum lubricity			
	<b>Loctite® Nordbak® 7228</b>	Brushable Ceramic White; Providing a smooth, protective, abrasion resistant coating	Aluminium oxide filled; ultra smooth brushable consistency; ideal thickness: 0.5 mm, max. temp. 90°C	<b>Loctite® 480</b>	Toughened Instant Adhesive	Black, rubber toughened grade for bonding metal to metal and metal to rubber	<b>Loctite® 8023</b>	Marine Grade Anti-Seize; Use in high humidity/ water concentration; all metals	All metals; temp. range: -30 to +1315°C	<b>Loctite® 7649</b>	Activator N	In combination with anaerobic adhesives; for applications with passive metals or inert surfaces and large bonding gaps or where prevailing temperature is low
	<b>Loctite® Nordbak® 7234</b>	High temperature Brushable Ceramic Grey	Smooth, wear, resistant; low friction coating; ideal thickness: 0.5 mm, max. temp. 205°C				<b>Loctite® 8060 stick</b>	Aluminium Anti-Seize; For Screws, nuts, pipes, heat exchangers	All metals; temp. range: -30 to 870°C			
							<b>Loctite® 8065 CS-A® stick</b>	Copper Anti-Seize; for screws, nuts, pipes, heat exchangers	Metals (except stainless steel and Ni alloys); temp. range: -30 to 980°C	<b>Loctite® 8192</b>	Dry Film Lubricant Release Agent	Using as a release agent; Food grade (H2NSF), PTFE coating





## Parallel Key



## CHALLENGE



### Shaft mounted component: e.g. Gear Wheel or Pulley

- Stop key and keyway wear
- Repair worn keys
- Protection of new and reclaimed components against wear, abrasion and chemical attack

#### Note:

The following procedures can be used in a similar way on all types of key systems, but the repair method is explained for parallel keys. Example for other keys which can be repaired are:

- Woodruff keys
- Gib head keys
- Taper keys

#### Cause:

- Out of tolerance machining results in loose components; this leads to micro-movement and wear
- Alternating loads
- Worst case combined loading
- Damage during assembly
- Incorrect assembly due to contamination of the parts
- Incorrect specified keyway assembly – producing overload during operation



## SOLUTION

Depending on the extent of the wear, the following adhesives are recommended

Solution	Repair Method	Adhesive Group	Repair Adhesive	Kind of Fit:	Repair Gap/ Bonding Gap:	Curing time (Steel):
1.	Alignment of parallel key (Worn shaft keyway)	Anaerobic Adhesive	Loctite® 648	Transition/ Clearance Fit	Badly worn keyway	12 hrs*
2.	New parallel keyway (Worn keyway at shaft and collar)	Metal filled Epoxy	Loctite® Hysol® 3478 A&B	Transition/ Clearance Fit	Badly worn keyway	24 hrs*
3.	Bonding (Worn shaft keyway)	Anaerobic Adhesive and Activator	Loctite® 660 + Loctite® 7649	Medium Gap	< 0.25 mm	12 hrs*
4.	Bonding (Worn shaft keyway)	Epoxy and Release Agent	Loctite® Hysol® 9466 A&B	Medium Gap	> 0.2 mm – 0.5 mm	24 hrs*
5.	Rebuilding (Worn shaft keyway)	Metal filled Epoxy and Release Agent	Loctite® Hysol® 3478 A&B	Large Gap	> 0.5 mm	24 hrs*

\* Apply heat to the joint under repair for a faster curing time  
Note: Refer to Technical Data Sheets for more details



## Parallel Key



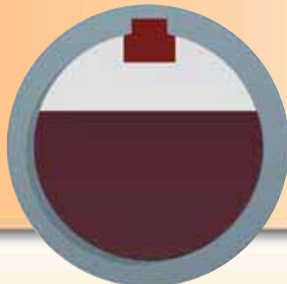
### SOLUTION #1

#### Alignment of parallel key

##### Steps:

##### Badly worn parallel key assembly

- Disassemble the machine components
- Select a parallel key of the next larger size
- Mill the worn shaft keyway to the size of the new parallel key
- Machine a step in the new parallel key to fit the original keyway in the female component. Reduce the height of the key to fit the keyway
- Roughen the surface
- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply Loctite® 648 to the keyway of the shaft
- Assemble the parallel key into the shaft
- Wipe off excess adhesive
- Where there is a high power application, apply Loctite® 648 on to the whole shaft at the engagement area
- Assemble with the key in place
- Wipe off adhesive excess
- Allow adhesive to cure



### SOLUTION #2

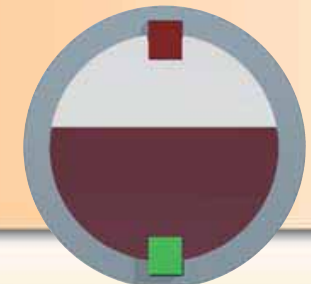
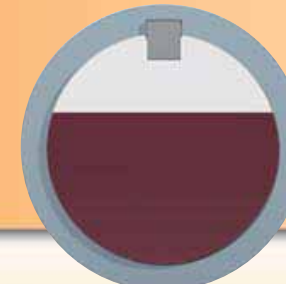
#### New keyway in existing shaft and collar

If parts are very badly worn it may be necessary to cut new keyways, in this situation the old keyways can be filled as described below.

##### Steps:

##### Worn parallel keyway at shaft and collar

- Disassemble the machine components
- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply Loctite® Hysol® 3478 A&B Superior Metal into the keyway of both the shaft and collar. Fill all the available space
- Allow 24 hours curing time
- If a rounded surface is required, machine the cured adhesive to the original dimensions of the shaft and bore of the collar
- Machine a new keyway in the shaft and collar
- Re-clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply several drops of Loctite® 243 Threadlocker directly into the new keyway
- Insert the key into the keyway
- Wipe off any excess adhesive
- Assemble the components
- Allow adhesive to cure





## Parallel Key



## SOLUTION #3, 4, 5

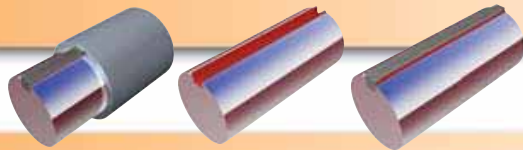


### Bonding + Rebuilding

#### Steps:

Select the repair adhesive according to the extent of component wear

- Disassembly of the parallel key assembly is necessary. However, the repair is possible without removal of the shaft
- Prepare the surface by roughening with a file or rotary cutting/grinding tool
- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply a thin layer of Loctite® 8192 Dry Film Lubricant to the collar and to any other area where adhesion is not required
- Coated parts should not be disturbed during time, 15 to 30 minutes at room temperature
- Apply the selected repair adhesive using a spatula or putty knife. Use a thin coat on the bottom and a thicker layer on the side walls. This ensures the key will not sit too high in the assembly, and produces a close tolerance fit
- Scrape away excess adhesive from the side of the keyway
- Immediately position the components in order to align the key, shaft and hub
- Allow the adhesive to fully cure before putting the equipment back into service



## RESULTS

- The assembly is restored and ready for service without a major overhaul
- The key is secured into the keyway
- Elimination of repeat wear

## PREVENT WEAR PROACTIVELY

#### Challenge:

- Secure the key in the keyway on new equipment
- Prevent micro-movements that lead to wear

#### Cause:

- In a new assembly the fit between the key and the keyway is usually tight. However, over time, wear can cause this fit to loosen – leading to damage to the keyway



#### Solution:

- Apply a Loctite® Medium Strength Threadlocker to the keyway or the key
- Loctite® Medium Strength Threadlocker is appropriate for the gap fill and provides sufficient strength, however, allows easy removal for servicing
- If the key needs removal, use a hammer to tap a metal chisel or drift against the key

#### Steps:

- Clean the keyway and key with Loctite® 7063 Cleaner and Degreaser
- Apply several drops of Loctite® 243 Threadlocker into the keyway, or Loctite® 248 Threadlocker onto the key
- Insert the key into the keyway
- Wipe off any excess adhesive
- Allow the adhesive to cure before the assembling of the shaft mounted component

#### Results:

- Eliminate the micro-movements which lead to fretting
- Prevent keyway wear
- Prevent corrosion



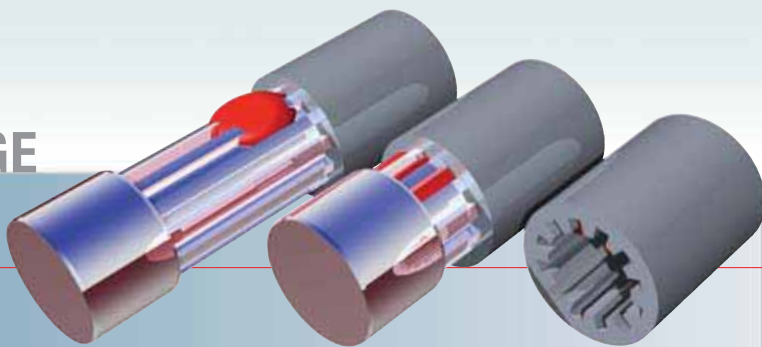




## Spline and Toothed Shaft



## CHALLENGE



### Shaft mounted component: e.g. Cardan Joint

With spline and toothed shaft it is necessary to differentiate between fixed and sliding splines. The methods mentioned below describe the repair solution for fixed splines only.

- Stop spline wear and failure
- Reduce downtime
- Eliminate costs of new parts
- Reuse previously worn components

#### Cause:

- Out of tolerance machining of components leads to micro-movement and wear
- Alternating loads
- Worst case combined loading
- Damage during assembly
- Incorrect assembly due to contamination of the parts
- Incorrectly specified spline drive – producing overload during operation

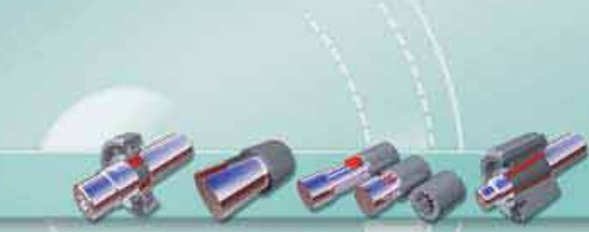


## SOLUTION

Depending on the extent of the wear, the following adhesives are recommended

Solution	Repair Method	Adhesive Group	Repair Adhesive	Kind of Fit:	Repair Gap/ Bonding Gap:	Curing time (Steel):
1.	Bonding non sliding spline	Anaerobic Adhesive and Activator	Loctite® 660 + Loctite® 7649	Medium Gap	< 0.25 mm	12 hrs*
2.	Bonding non sliding spline	Epoxy	Loctite® Hysol® 9466 A&B	Medium Gap	> 0.2 mm – 0.5 mm	24 hrs*
3.	Rebuilding non sliding spline	Metal filled Epoxy	Loctite® Hysol® 3478 A&B	Large Gap	> 0.5 mm	24 hrs*

\* Apply heat to the joint under repair for a faster curing time  
Note: Refer to Technical Data Sheets for more details



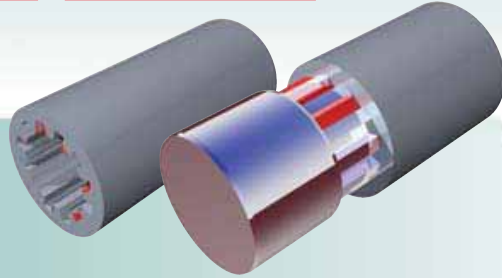
## SOLUTION #1, 2, 3

### Rebuilding

#### Steps:

Select the repair adhesive according to the extent of component wear

- Disassemble the machine components
- If there is no chamfer on the leading edges of the socket, create one using a file or grinding wheel
- Abrasive blast the surface of the spline/toothed shaft and socket
- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Check the spline area for uniformity. Remove high spots or rough areas by filing or stone sanding. Clean again
- Mix (not for Loctite® 660) and apply the adhesive to the spline shaft.  
Use a spatula for Loctite® Hysol® 3478 A&B. Do not apply adhesive into the socket.
- Immediately push the spline/toothed shaft into the socket and remove excess adhesive
- Allow the adhesive to cure before putting the equipment back into service



## RESULTS

Assembly is restored and ready for service without a major overhaul.



## Spline and Toothed Shaft



## PREVENT WEAR OF SPLINE OR TOOTH SHAFT PROACTIVELY

#### Challenge:

- Protecting the spline inside of the socket to prevent unnecessary fretting

#### Cause:

- Wear will occur where there is friction and movement in the spline coupling
- Contamination between shaft and socket

#### Solution:

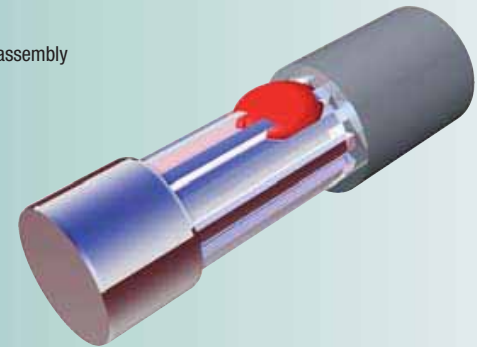
- Use Loctite® 8012 Moly Paste proactively
- Loctite® 8012 Moly Paste contains 65% molybdenum disulfide for maximum lubricity
- Moly Paste reduces friction
- The low and uniform friction coefficient of 0.06 creates reliable assembly conditions

#### Steps:

- Clean mating surface before application
- Coat mating surface Loctite® 8012 Moly Paste
- Assemble parts

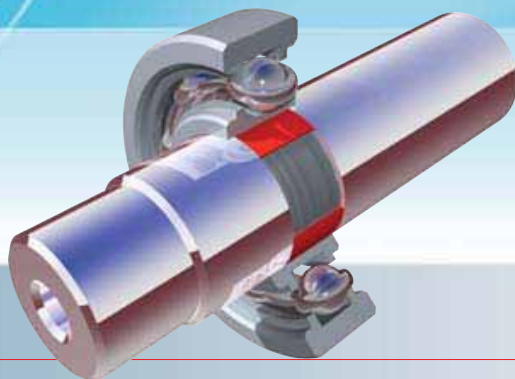
#### Results:

- Prevention of wear caused by friction
- Prevention of corrosion





## CHALLENGE



### Shaft mounted component: e.g. Bearing

- Repair worn cylindrical shaft
- Prevent downtime and scrap costs
- Protection of new components against wear, abrasion and chemical attack

#### Cause:

- Out of tolerance machining results in loose components; this leads to micro-movement and wear
- Load produces axial forces that are higher than original calculations
- Spun bearing caused by insufficient interference or inappropriate loads
- Use of components in aggressive environments and at elevated operating temperatures



## SOLUTION

Depending on the extent of the wear, the following adhesives are recommended

Solution	Repair Method	Adhesive Group	Repair Adhesive	Kind of Fit:	Repair Gap/ Bonding Gap:	Curing time (Steel):
1.	Sleeving	Anaerobic Adhesive	Loctite® 648/668	Press/ Transition Fit	< 0.0 mm (Bonding Gap)	12 hrs*
2.	Bonding	Anaerobic Adhesive	Loctite® 648/668	Transition Fit up to Small Gap	0.0 – 0.08 mm (Repair Gap)	12 hrs*
3.	Bonding	Anaerobic Adhesive and Activator	Loctite® 660 + Loctite® 7649	Medium Gap	> 0.05 – 0.25 mm (Repair Gap)	12 hrs*
4.	Bonding	Epoxy	Loctite® 9466	Medium Gap	> 0.2 – 0.5 mm (Repair Gap)	24 hrs*
5.	Rebuilding + Bonding	Metal Filled Epoxy	Loctite® Hysol® 3478 A&B + Loctite® 660	Large Gap	> 0.5 mm (Repair Gap)	24 hrs*

\* Apply heat to the joint under repair for a faster curing time  
Note: Refer to Technical Data Sheets for more details







## Cylindrical Joint

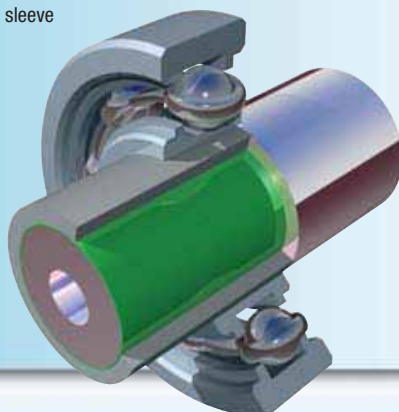
### SOLUTION #1

#### Sleeving

##### Steps:

**Badly worn shaft and high load application**

- Determine appropriate size of a sleeve and manufacture as follows:
  - Create a transition fit joint between shaft and sleeve
  - Ensure the outside diameter is the specified shaft diameter
  - Roughen the surface
- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply a bead of Loctite® 648 to the circumference of the shaft at the leading edge of the component to be inserted. Apply the adhesive to both parts of the assembly. In the case of a shrink fit (using thermal energy for assembling) apply the adhesive onto the cold part, coating the complete engagement area
- Assemble sleeve: In some cases, heat should be applied to the transition fit
- Wipe off excess
- Allow adhesive to cure
- Adopt the same procedure for press fit joints between the sleeve and bearing



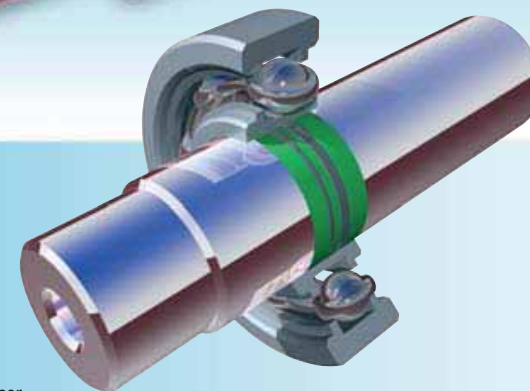
### SOLUTION #2, 3, 4

#### Bonding

##### Steps:

**Select the repair adhesive according to the extent of component wear**

- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Roughen shaft mounted component and shaft with abrasive paper at the bonding area
- Re-clean parts
- Apply a bead of the repair adhesive to the circumference of the shaft at the leading edge of the component. Apply the adhesive to both parts of the assembly. In the case of a shrink fit (using thermal energy for assembling) apply the adhesive onto the cold part, coating the complete engagement area  
Note: For the solution #3 with Loctite® 660 an activator, Loctite® 7649 is recommended
- Assemble shaft mounted component: In some cases, heat should be applied to the transition fit
- Wipe off excess
- Allow the repair adhesive to cure before putting the equipment back into service



## SOLUTION #5

### Rebuilding + Bonding

#### Steps:

##### Badly worn shaft

- Using a lathe, undercut the shaft in the worn area as follows:  
Shaft diameter: 13 – 25 mm: Desired undercut: 1.5 mm  
Shaft diameter: 25 – 75 mm: Desired undercut: 3 mm
- Dovetail the ends of the worn area to lock the application into place. This serves as a guide when repairing
- Finish undercutting by machining a rough cut surface (e.g. Rz := 100 µm). The larger the shaft diameter, the coarser the cut
- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply a very thin layer of Loctite® Hysol® 3478 A&B Superior Metal and force it into the rough surface finish. Turn the shaft at a very low speed and continue to apply adhesive by using a putty knife or similar. Build the surface above the final desired level
- Allow the adhesive to cure for 12 hours at room temperature. If necessary apply dry heat to the repair area to speed the cure
- Machine the repair to the required dimensions
- Cut the material with the component dry, using carbide or high speed steel. If polishing is required, use an abrasive paper
- Retain the joint between the shaft and the shaft mounted component with Loctite® 660 (See solution #3)

#### Note:

The Loctite® 7649 Activator is necessary on the rebuilt surface of the shaft, because of the passive surface

## RESULTS

- Worn shaft is repaired
- Cylindrical joint is strengthened by using a Loctite® Retaining Compound



## PREVENT BEARING SPINOUT PROACTIVLY

#### Challenge:

- Prevent bearing spinout
- Prevent corrosion and component damage
- Salvage worn components

#### Cause:

- Bearings are prone to spinning either on their shafts or within their housings. This results in damage to these parts regardless of whether or not they are a press, shrink or slip fit
- The air space that exists between a bearing and shaft is an area where rust can form and cause damage to the parts

#### Solution:

- Retain joint using Loctite® 648 (universal, high strength) or Loctite® 603 (oil tolerant, high strength) Retaining Compound

#### Steps:

- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply a bead of Loctite® 648/603 Retaining Compound to the circumference of the shaft at the leading area of the component
- Press the bearing on to the shaft using normal techniques
- Wipe of excess material

#### Results:

- Shaft and/or bearing housing damage is eliminated
- Micro movement between the bearing and the repair area is eliminated
- Corrosion is stopped because the air space between the bearing and the shaft housing is sealed







## Taper Joint



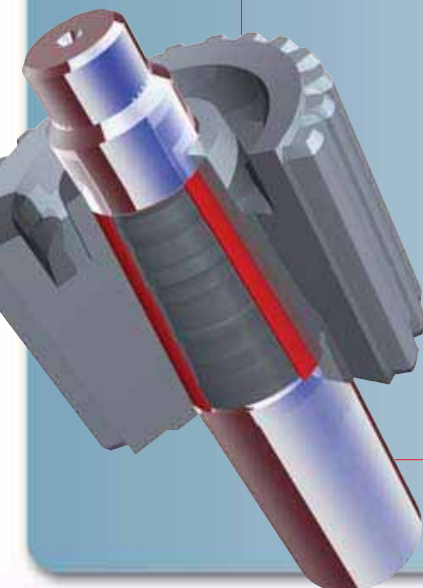
## CHALLENGE

### Shaft mounted component: e.g. Gear Wheel

- Repair worn taper joints
- Prevent downtime and scrap costs
- Protection of new components against wear, abrasion and chemical attack

#### Cause:

- Inaccurate machining of components producing incorrect dimensions – leading to micro-movements
- Dirt between the shaft-mounted component and the shaft
- Use of components in elevated operating temperatures



## SOLUTION

Depending on the extent of the wear, the following adhesives are recommended

Solution	Repair Method	Adhesive Group	Repair Adhesive	Kind of Fit:	Repair Gap/ Bonding Gap:	Curing time (Steel):
1.	Sleeving	Anaerobic Adhesive	Loctite® 648	Press/ Transition Fit	< 0.0 mm (Bonding Gap)	12 hrs*
2.	Bonding	Anaerobic Adhesive	Loctite® 648	Press Fit and Transition Fit	< 0.0 mm (Bonding Gap)	12 hrs*
3.	Rebuilding + Bonding	Metal Filled Epoxy	Loctite® Hysol® 3478 A&B + Loctite® 648	Large Gap	> 0.5 mm (Repair Gap)	24 hrs*

\* Apply heat to the joint under repair for a faster curing time  
Note: Refer to Technical Data Sheets for more details



## SOLUTION #1

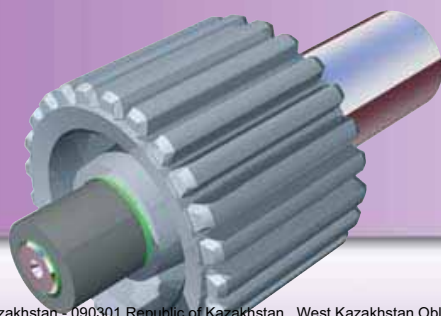
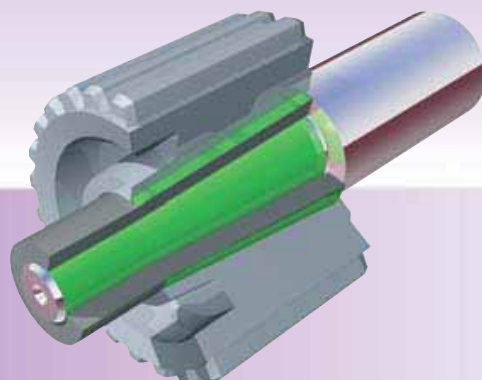
### Sleeving

#### Steps:

##### Badly worn shaft and high load application

- Determine an appropriate size of a sleeve
- Create a press fit joint between shaft and sleeve
- Outside diameter of the sleeve should be the nominal diameter of the original cone
- Roughen the surface
- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply a bead of Loctite® 648 to the circumference of shaft at leading edge of the component. Apply to both parts of the assembly. In case of a shrink fit (using thermal energy for assembling) apply onto the cold part
- Press fit with heating up the sleeve or without heat, depending on the requirements of the assembly. In general, assembling with thermal energy gives better performance of the cured adhesive
- Wipe off excess
- Allow adhesive to cure
- Use the same procedure for press fit joints between the sleeve and the shaft-mounted component

**Note:** If the gear wheel needs a specified axial position it is to recommend that the cone sleeve be machined to the original dimensions after bonding it to the shaft.

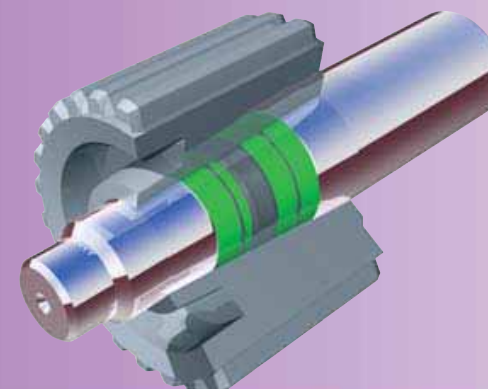


## SOLUTION #2

### Bonding

#### Steps:

- Roughen inside of the sleeve and cone shaft with abrasive paper
- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply a bead of Loctite® 648 to the circumference of the shaft at leading edge of component. Apply to both parts of the assembly. In the case of a shrink fit (using thermal energy for assembling) apply onto the cold part
- Press fit with heating up the sleeve or without heat, depending on the requirements of the assembly. In general, assembling with thermal energy gives better performance of the cured adhesive
- Wipe off excess
- Allow adhesive to cure





## Taper Joint

### SOLUTION #3

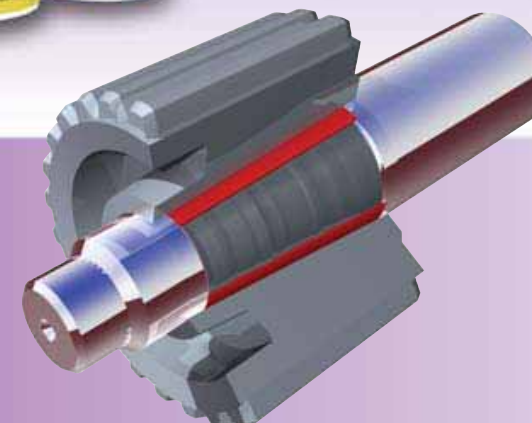
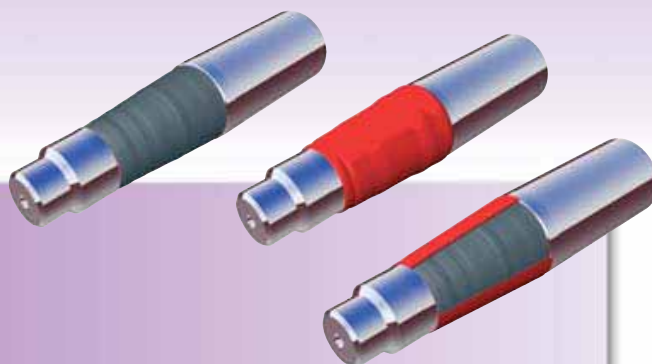
#### Rebuilding + Bonding

##### Steps:

- Using a lathe, undercut the shaft in the worn area as follows:
  - Cone middle diameter: 13 – 25 mm: Desired undercut: 1.5 mm
  - Cone middle diameter: 25 – 75 mm: Desired undercut: 3 mm
- Dovetail the ends of the worn area to lock the application into place. This serves as a guide when repairing
- Finish undercutting by machining a rough cut surface. The larger the shaft diameter, the deeper the threads
- Clean parts with Loctite® 7063 Cleaner and Degreaser
- Apply a very thin layer of Loctite® Hysol® 3478 A&B Superior Metal and force it into the rough surface finish. Turn the shaft at a very low speed and continue to apply adhesive by using a putty knife or similar. Build the surface above the final desired level
- Allow the adhesive to cure for 12 hours at room temperature. If necessary apply dry heat to the repair area to speed the cure
- Machine the repair area to the required dimensions
- Cut the material with the component dry, using carbide or high speed steel. If polishing is required, use an abrasive paper
- For the cone fit between the repaired cone shaft and the cone-mounted component, use Loctite® 648. Use procedure of solution #2, see page 29

##### Note:

The Loctite® 7649 Activator is necessary on the rebuilt surface of the shaft, because of the passive surface.



### RESULTS

- Assembly is restored and ready for service without a major overhaul
- Cone joint is strengthened by using a Loctite® adhesive as a Retaining Compound

### PREVENT CONE FIT WEARING PROACTIVELY

Use of Loctite® 648 Retainer will proactively prevent wearing of a cone fit. Proceed as described in Solution #2, see page 29.

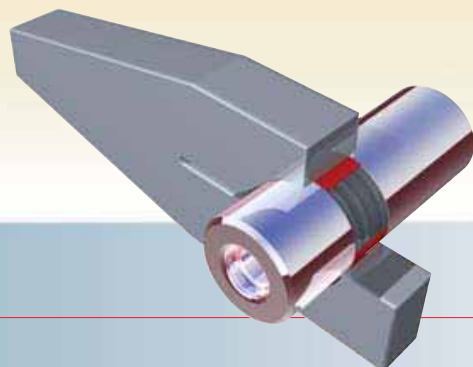




## Tensioning Element & Clamp Connection



### CHALLENGE

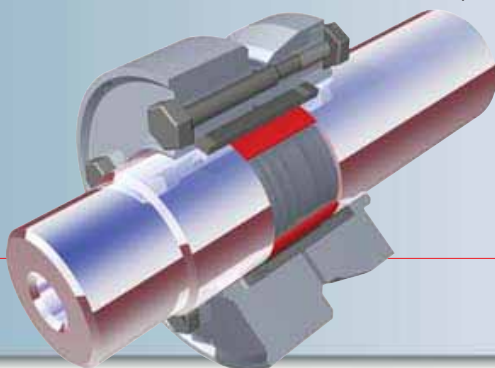


#### Shaft mounted component: Tensioning Element & Clamp Connection

- Repair worn shaft with a shaft-mounted tensioning element or clamp connection
- Prevent downtime and scrap costs
- Protection of new components against wear, abrasion and chemical attack

#### Cause:

- Exceeding the design load of the tension or clamp system
- Incorrect assembly/tightening components
- Contamination between shaft and shaft-mounted component



### SOLUTION

Depending on the extent of the wear and the kind of load, the following adhesives are recommended

Solution	Repair Method	Adhesive Group	Repair Adhesive	Kind of Fit:	Repair Gap/ Bonding Gap:	Curing time (Steel):
1.	Sleeving: Heavily loaded assemblies	Anaerobic Adhesive	Loctite® 648	Press/ Transition Fit	< 0.0 mm (Bonding Gap)	12 hrs*
2.	Rebuilding: Moderately loaded assemblies	Metal Filled Epoxy	Loctite® Hysol® 3478 A&B	Large Gap	> 0.5 mm (Repair Gap)	24 hrs*

\* Apply heat to the joint under repair for a faster curing time  
Note: Refer to Technical Data Sheets for more details





## Tensioning Element & Clamp Connection

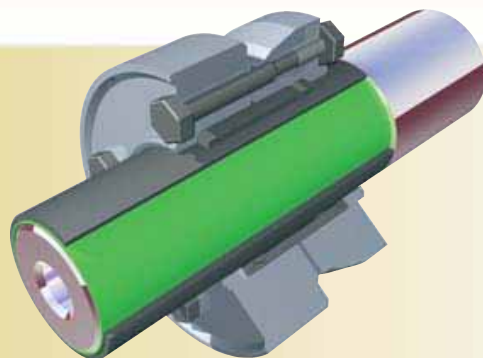


### SOLUTION #1

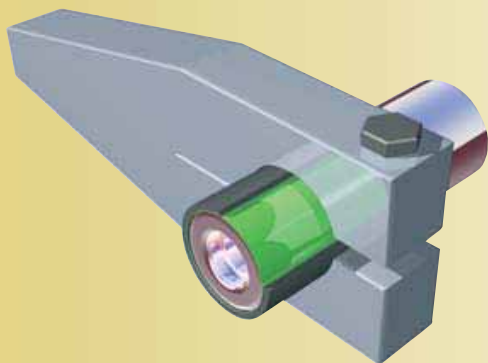
#### Sleeving

##### Steps:

Badly worn shaft and high load requirement



Repaired shaft for a tensioning element with a sleeve



Repaired shaft for a clamp connection with a sleeve

- Repair steps for sleeving see solution #1 "Cylindrical Joint", page 22

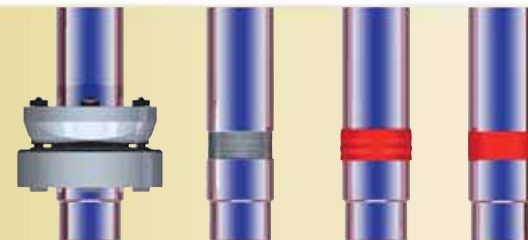
### SOLUTION #2

#### Rebuilding

##### Steps:

Badly worn shaft and moderate loading

Rebuild surface of the shaft for a tensioning element



Rebuild surface of the shaft for a clamp connection

- Repair steps for rebuilding worn surfaces with metal filled epoxy see solution #5 "Cylindrical Joint", page 24

## RESULTS

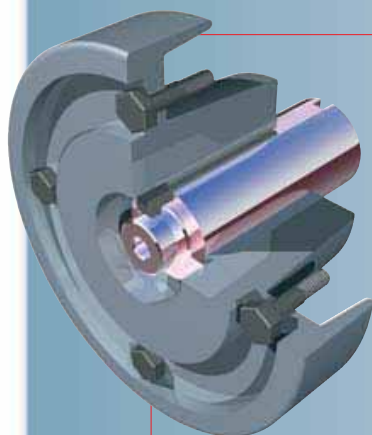
- Assembly is restored and ready for service without a major overhaul



## Keys & Pin or Bolt Connection



### CHALLENGE



#### Keys:

- Securing a key in the keyway
- Protection of new components against wear, abrasion and chemical attack

#### Cause:

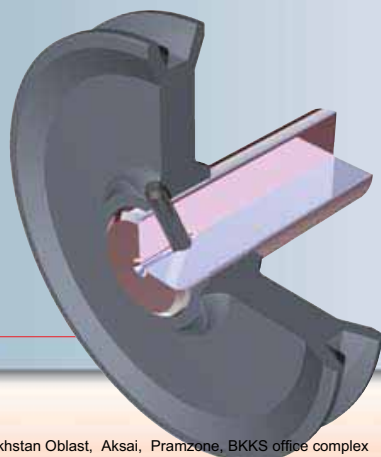
- Keys:**
- Keys become loose in the keyway over time

#### Pin or bolt connection:

- Securing the pin or bolt in the pin/bolt connection
- Protection of new components against wear, abrasion and chemical attack

#### Pin or bolt connection:

- Pins and bolts become loose in the pin or bolt connection



### SOLUTION

#### Keys:

- Apply a Loctite® Medium Strength Threadlocker to the keyway and then insert the key

#### Pin or bolt connection:

- Apply a Loctite® Medium Strength Threadlocker on to the pin or bolt and then insert into the bore

Solution	Repair Method	Adhesive Group	Repair Adhesive	Kind of Fit:	Bonding Gap:	Curing time (Steel):
1.	Securing the key stock in the keyway proactively	Medium Strength Threadlocker	Loctite® 243	Press/ Transition Fit	< 0.0 mm	3 hrs*
2.	Securing the pin or bolt in the pin/ bolt connection proactively	Medium Strength Threadlocker	Loctite® 243	Press/ Transition Fit	< 0.0 mm	3 hrs*

\* Apply heat to the joint under repair for a faster curing time  
Note: Refer to Technical Data Sheets for more details

### RESULTS

- Prevention of movement and wear
- Prevention of corrosion
- A long life assembly



## Other Shafts



## CHALLENGE

### Rollers and idlers subjected to abrasion, corrosion and chemical attack

- Components: Protection against abrasion, corrosion and chemical attack

#### Cause:

- Pitting caused by chemical attack or corrosion
- Abrasive wear caused by abrasive particles



## SOLUTION

Repair minor surface wear. Protect and coat the surface with Loctite Brushable Ceramic or Chemical Resistant Coating. Provides a high gloss, low friction finish.

Shaft Function	Repair Method	Adhesive Group:	Repair Adhesive	Cleaner	Repair Gap/ Bonding Gap:	Curing time (Steel):
Roller, Idler subjected to abrasion and corrosion	Protect with a wear resistant coating	Wearing Compound	Loctite® Nordbak® 7227/7228	Loctite® 7063 Cleaner and Degreaser	Layer thickness of min. 0.5 mm	6 hrs*
			Loctite® Nordbak® 7221			16 hrs*

\* Apply heat to the joint under repair for a faster curing time

Loctite® Nordbak® 7227 Brushable Ceramic Grey and Loctite® Nordbak® 7228 Brushable Ceramic White are similar products. Layers of different colour allow for easy visual inspection of the coating and wear.

Loctite® Nordbak® 7221 Chemical Resistant Coating provides an excellent coating to protect components from a variety of severe chemical environments

Refer to the Technical Data Sheet for additional information.





## Other Shafts



## SOLUTION

### Steps:

- Remove visible and invisible contaminants by degreasing, steam cleaning or pressure wash. Clean with Loctite® 7063 Cleaner & Degreaser
- Abrasive blast the surface. A surface roughness (Rz) of 75 µm, and cleanliness standard of SA 2.5 to 3 is ideal
- Remove dust. Clean with Loctite® 7063 Cleaner & Degreaser
- Do not contaminate clean surface. Wear gloves
- Mix products according to the package instructions  
Note: The optimum material and environment temperature is between 20°C and 30°C; below 10°C no application is possible
- Solution 1: Apply a coat of Loctite® Nordbak® 7228 Brushable Ceramic White. When gel time is reached, mix and apply a second coat of Loctite® Nordbak® 7227 Brushable Ceramic Grey, to a min 0.5 mm final thickness (or higher if necessary). Allow product to cure
- Solution 2: Apply one coat of Loctite® Nordbak® 7221 Chemical Resistant coating. When gel time is reached, apply a second coat to a min 0.5 mm final thickness (or higher if necessary). Allow product to cure

Coverage: Loctite® Nordbak® 7221/7227/7228: 1.2 m<sup>2</sup> @ 0,5 mm Thick per 1 kg



## RESULTS

- Reduced cost by extending the life of the components
- Rollers and idlers protected from abrasion, corrosion and chemical attack



## Shaft application product table

### REPAIR ADHESIVE & COMPOUNDS

APPLICATIONS	LOCTITE® SOLUTIONS	BENEFITS	COMPOUNDS	MATERIAL	MIN. – MAX. GAP	PACK SIZE	IDH NO.	PAGE
<b>PARALLEL KEY</b>								
Bonding	Loctite® 648 Retaining Compound	High temperature, high strength	ANAEROBIC RETAINING COMPOUND	Metals	Press fit – 0.08 mm gap	50 ml	234880	10
Rebuilding	Loctite® Hysol® 3478 A&B Superior Metal	Ferro silicon filled epoxy, with outstanding compressive strength	METAL FILLED EPOXY	Metals	> 0.5 mm gap			10
Bonding	Loctite® 660 Quick Metal, Retaining Compound	High strength, gap filling up to 0.25 mm	ANAEROBIC RETAINING COMPOUND	Metals	Up to 0.25 mm gap	12 x 50 ml	229232	10
Bonding	Loctite® Hysol® 9466 A&B Structural Adhesive	Toughened; multi purpose application; long open time; high strength	2K EPOXY	Metals; All Materials	0.2 – 0.5 mm gap	50 ml	451198	10
<b>SPLINE AND TOOTHED SHAFT</b>								
Bonding non sliding spline	Loctite® 660 Quick Metal, Retaining Compound	High strength, gap filling up to 0.25 mm	ANAEROBIC RETAINING COMPOUND	Metals	Up to 0.25 mm gap	12 x 50 ml	229232	16
Bonding non sliding spline	Loctite® Hysol® 9466 A&B Structural Adhesive	Toughened; multi purpose application; long open time; high strength	2K EPOXY	Metals; All Materials	0.2 – 0.5 mm gap	50 ml	451198	16
Rebuilding non sliding spline	Loctite® Hysol® 3478 A&B Superior Metal	Ferro silicon filled epoxy, with outstanding compressive strength	METAL FILLED EPOXY	Metals	> 0.5 mm gap			16
<b>CYLINDRICAL JOINT</b>								
Sleeving + Bonding	Loctite® 648 Retaining Compound	High temperature, high strength	ANAEROBIC RETAINING COMPOUND	Metals	Press fit – 0.08 mm gap	50 ml	234880	20
Bonding	Loctite® 660 Quick Metal, Retaining Compound	High strength, gap filling up to 0.25 mm	ANAEROBIC RETAINING COMPOUND	Metals	Up to 0.25 mm gap	12 x 50 ml 15 x 19 g	229232 705053	20
Bonding	Loctite® Hysol® 9466 A&B Structural Adhesive	Toughened; multi purpose application;	2K EPOXY	Metals; All Materials	0.2 – 0.5 mm gap	50 ml	451198	20
Rebuilding	Loctite® Hysol® 3478 A&B Superior Metal	Ferro silicon filled epoxy, with outstanding compressive strength	METAL FILLED EPOXY	Metals	> 0.5 mm gap			20
Sleeving + Bonding	Loctite® 603 Retaining Compound	High strength, oil tolerant	ANAEROBIC RETAINING COMPOUND	Metals	Press fit – 0.05 mm gap	12 x 50 ml	135280	20



## Shaft application product table

### REPAIR ADHESIVE & COMPOUNDS

APPLICATIONS	LOCTITE® SOLUTIONS	BENEFITS	COMPOUNDS	MATERIAL	MIN. – MAX. GAP	PACK SIZE	IDH NO.	PAGE
<b>TAPER JOINT</b>								
<b>Sleeving + Bonding</b>	Loctite® 648 Retaining Compound	High temperature, high strength	ANAEROBIC RETAINING COMPOUND	Metals	Press fit – 0.08 mm	50 ml	234880	26
<b>Rebuilding</b>	Loctite® Hysol® 3478 A&B Superior Metal	Ferro silicon filled epoxy, with outstanding compressive strength	METAL FILLED EPOXY	Metals	> 0.5 mm gap			26
<b>Sleeving + Bonding</b>	Loctite® 603 Retaining Compound	High strength, oil tolerant	ANAEROBIC RETAINING COMPOUND	Metals	Press fit – 0.05 mm gap	50 ml	135280	26
<b>TENSIONING ELEMENT &amp; CLAMP CONNECTION</b>								
<b>Sleeving + Bonding</b>	Loctite® 648 Retaining Compound	High temperature, high strength	ANAEROBIC RETAINING COMPOUND	Metals	Press fit – 0.08 mm	50 ml	234880	26
<b>Rebuilding</b>	Loctite® Hysol® 3478 A&B Superior Metal	Ferro silicon filled epoxy, with outstanding compressive strength	METAL FILLED EPOXY	Metals	> 0.5 mm gap			26
<b>KEYS &amp; PIN OR BOLT CONNECTION</b>								
<b>Bonding</b>	Loctite® 243 Threadlocker	Medium strength, liquid	ANAEROBIC RETAINING COMPOUND	Metals	Up to 0.05 mm	50 ml	135278	32
<b>OTHER SHAFTS</b>								
<b>Rebuilding a wear resistant coating</b>	Loctite® Nordbak® 7227 Brushable Ceramic Grey	Thin film, temp. resistance: 90°C; ultra smooth	WEARING COMPOUND	Metals	> 0.5 mm (layer)	1 kg	255893	38
<b>Rebuilding a wear resistant coating</b>	Loctite® Nordbak® 7228 Brushable Ceramic White	Thin film, temp. resistance: 90°C; ultra smooth	WEARING COMPOUND	Metals	> 0.5 mm (layer)	1 kg	255894	38





## Shaft application product table

### ADDITIONAL PRODUCTS

APPLICATIONS	LOCTITE® SOLUTIONS	BENEFITS	PACK SIZE	IDH NO.
<b>THREADLOCKER</b>				
Bonding	Loctite® 248 Threadlocker	Medium strength, semi-solid, Stick	19 g stick	540491
<b>ANAEROBIC RETAINING COMPOUND</b>				
Sleeving + Bonding	Loctite® 620 Retaining Compound	Medium to high strength; high temperature	250 ml	135515
	Loctite® 638 Retaining Compound	High strength	50 ml	234795
	Loctite® 640 Retaining Compound	High strength, high temperature; slow cure	250 ml	267441
	Loctite® 641 Retaining Compound	Medium strength; possibility to dismantle	50 ml	135522
	Loctite® 668 Retaining Compound	Medium strength; high temperature; Stick	19 g stick	705053
<b>EPOXY</b>				
Bonding	Loctite® Hysol® 3421 A&B Structural Adhesive	2K, General Purpose, medium viscosity, extended working life; humidity resistant	1 kg	431949
	Loctite® Hysol® 3430 A&B Structural Adhesive	2K, fast cure; Five Minute Epoxy; Ultra Clear; General Repair;	1 kg	431948
	Loctite® Hysol® 3430 A&B Structural Adhesive	2K; Fast Cure; Five Minute Epoxy; large gaps; damaged components	50 ml	451277
	Loctite® Hysol® 9492 A&B Structural Adhesive	2K; High temperature; Multi Purpose High strength	2 x 25 ml	229177
<b>METAL FILLED EPOXY</b>				
Rebuilding	Loctite® Hysol® 3471 A&B Metal Set S1	Steel Putty	500 g	229176
	Loctite® Hysol® 3472 A&B Metal Set S2	Steel Pourable	500 g	229175
	Loctite® Hysol® 3473 A&B Metal Set S3	Steel Fast Cure	500 g	229174
	Loctite® Hysol® 3474 A&B Metal Set M	Metallic parts under friction; wear resistant	500 g	195891
	Loctite® Hysol® 3475 A&B Metal Set A1	Aluminium; Multi Purpose	500 g	229173
	Loctite® Hysol® 3479 A&B Metal Set HTA	Aluminium, High temperature resistant	500 g	195826
<b>WEARING COMPOUND</b>				
Rebuilding a wear resistant coating	Loctite® Nordbak® 7221 Chemical Resistant Coating	Chemical resist	1 kg	
	Loctite® Nordbak® 7234 High Temperature Brushable Ceramic	Thin film, temp. resistance: 205°C; grey	1 kg	254469
<b>INSTANT BONDING</b>				
Bonding	Loctite® 401 Instant Adhesive	General Purpose	20 g	135428
	Loctite® 454 Instant Adhesive	General Purpose Gel	20 g	195678
	Loctite® 480 Instant Adhesive	Peel resistant; rubber toughened; black	20 g	135250

APPLICATIONS	LOCTITE® SOLUTIONS	BENEFITS	PACK SIZE	IDH NO.
<b>ANTI-SEIZE</b>				
Avoid Wear Corrosion and Seizing Lubrication property	Loctite® 8009 C5-A® Heavy Duty Anti-Seize	Metal-free, high lubricity	454 g	504219
	Loctite® 8012 Moly Paste	High loads, protection during running	454 g	504236
	Loctite® 8023 Marine Grade Anti-Seize	Wash out resistance, use on stainless steel	454 g	504618
	Loctite® 8060 Aluminium Anti-Seize	Semi-solid stick, general purpose	20 g stick	525113
	Loctite® 8065 C5-A® Copper Anti-Seize	Semi-solid stick, general purpose	20 g stick	525380
	Loctite® 8191 MoS <sub>2</sub> Anti-Friction Coating	General purpose, dry film lubricant	400 ml	
<b>CLEANING</b>				
For cleaning and degreasing	Loctite® 7063 Cleaner & Degreaser	General parts Cleaner Aerosol; solvent based	400 ml	88344
<b>SURFACE PREPARATION</b>				
To improve adhesion	Loctite® 7649 Activator	Solvent based Activator for anaerobic products	150 ml	142479
	Loctite® 7240 Activator	Solvent free Activator for anaerobic products	90 ml	333369
<b>LUBRICATION – OIL DRY FILM</b>				
To prevent seizing and galling	Loctite® 8192 Dry Film Lubricant Release Agent	Dry Film Lubricant Aerosol; Used as a release agent for shaft repair	12 x 400 ml	



The data contained herein are intended as reference only. Please contact your local Henkel Technical Support Group for assistance and recommendation on specifications for these products.

**Henkel Loctite Adhesives Ltd**  
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Wood Lane End  
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