



50 SERIES MECHANICAL BALL AND CAPS JOINTS

CREATING
VALUE

JOYGLOBAL

BALL AND SOCKET JOINTS

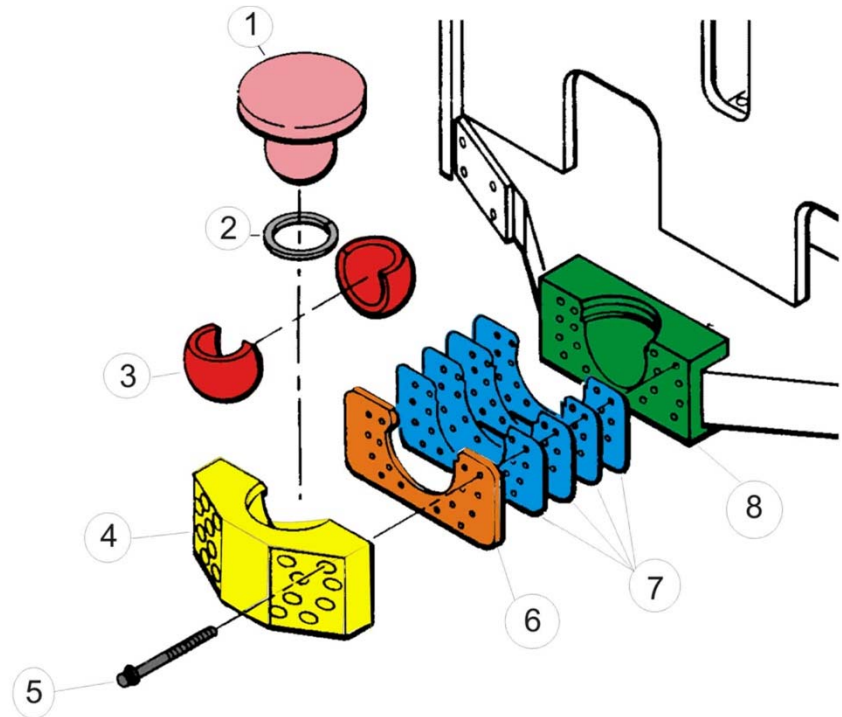
Theory of Operation



BALL AND SOCKET COMPONENTS

Component Description

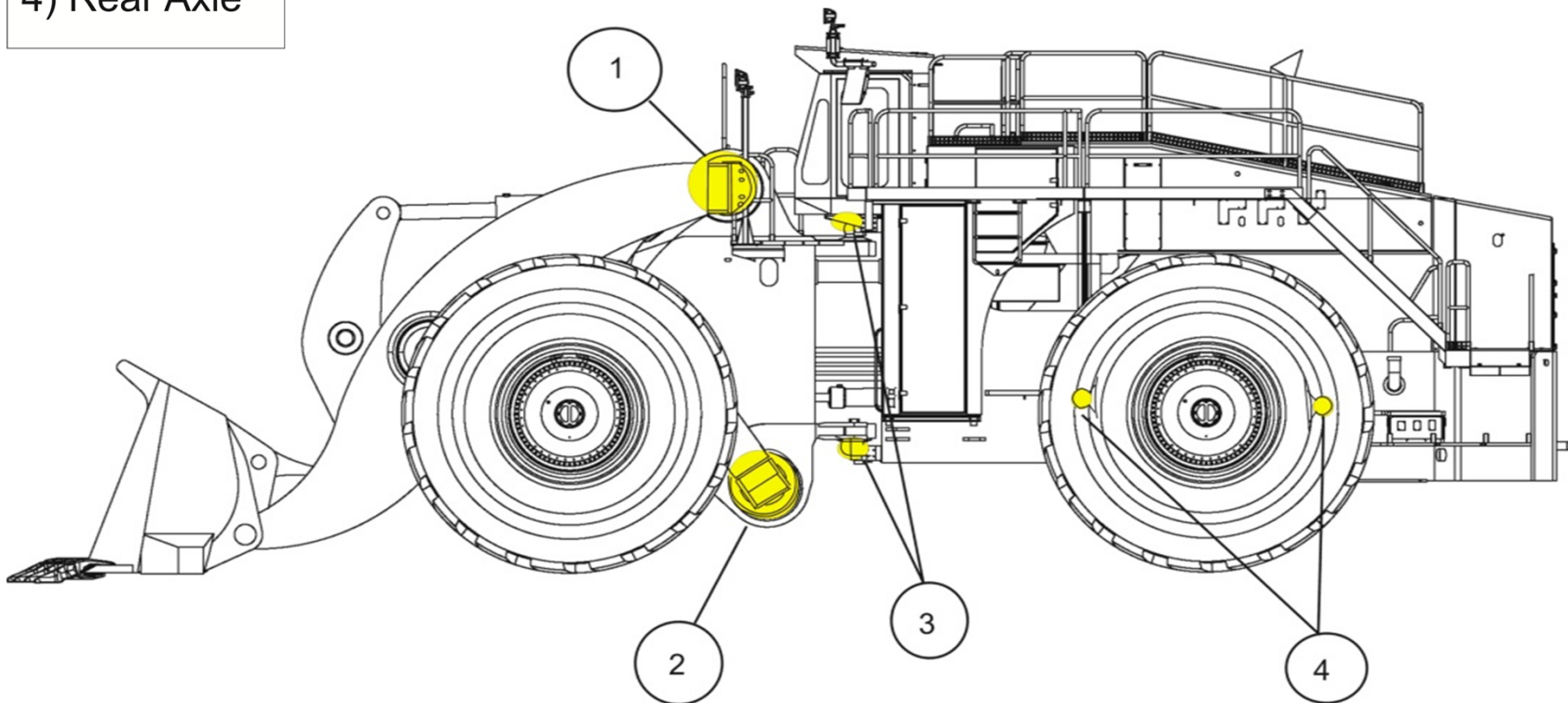
1. The Ball
2. The Lip Seal
3. The Liner
4. The Socket Cap
5. The Bolt
6. The Spacer Plate
7. The Shims
8. The Socket



BALL LOCATION

Component Description

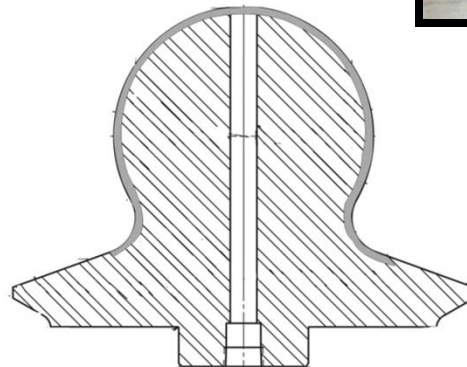
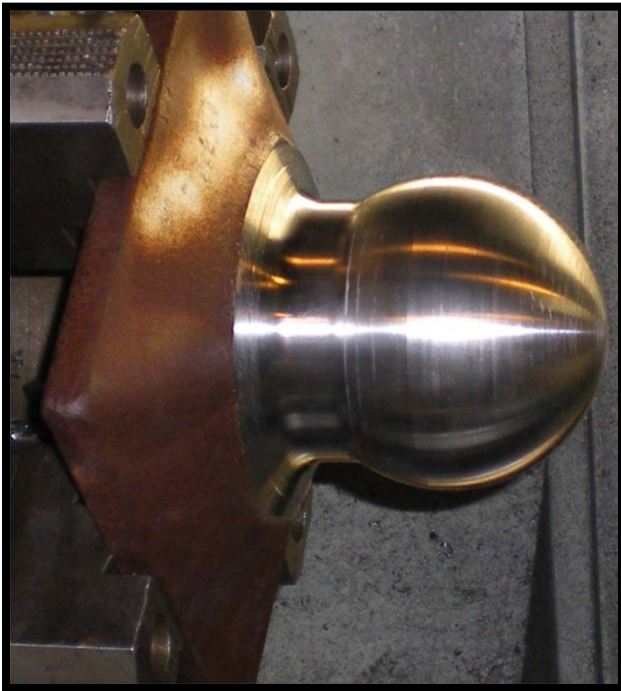
- 1) Lift Arm
- 2) Hoist
- 3) Articulation
- 4) Rear Axle



THE BALL

Component Description

Ball is machined
thru hole drilled for lubrication
case hardened ball for wear
Hardened surface ends at neck
to allow weld ability of ball base



THE SOCKET

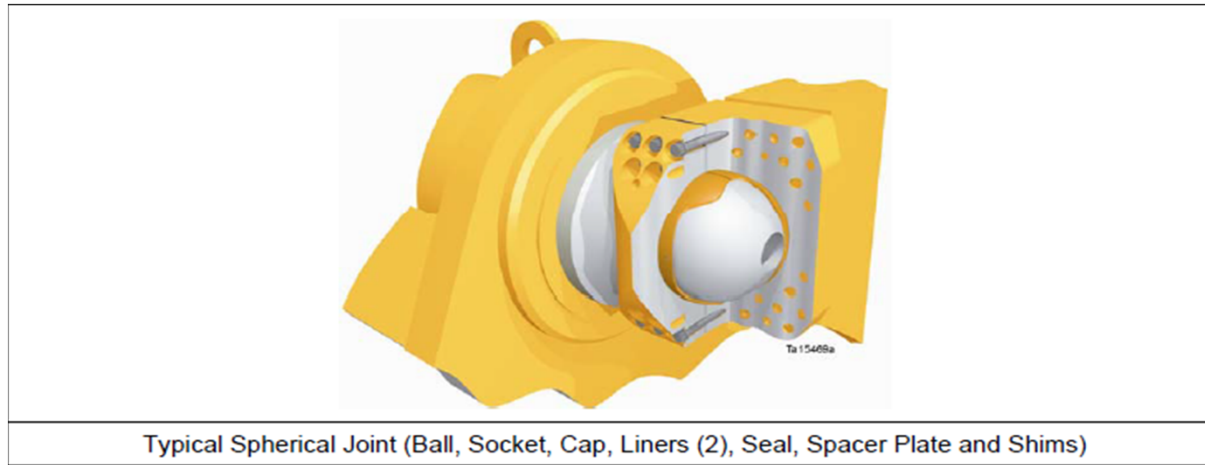
Component Description

The Socket is the stationary portion of the joint that is welded solid to the machine or structure.



Spherical Ball Bearing Joints

Component Description



The spherical ball bearing surface absorbs loads from all directions. The spherical ball bearing joint is simple to maintain with easily replaceable liners. The liner is made from a special aluminum bronze material which is harder than normal bushing material. The joint has long life if properly lubricated by the auto lube system. Shims allow the joint clearance to be adjusted on a periodic basis with normal wear of the liners. The joint also features a seal to keep contamination out of the joint. The ball is hardened, heat treated and carburized.

This document provides information on the following areas related to the spherical ball joint:

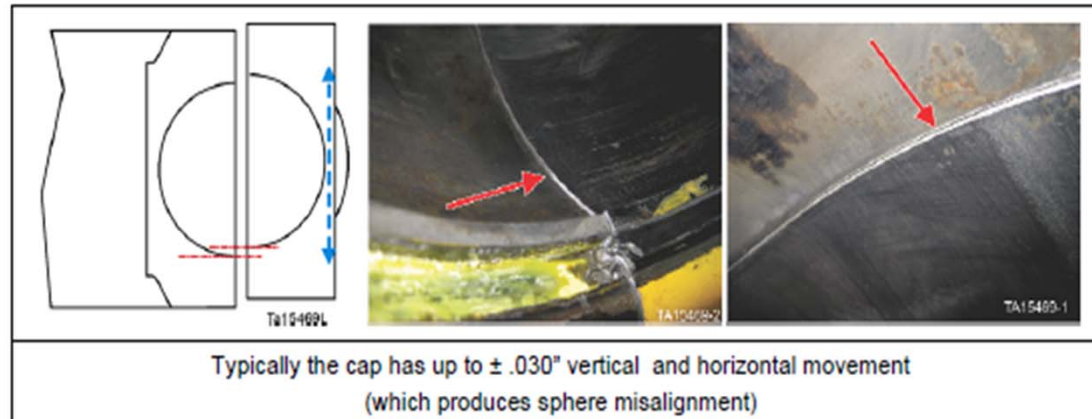
1	Ball cap to socket alignment	These items apply primarily to the 12" and 14" spherical ball joints.
2	Temperature limits	
3	Bronze liner thickness	
4	Bronze liner edge chamfer	
5	Socket flatness	
6	Grease recommendations	These items apply to all sizes of spherical ball joints
7	Ball Lubrication Methods	
8	Clearance recommendations	

BALL CAP TO SOCKET ALIGNMENT

Component Description

1) BALL CAP TO SOCKET ALIGNMENT

Testing has shown that the alignment of the cap and socket is important and misalignment may contribute to excessive heat. A certain amount of manufacturing tolerance is required so that threaded holes in the socket and the drilled holes in the cap will align properly. This tolerance means that the cap has some up, down and/or side to side movement prior to tightening the bolts. Testing has shown that this tolerance is typically in the $\pm .030''$ range. If the cap is positioned improperly it can cause the joint clearances to be reduced and may cause excessive heating.



Testing has shown that self centering does not happen in most cases because the ball joint clearances are too loose.

The socket and cap should be checked prior to installation. The cap should be centered and match marked with the socket. During installation onto the machine, the match marks should be lined up prior to tightening the capscrews.

The manufacturing process at the Factory has been changed. New machines have the caps and sockets matched visually and marked at the time of manufacturing. If a cap is replaced in the field, the cap should be matched to the existing socket. This SIL contains the instructions for the proper matching of the cap to the socket.

BALL CAP TO SOCKET ALIGNMENT

Component Description

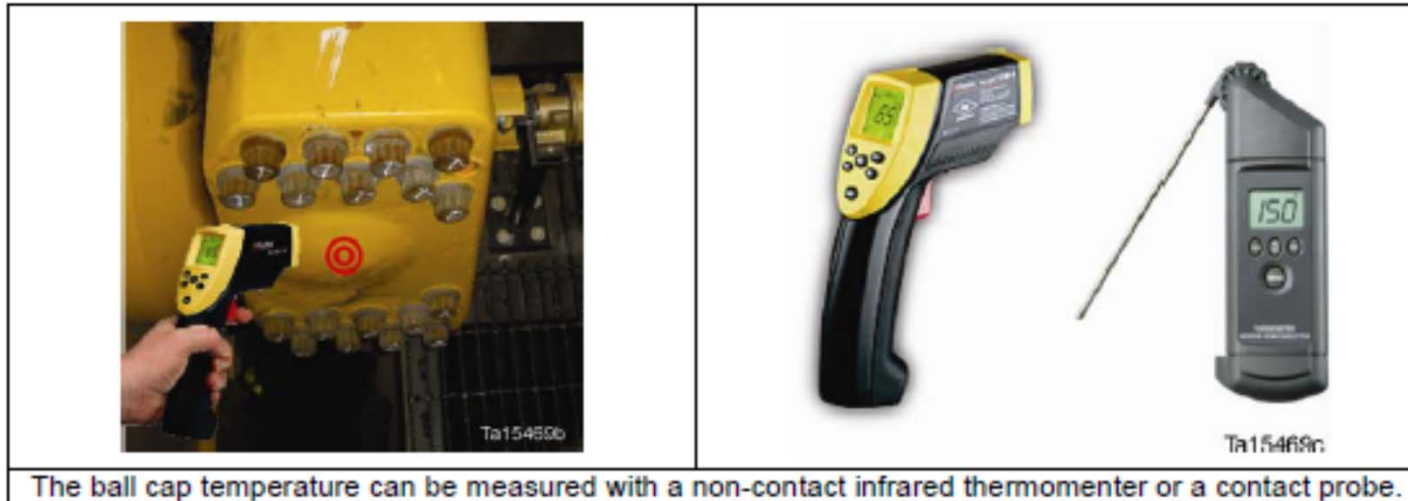
Using a letter stamp, mark the caps left or right to indicate the cap location on the lift arms.



Letter Stamp

BALL CAP TO SOCKET ALIGNMENT

Component Description



NOTE

The average temperature limit of 125°F (52°C) and short term temperature limit of 170°F (77°C) above ambient are very conservative and are based on use of a low temperature grease of minimum specification. Higher quality auto lube greases used in most locations permit a much higher temperature limit prior to concern. The specifications for the grease used should be examined to determine the temperature limits for your application.

If the ball cap alignment is correct and temperature continually rises above these limits then the joints should have the following parameters checked:

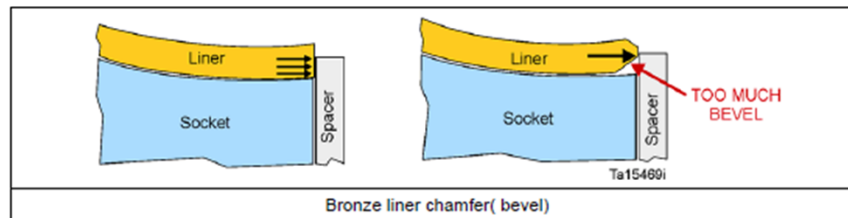
- Bronze liner thickness
- Clearance
- Grease quality and quantity
- Socket flatness

THE LINER

Component Description

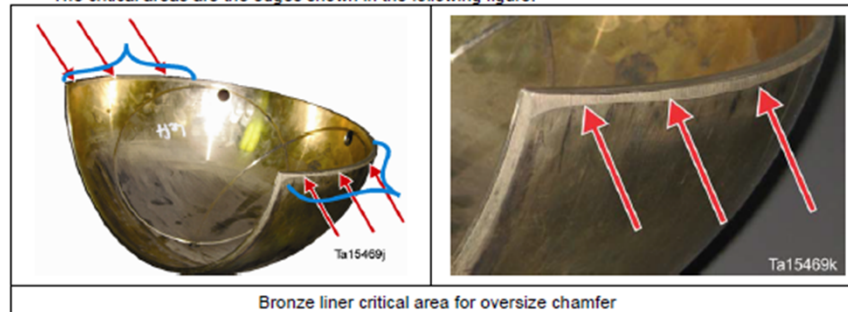


If the chamfer is too large in certain areas of the bronze liner, the liner can rotate and wedge underneath the spacer, break the spacer and shims and cause damage to the seal retainer in the socket and cap.



Any 14" bronze liners that are found to have excess machining in the critical areas shown in the following figure should not be used.

The critical areas are the edges shown in the following figure:



The critical areas shown are:

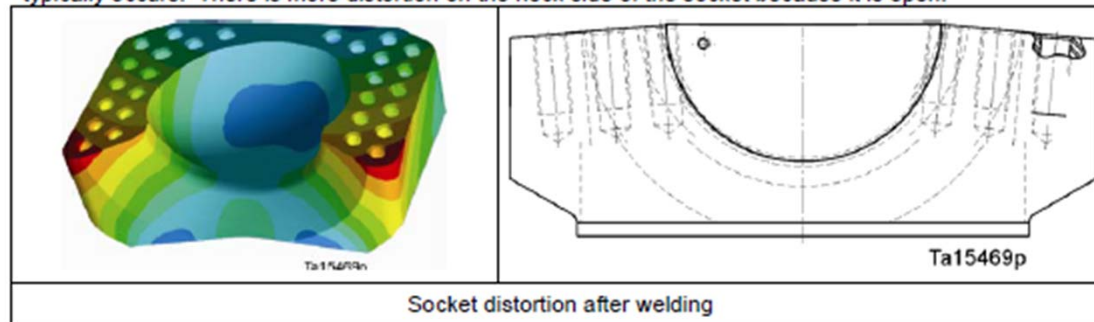
- On the outside edge of the sphere (not the inside edge)
- On the edge of the sphere against the spacer (not the neck)
- On the edge that is closest to the neck opening (not the neck opening)

The Socket and Cap

Component Description

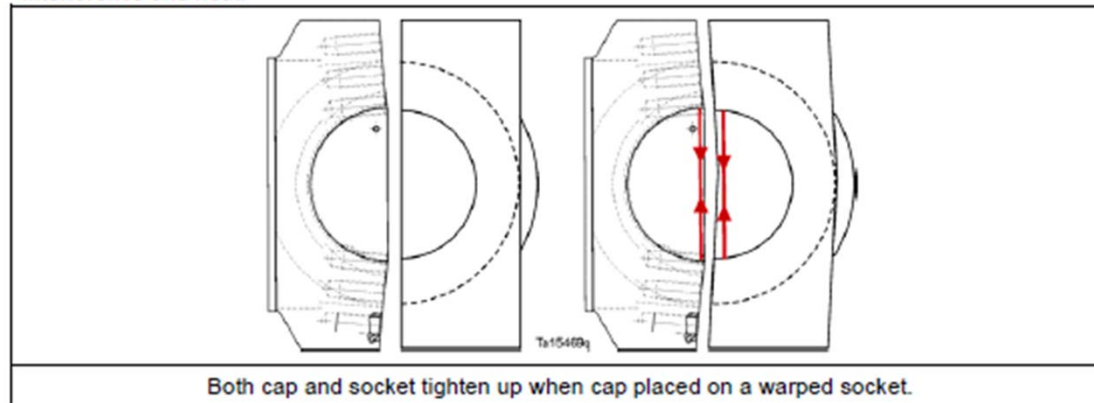
5) SOCKET FLATNESS

There has been some variance with the welding processes used to install the socket into the lift arm. LeTourneau has found that the socket can warp during the installation welding process. In most cases the socket will warp open. In the following picture the colors represent the type of distortion that typically occurs. The light blue represents minimal distortion and the red represents where the maximum distortion typically occurs. There is more distortion on the neck side of the socket because it is open.



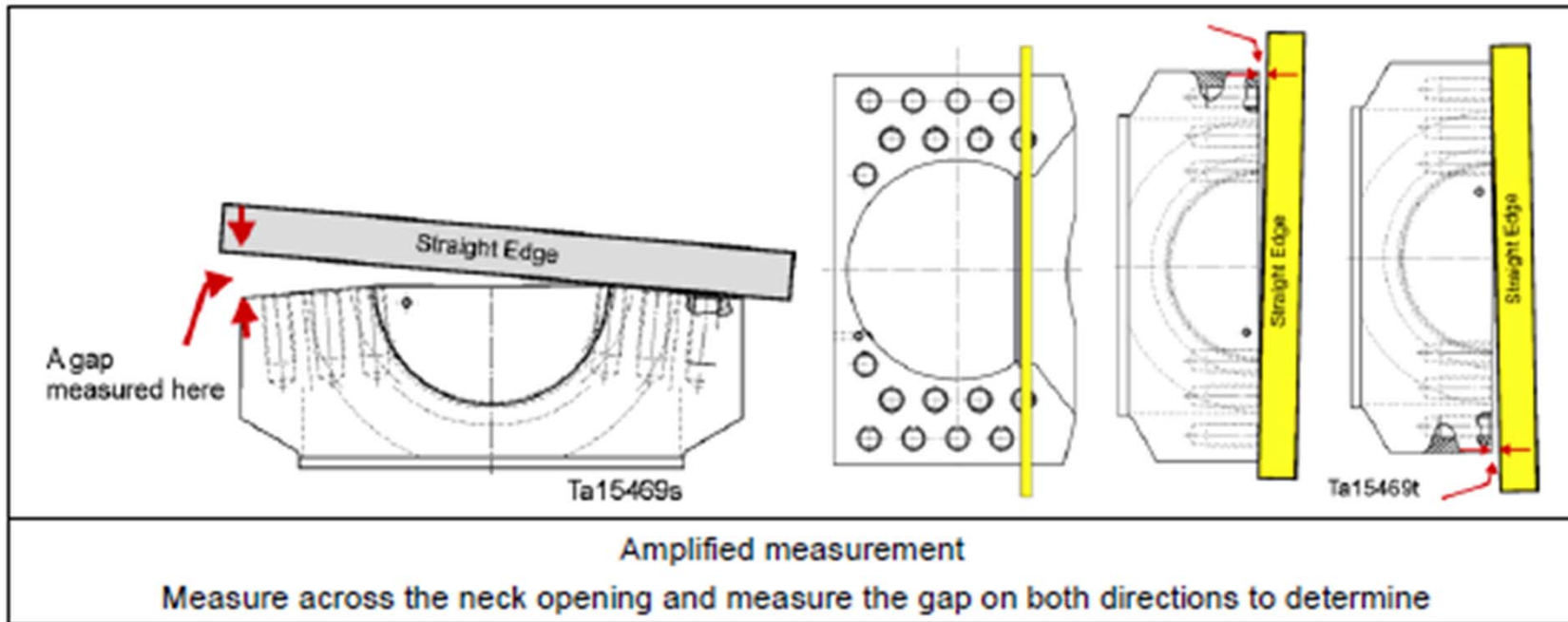
The joint design and bronze liner can tolerate the sphere opening up. However the flat mating surface needs to be flat with in .010" or distortion of the cap can occur.

When the cap is installed onto a warped socket – the cap and the socket will both move and tighten up the sphere when the capscrews are tightened. This will make the sphere in the cap undersize causing interference and heat.



The Socket and Cap

Component Description



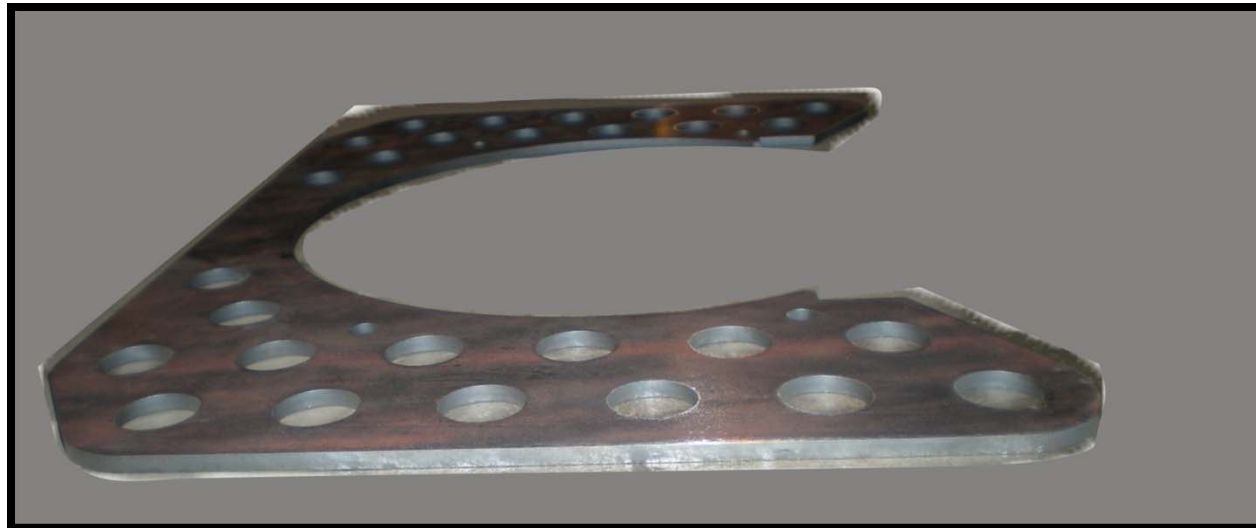
The straight edge is placed on one side of the flat surface and the gap on the opposite side is measured with feeler gauges. This is done in the area of the socket near the neck as shown. The gap is checked on both sides.

THE SPACER

Component Description

The spacer serves two purposes:

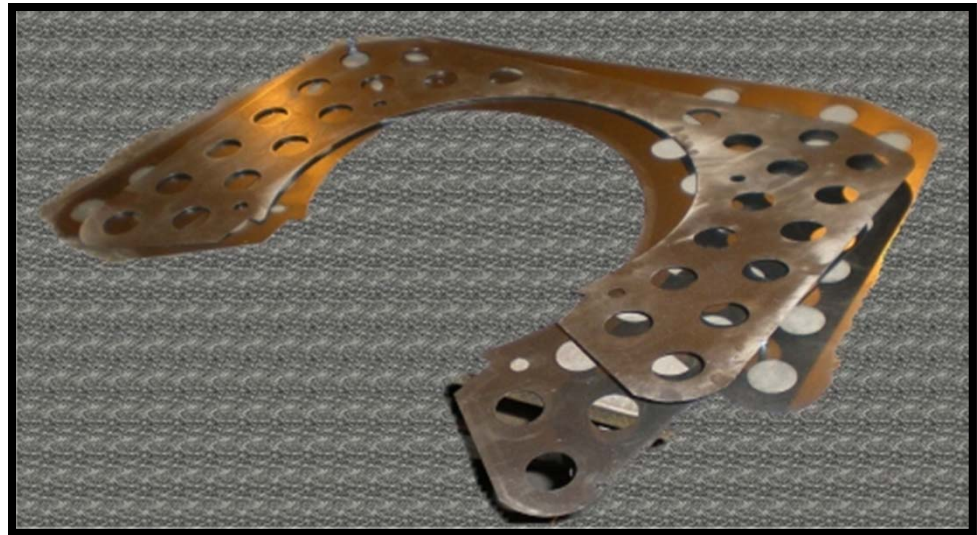
- One -- is to complete the sphere of the cap and socket.
- Two -- locks the liner halves into the socket and cap and prevents them from rotating in the joint.



THE SHIMS

Component Description

The purpose of the shims are to provide adjustment of the clearance in the joint that allows for movement and lubrication.



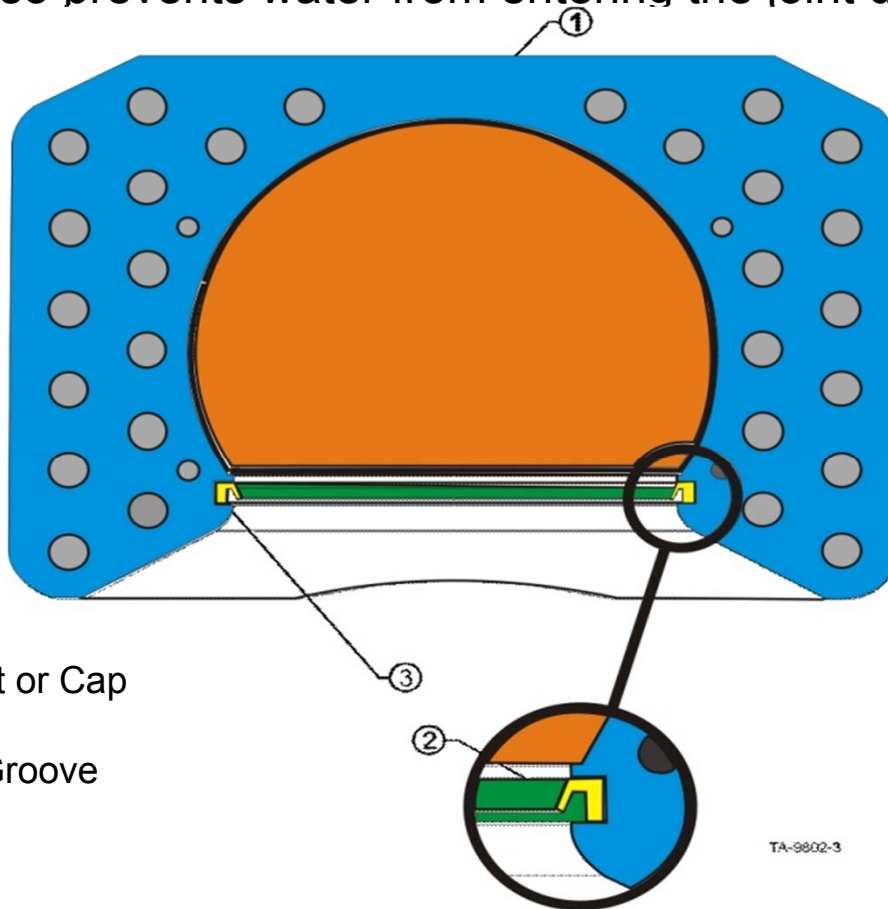
7.5"	9"	12"	14" Liftarm	14" Hoist
1 ea. 3/16" spacer plate	1 ea. 3/16" spacer plate	1 ea. 3/16" spacer plate	1 ea. 1/4" spacer plate	1 ea. 3/16. spacer plate
4 ea. .030" shim	4 ea. .030" shim	4 ea. .030" shim	1 ea. .030" shim	1 ea. .030" shim
1 ea. .018" shim	2 ea. .018" shim	2 ea. .018" shim	2 ea. .018" shim	2 ea. .018" shim
4 ea. .007" shim	2 ea. .007" shim	2 ea. .007" shim	3 ea. .007" shim	3 ea. .007" shim

THE LIP SEAL

Component Description

The purpose of the lip seal is to:

- ❑ prevent contamination from entering the socket joint.
- ❑ It also prevents water from entering the joint during washing of the machine.



1. Socket or Cap
2. Seal
3. Seal Groove



TA-9802-3

BOLTS

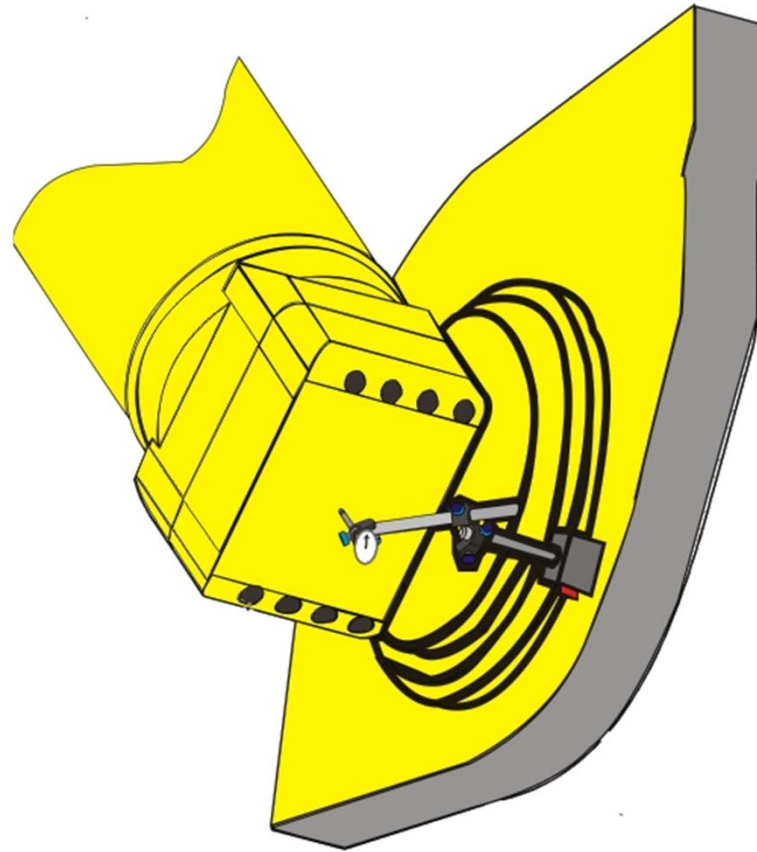
Component description



See SIL 294

PLACEMENT OF INDICATOR

Setting and Adjustments

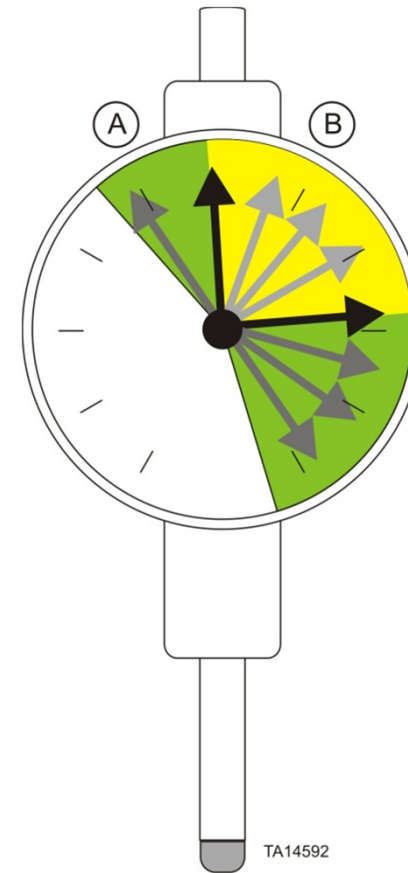


TA9520-8w

READING JOINT CLEARANCE

Setting and Adjustments

The joint clearance is referred to as the “Snap Value”



(A) Green area – needle moves slowly in proportion to how much machine is moved, steered, hoisted, etc. This is **DEFLECTION**

(B) Yellow area – Needle snaps quickly between low and high when the machine is moved, steered, hoisted, etc. This is the **CLEARANCE**

EXCESSIVE HEAT IN JOINT

Troubleshooting

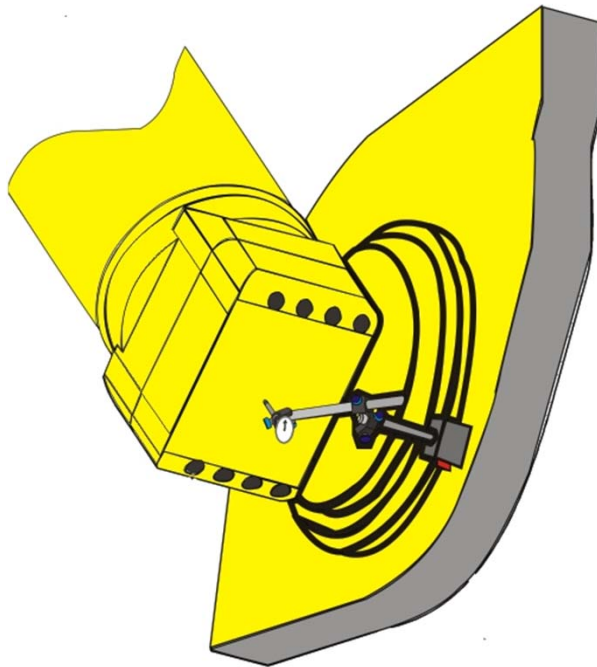
CAUSES:

- ❑ Clearance to tight.
 - ❑ Check adjust of clearance.
- ❑ Cap Misaligned
 - ❑ Align cap
- ❑ Lack of lubrication .
 - ❑ Check lubrication supply.
 - ❑ Check lubrication lines.
- ❑ Liners out of specification
- ❑ Warped socket or cap.

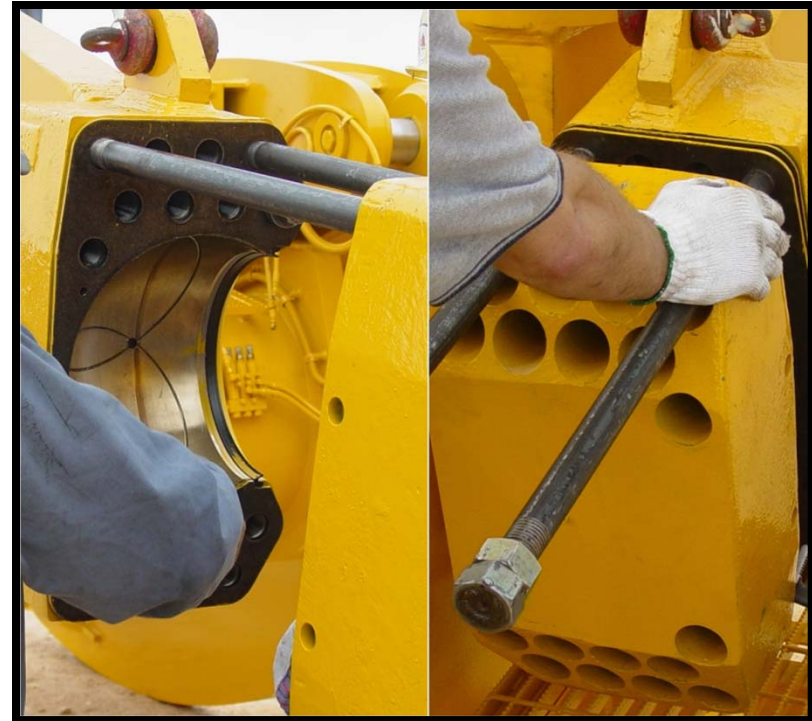
JOINT IS TOO TIGHT

Troubleshooting

Check clearance of Joint.



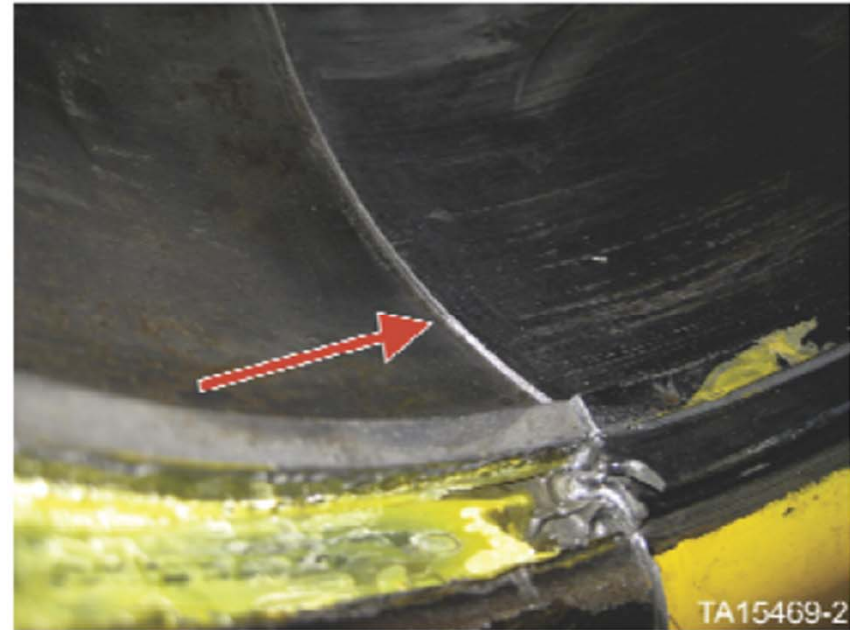
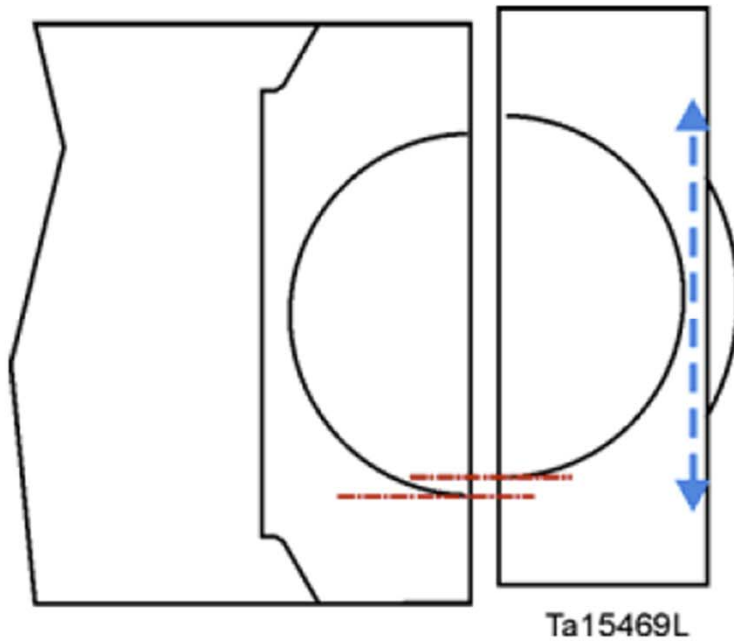
TA9520-8w



Add shim to adjust.

Misaligned Cap

Troubleshooting



Align cap to socket and mark
the side and top

LUBRICATION

Troubleshooting



Make sure that there is fresh grease present at the joint.



Make sure there is grease in the grease reservoir



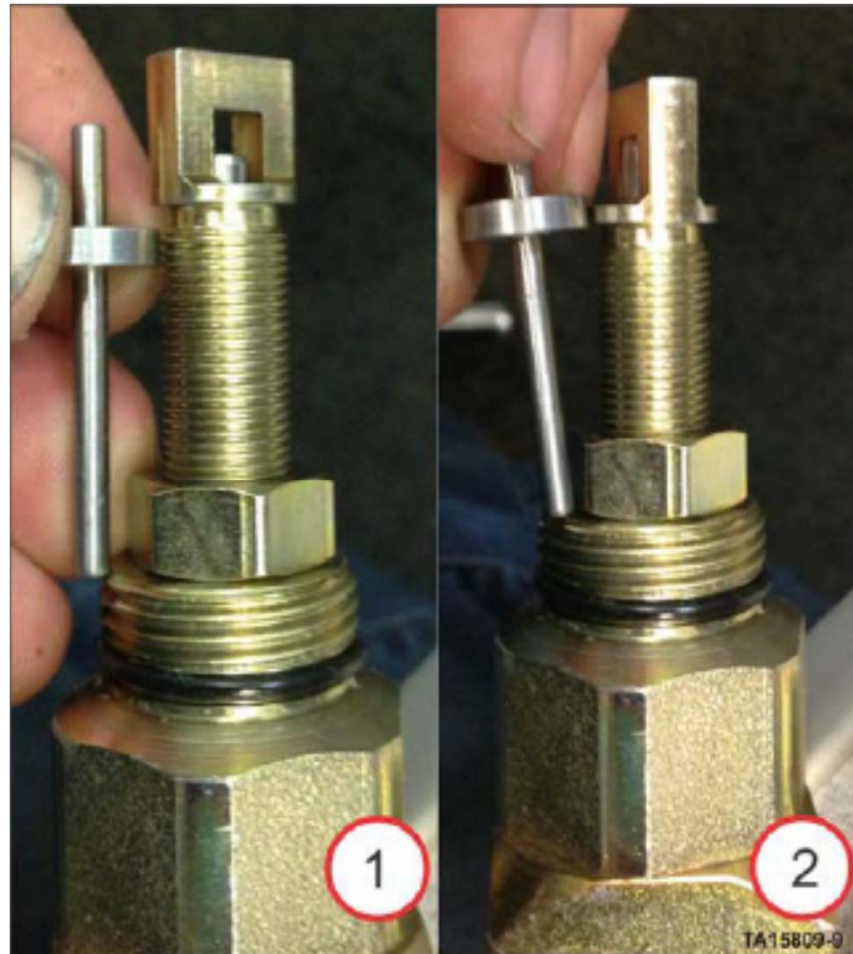
Check injector settings.



Check for broken or loose grease lines.

LUBRICATION

Troubleshooting



Check injector settings.

LUBRICATION

Troubleshooting

The joints are lubricated by two methods:

1. From the outside of the ball socket and cap.
2. From the center of the ball.

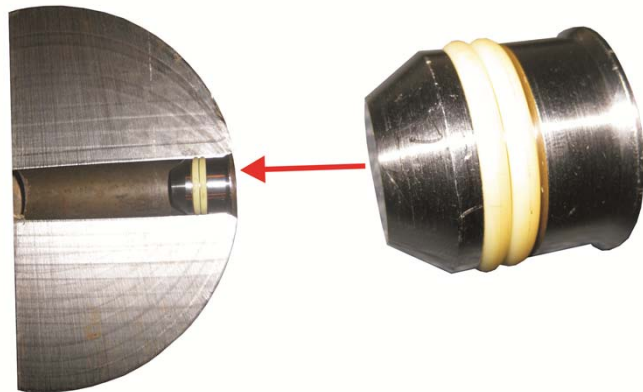


LUBRICATION

Troubleshooting

Lubrication from the outside of the joint is done at the:

- Hoist Cylinder
- Rear Axle



LUBRICATION

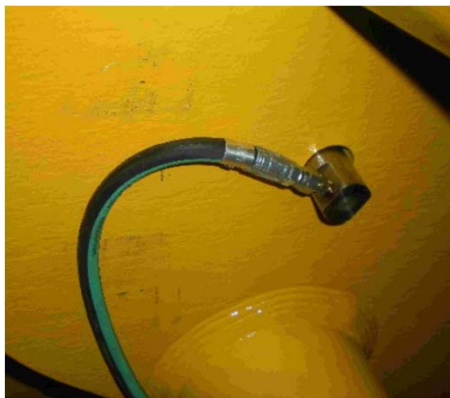
Troubleshooting

Lubrication from the center of the ball done at the:

Liftarm Ball and the Middle Pivot



The Liftarm Ball uses a drilled and taped plug with a lube line attached.

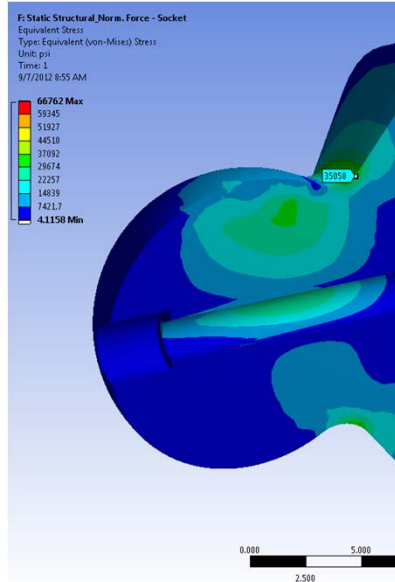
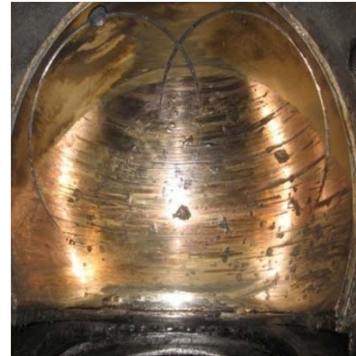


The middle pivot uses a thru hole tapped at the bottom and nipple extension.

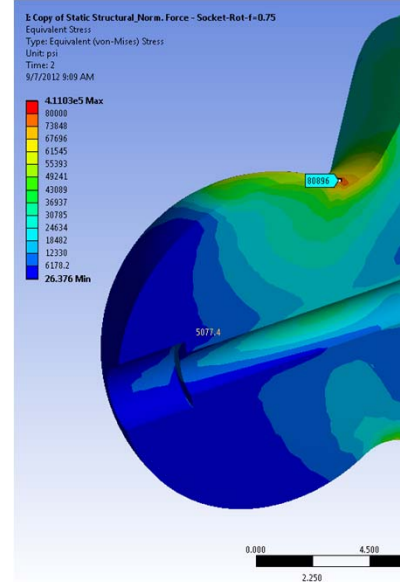
LUBRICATION

Troubleshooting

Center plug not installed in hoist cylinder balls could cause.



Good lubrication



Reduced lubrication



INSPECTION

Troubleshooting

Worn Socket
and Cap.



Worn Ball



Cracked or broken Ball or Slab.



WORN SOCKET OR BALL

Troubleshooting

BALL SOCKET SPECIFICATIONS				
Nominal diameter	7.5"	9"	12"	14"
Machined diameter	8.003" ± .002"	9.503" ± .002"	12.503" ± .002"	14.503" ± .002"
*Maximum socket wear before liner may be affected.	0.030"	0.030"	0.030"	0.030"

If any of these measurements are out of specification replace the socket and cap.

BALL BASE SPECIFICATIONS				
Nominal diameter	7.5"	9"	12"	14"
Machined diameter	7.500" ± .003"	8.997" ± .003"	12.000" ± .003"	14.000" ± .003"
*Max ball wear before liner may be affected	0.060"	0.065"	0.070"	0.080"

Replace Balls using Let 1 welding procedures.

REPAIR OF SOCKET OR BALL

Removal and Installation

Follow Let 1 procedure for removal and installation repairs of balls and sockets.



Do not do this.

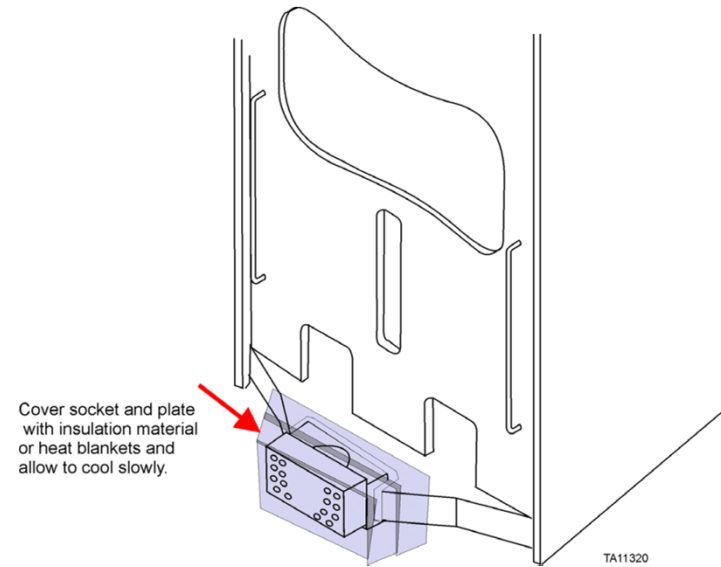
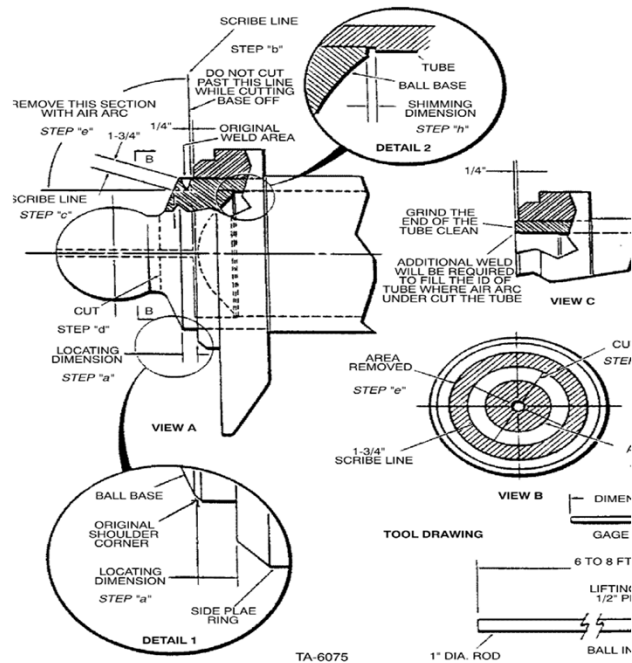


Pre-heat before gouging and welding.
Maintain heat during welding.

CRACKED AND BROKEN BALLS

Removal and Installation

When welding use Let 1 Field Welding Procedure found on Knowledge Base Article 436



Make sure preheat is used and post heat is used.

Commissioning Worksheet

Commissioning Worksheet Form – Factory assembly

Machine:		Date:
S/N:		

Item	Result	Comments	Date	Signature
Grease Plug installed in <u>hoist or lift arm ball</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New O-ring	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease extension tube installed into <u>articulation ball base</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Thread sealant used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Connect the grease hose	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Tighten hose and fitting	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New Grease hose used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new brass liners in socket and cap	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Chase hole threads in socket by hand	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Clean hole threads in socket to remove all contaminants	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the OD of the ball with <u>auto lube</u> grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Fill the hole in the ball with <u>auto lube</u> grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the socket and cap with a thin coat of <u>auto lube</u> grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the brass liner <u>auto lube</u> grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Verify that the arms fit without spreading or pulling together	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Heat striping required?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
<i>This section applies to Lift arm balls ONLY</i>				

Commissioning Worksheet

Commissioning Worksheet Form – Factory assembly

Page 2 of 2

Item	Result	Comments	Date	Signature
Align the ball caps on the lift arm sockets	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Match marks	YES <input type="checkbox"/> NO <input type="checkbox"/>			
<i>This section applies to Lift arm balls ONLY</i>				
Capscrew lubricant – 30W oil	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Hand start all capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Follow specified torque pattern	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Torque value	_____ ft-lb			
Purge the grease system to all balls that were replaced?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Use external grease pump?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Check the snap clearance	YES <input type="checkbox"/> NO <input type="checkbox"/> _____ "/mm			
In or out of specification?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Adjusted?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Final value?	_____ "/mm			
Verify grease system functioning:				
System timing	_____ min/cycle			
Leaks?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
System building pressure?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Oil supply pressure?	_____ psi			
Grease pressure at stall?	_____ psi			
Ball injector functioning ?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Injectors functioning?	YES <input type="checkbox"/> NO <input type="checkbox"/>			