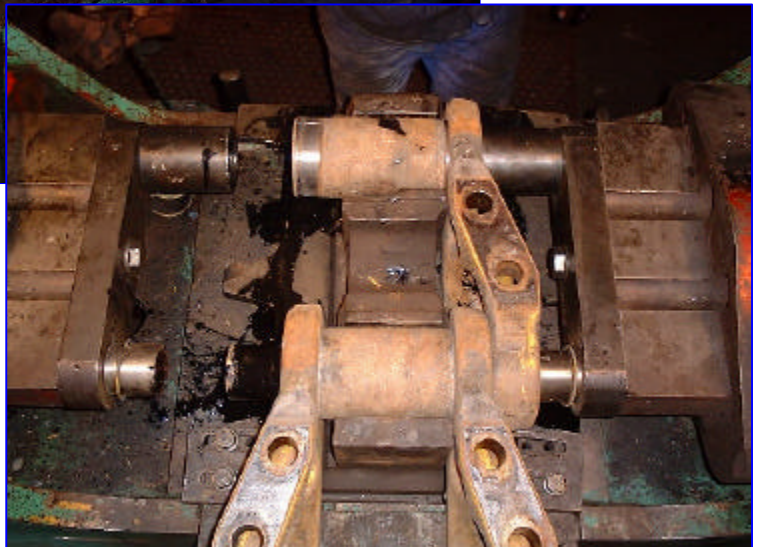
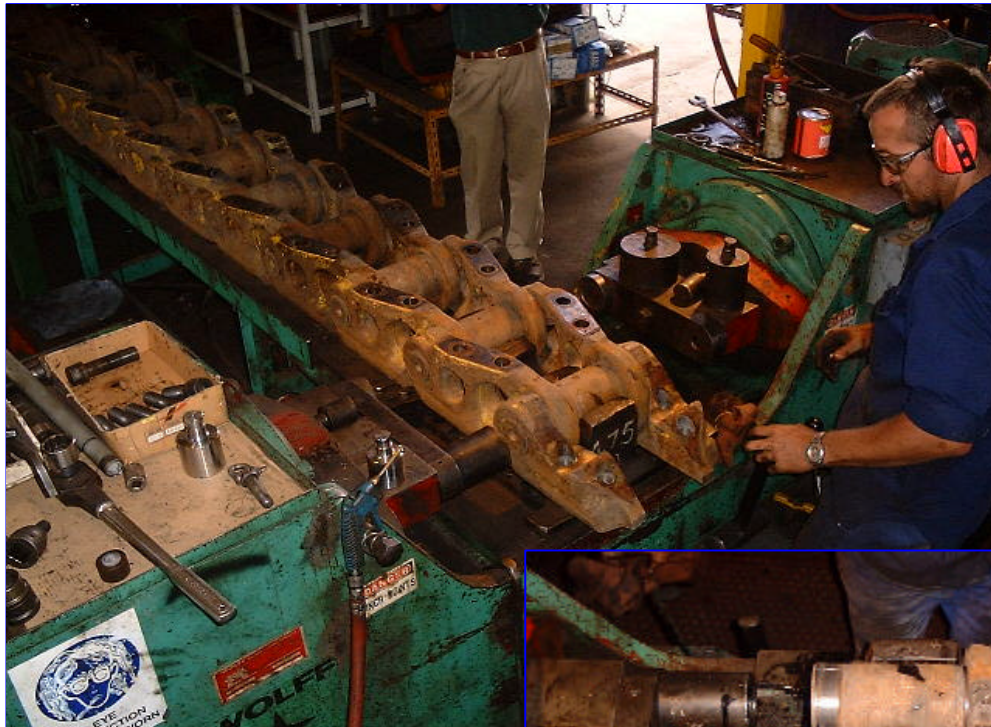


# GUIDANCE FOR REUSABLE PARTS

## LUBRICATED TRACKS (III)

# TRACK BUSHING WET TURN PROCEDURE MANUAL



# GUIDANCE FOR REUSABLE PARTS

## INDEX

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<b>INTRODUCTION</b>	.....	<b>1</b>
<b>FEATURE OF NEW TRACK</b>	.....	<b>2</b>
<b>STRUCTURE AND FUNCTION OF SEALED &amp; LUBRICATED TRACK</b>		
1) TRACK STRUCTURE	.....	<b>3</b>
2) SEAL STRUCTURE AND FUNCTION	.....	<b>4</b>
3) SEAL MECHANISM	.....	<b>5</b>
4) KEY POINT ON BUSHING TURN	.....	<b>6</b>
5) KEY POINT ON SEAL PROTECTION	.....	<b>7</b>
<b>BUSHING TURN PROCEDURE</b>		
1) DISASSEMBLY	.....	<b>8</b>
2) REWORK	.....	<b>15</b>
3) ASSEMBLY	.....	<b>19</b>
<b>STANDARD VALUE TABLE</b>	.....	<b>31</b>
<b>PRESS JIG</b>	.....	<b>32</b>
<b>TOOLS</b>	.....	<b>33</b>
<b>TRACK SHOP LAYOUT</b>	.....	<b>39</b>

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### Application of this Guide

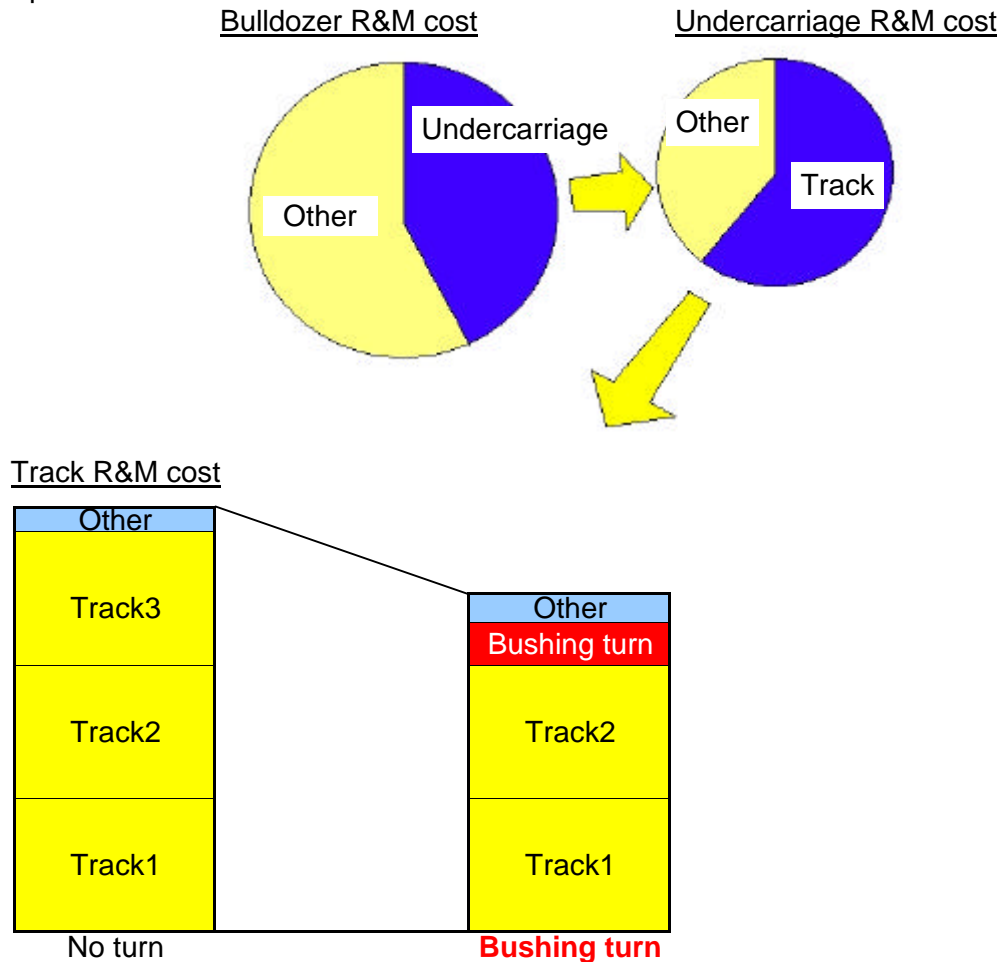
This manual, Guidance for Reusable Parts is applicable to the sealed & lubricated track fitted with F3 & F5 type seals.

This Manual was published by the following persons,

- |   |   |  |
|---|---|--|
| 1 | Structure and Function &<br>General Technical information | Hiroyuki Nakaishi & CETC1<br>Akira Hashimoto CETC1 |
| 2 | Bushing turn procedure with photos                        | Hidetoshi Okuno CS Division                        |
| 3 | Actual bushing turn work coordination                     | Yasu Iiyama NSK                                    |

# INTRODUCTION

**Undercarriage** is the most expensive element among several elements of repair and maintenance (hereafter R&M) cost to run a large size bulldozer. And among undercarriage parts such as track, top(carrier) rollers, bottom(track) rollers, idlers, sprocket segments, roller guards and so on, track parts spend major portion of entire undercarriage cost such as 50% or more of the total cost. In order to manage R&M cost in reasonable one, **WET TURN OF TRACK BUSHING** is the most important issue for large size bulldozer and reduces number of tracks to be replaced with a new one as an example shown in below.



In 2001, a new D475A is launched with a new undercarriage system, which is explained in details on the next pages. **Wedge rings** fitted on both ends of pin assure holding pins and links in proper position even pins are fitted with less force to prevent scuffing. **K-bogies** prevent from link shoulder chipping by better following-up capability and **new guards** do not cause inclined wear on pin ends any more. A new **F5** seal is adopted and it extends seal life as well.

All these innovations enable **WET TURN OF TRACK BUSHING** more easily and this manual is issued to introduce the new undercarriage and its WET TURN OF TRACK BUSHING procedure correctly and practically. It would be more effective if this manual is utilized with separate volume of " Guidance for Reusable Parts - Lubricated Track (II)" Form No. SEBG4091" .

We thank very much for all persons of NSK(Australia) who gave us great cooperation on the occasion of taking pictures of actual jobs there for the draft creation.

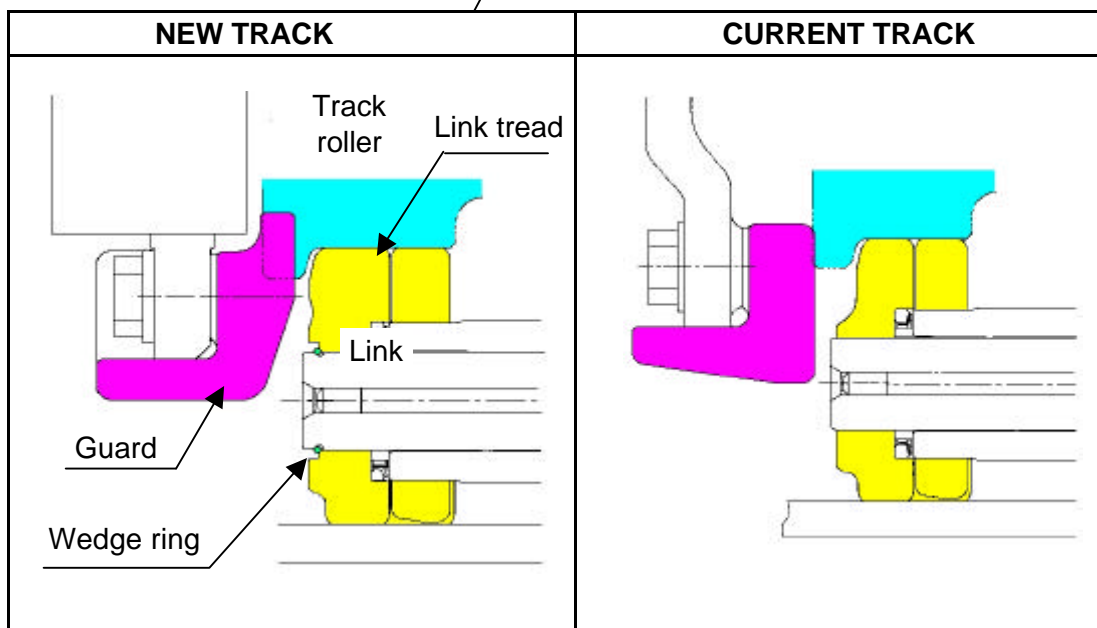
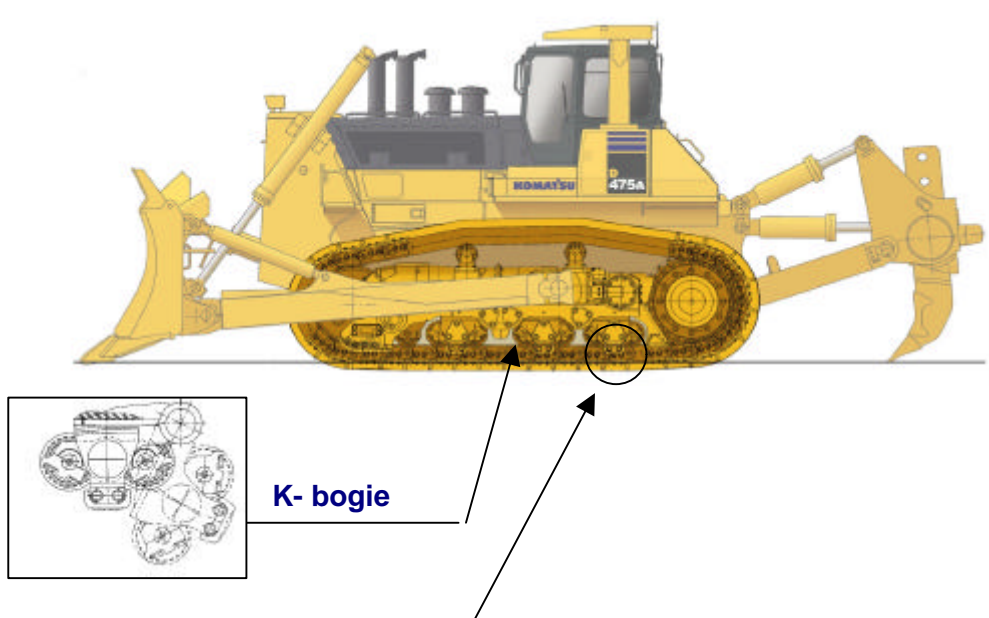
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Note: This publication is intended for guidance only and KOMATSU LTD. hereby expressly denies and excludes any representation, warranty or implied warranty for the reuse of sealed and lubricated track

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## NEW TRACK STRUCTURE & FEATURE

- 1) Adoption of **wedge ring** to the pin hold  
 effect: Pin press-fitting force can be reduced, and it reduce scuffing between pin and link bore at bushing turn. As a result, man-hour can be shortened and parts reusable ratio can be increased.
- 2) **Link guard and link shape** change to avoid interference of pin ends and guards.  
 effect: Pin end face wear can be eliminated, then it result man-hour reduction of pin end face maintenance and pin reusable ratio improvement.
- 3) Expanding of link and **rollers tread width**  
 effect: Wear life on track link and rollers can be elongated due to surface pressure reduction.
- 4) Adoption of **K-bogie** which rollers following-up track link movement.  
 effect: Elimination of track coming off, then rollers flange wear life can be extended. And riding comfort would be improved.



## STRUCTURE OF THE SEALED & LUBRICATED TRACK

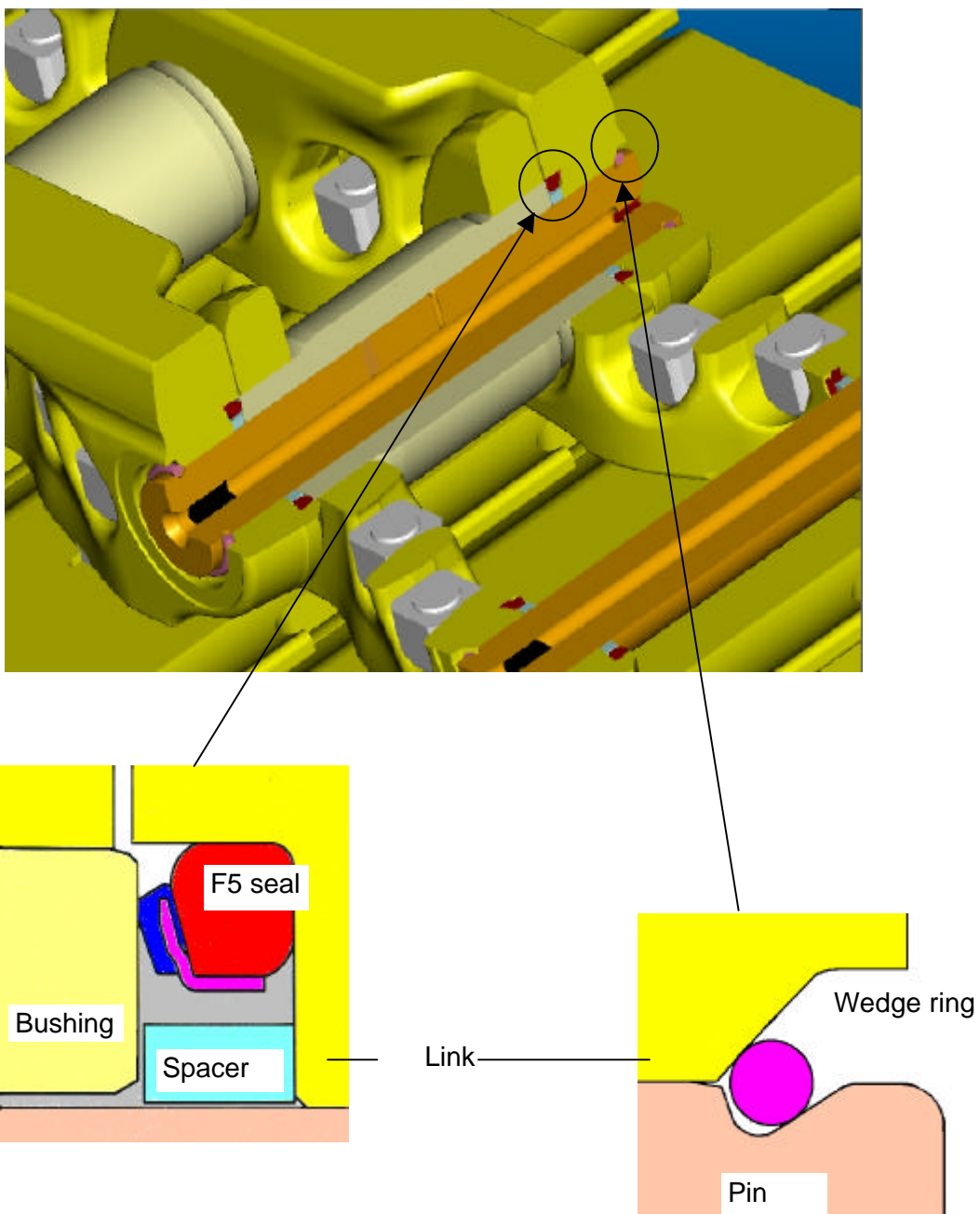
### TRACK STRUCTURE

Sealed & lubricated track differs greatly from grease sealed track in the following point. Oil is sealed in the area between pin and bushing (link connection), and special seal is used to prevent entry of soil or water. This greatly improves the elongation life of link pitch.

Sealed & lubricated track consists of the links, pins, bushings, seals, spacers, large plugs and small plugs.

As for the track that we adopted this time, the following points are changed formerly.

1. The adoption of F5 type seal that improved sealing follow-up ability.
2. The adoption of wedge ring that maintain the pin hold.

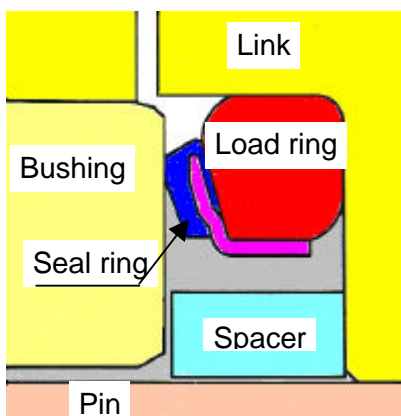


## SEAL STRUCTURE AND FUNCTION

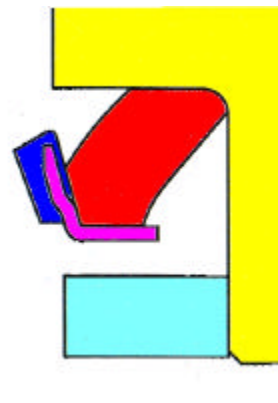
The structure of the seal is similar to that of seals used in idlers and rollers of undercarriage. It consists of a part which seals oil in and keeps dirt and sand out, and a load ring which imposes a thrust to the said part. The load ring is set in place in a crushed condition. Its resilience pushes the sealing portion in the direction of thrust, exerting the proper surface pressure on the sliding surface with the bushing. The thrust is also given in the radial direction of the link counterbore, preventing oil from leaking from the bores. The spacer is set inside the seal to protect it from overload and keep the direction of the seal at proper level while the machine is traveling.

### 1) F5 seal

Adopted on large size bulldozer



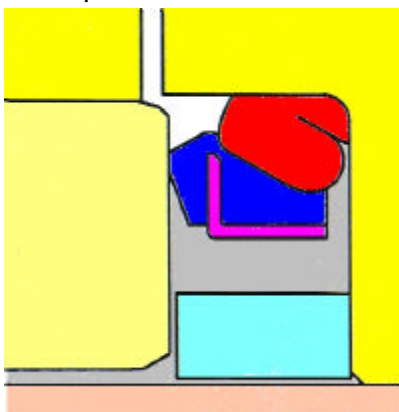
(Assembled)



(Free load)

### 2) F3 seal

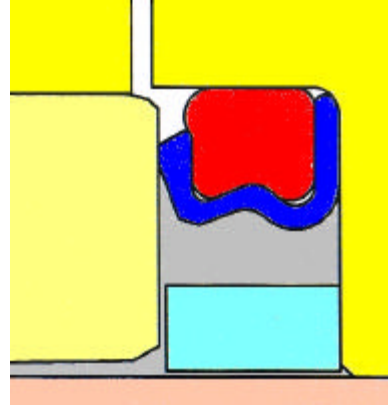
Adopted on middle size bulldozer



(Assembled)

### 3) W7 seal

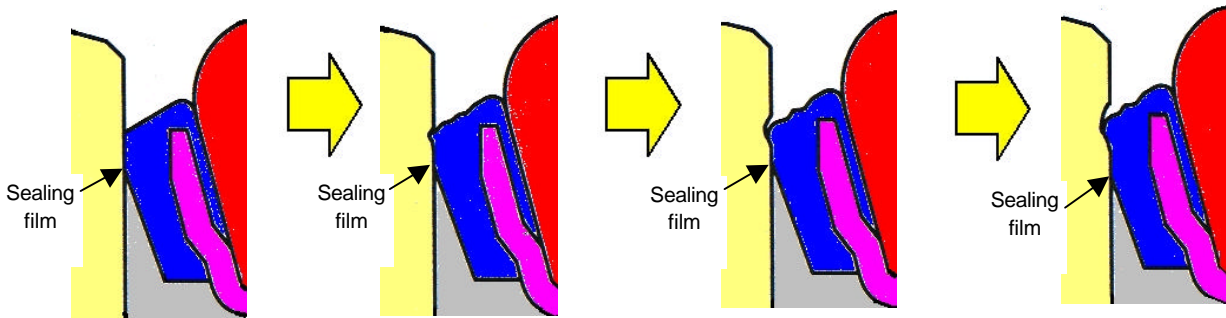
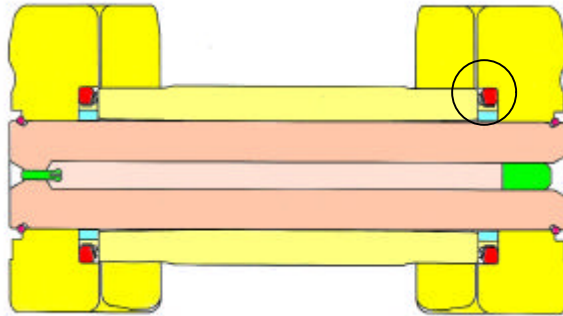
Adopted on small size bulldozer



(Assembled)

# SEALING MECHANISM

As for the contact portion of the seal and bushing the wear groove advances with the following mechanism.



When parts are new

Shallow sealing groove is formed

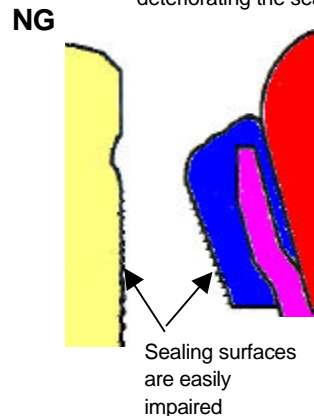
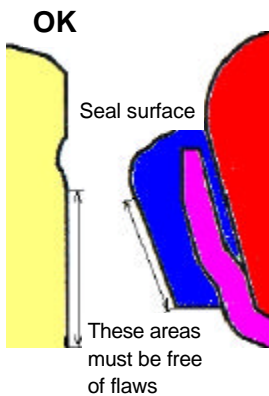
Sealing groove is larger

Sealing groove is transferred toward the bore

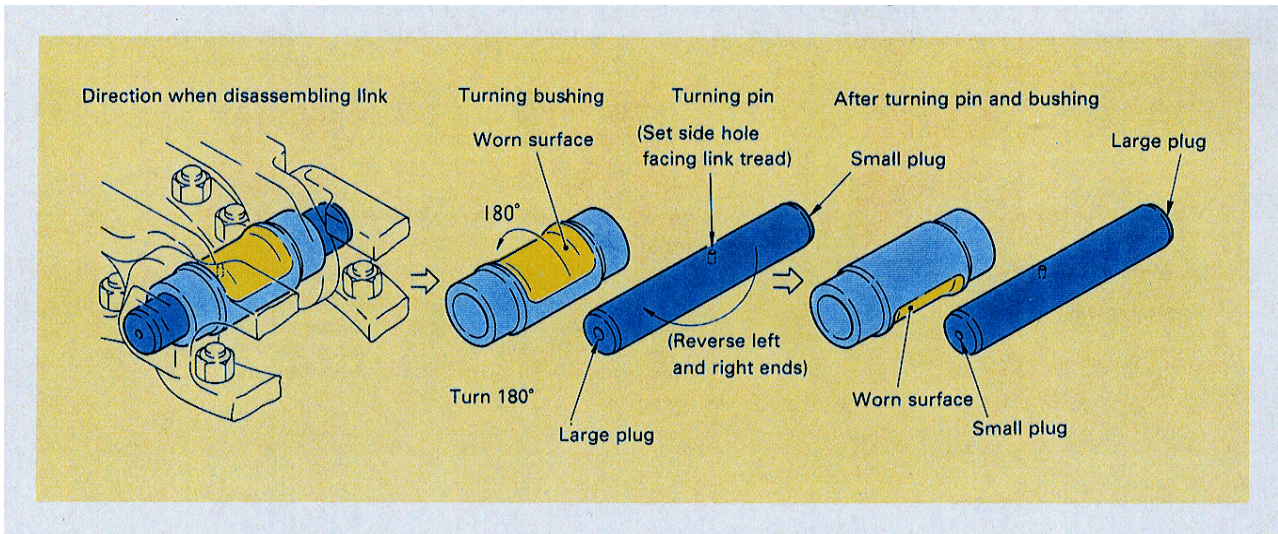
The contact portion of the seal and bushing gradually move inside while forming the seal groove as shown in the picture above. The sealing film becomes possible only by the seal part without damage that are formed inside this seal groove with bushing surface finished precisely.

The oil film is only formed during oil is supplied normally. The contact surface of seal and bushing are damage once sealed oil is leaked and it becomes dry internally with some causes, and oil film is not formed even if oil is refilled again.

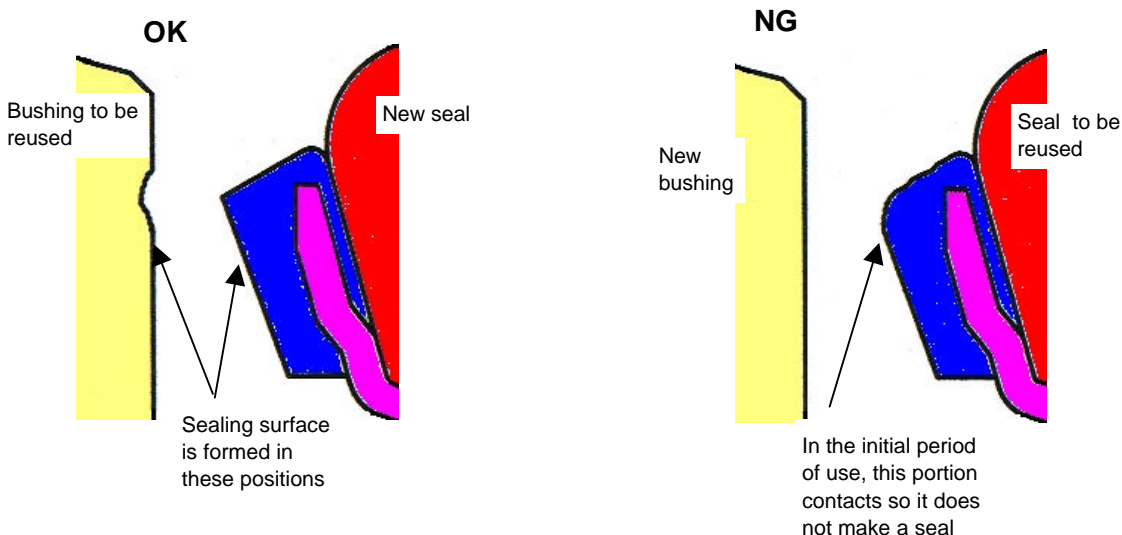
If dirt, sand etc. enter the sealing areas, the surfaces of seals and bushing will be easily impaired with dirt, sand etc. thereby deteriorating the sealing function.



## KEY POINTS AT WET TURN



- 1) With this method of turning, the pin and bushing are turned and reassembled and the assembly is filled with oil. Be careful to assemble the pin so that the side hole (branch hole) is on the link tread side in the same way as before turning.
- 2) Not only a bushing but also a seal need to be replaced with new one at the same time when a bushing is replaced with new one. On the other hand, a bushing can be reused if there is no abnormality even if a seal is changed with new one. And bushings and seals are not required to assemble as original set.



- 3) Pin will not be held enough and it would be come out if it is not assembled properly at bushing turn, and it will cause oil leakage by the sealing mechanism mentioned in the former page. Therefore, it is necessary to control dimensions strictly and assemble in proper steps. All parts must free from damage during assembling time, especially bushing end face.
- 4) Refer separate volume of shop manual "Guidance for Reusable parts-Lubricated Track ( II )" to judge parts resuability.



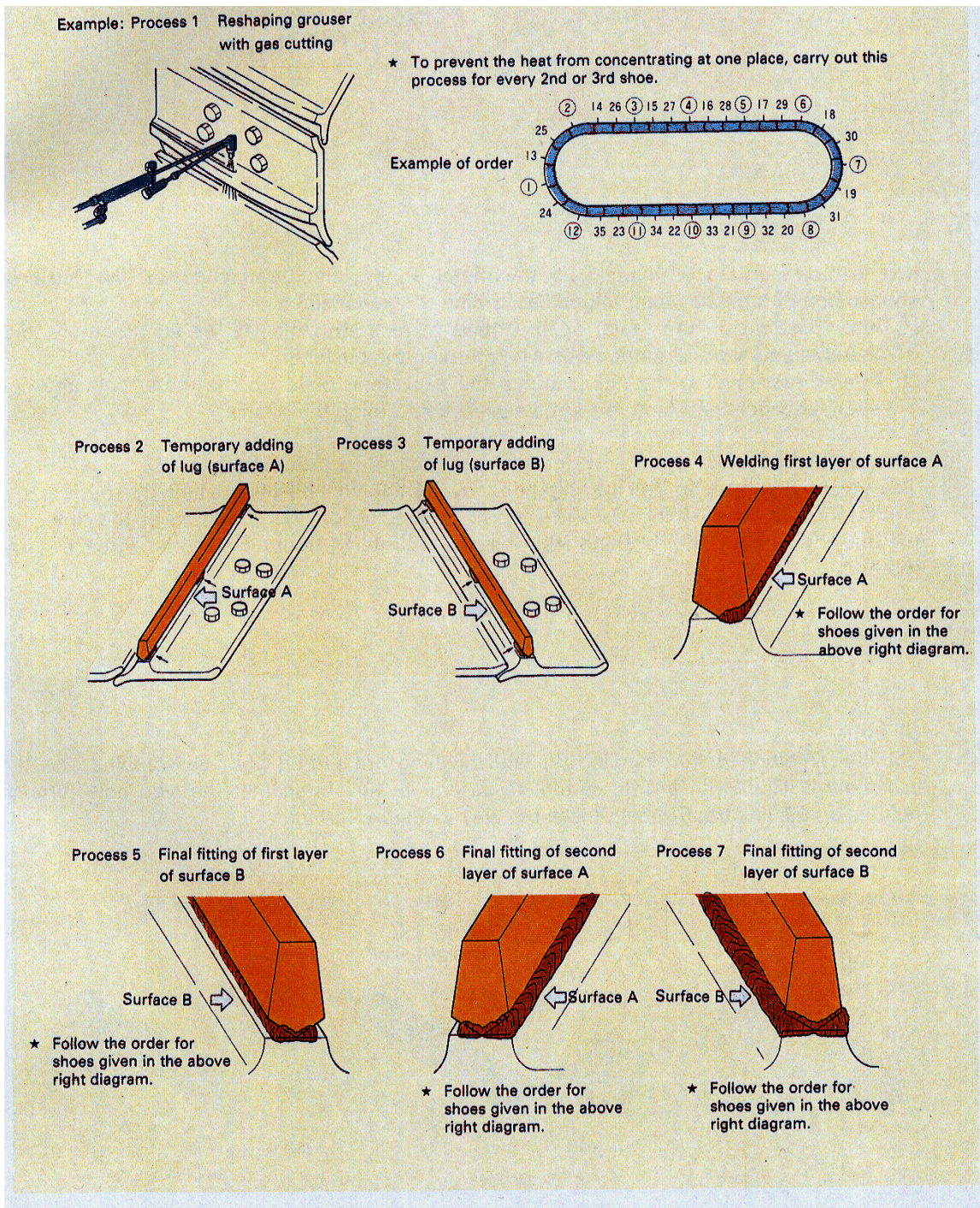
# KEY POINTS ON SEAL PROTECTION

## Rebuilding Track

Care is needed when welding the lug material to shoe grouser while the shoe is installed to the link assembly. If the grouser portion is shaped using gas cutting and lug welding is carried out continuously for one shoe, the heat will be concentrated in one place. This will mean that the seal will be subjected to high temperature and may deteriorate, so it is necessary to consider carefully the procedure to follow.

### Example of method of dissipating heat

To prevent the heat from concentrating at the seal at one place, divide the processes for rebuilding the lug into several parts, and carry out the work on every 2nd or 3rd shoe. When bolt is forced to cut by gas, keep temperature under 80 °C at seal portion to avoid seal deterioration, and protect spatter entering into the link gaps.



## DISASSEMBLY

### 1. Preparation of shoe removal from track link assembly.

Set the track assembly on a flat floor with the shoe facing up.

- ★ Remove all dirt from track assembly before start disassembly.



### 2. Shoe removal

Raise the track assembly with the shoe facing up, then use shoe impact wrench to remove shoe.

- ★ Do not loosen a bolt by force if it was hard, loosen other bolt.  
It will cause bolt seizure or link hole deformation, and rework will be required.
- ★ When bolt is forced to cut by gas, keep seal part temperature under 80 degree C to avoid seal deterioration, and protect entering of spatter into the link gap.



### 3. Shoe bolt & nut

Check damage on the thread of each shoe bolt, then keep in the pallet.



### 4. Track disassembly

- 1) Elevate removed shoes and pull link ass'y toward link press by winch if elevating table is available.

Place removed shoe plate on pallet if elevating table is not available, and pull link ass'y toward link press by winch.



2) Set master link on track link press jaw



**Master link disassembly.**

3) Press master link pin out.

Punch small plug into oil hole of the pin after disassembly. No need to remove large plugs. It can be done before disassembly, but oil will be spreaded out on the floor.

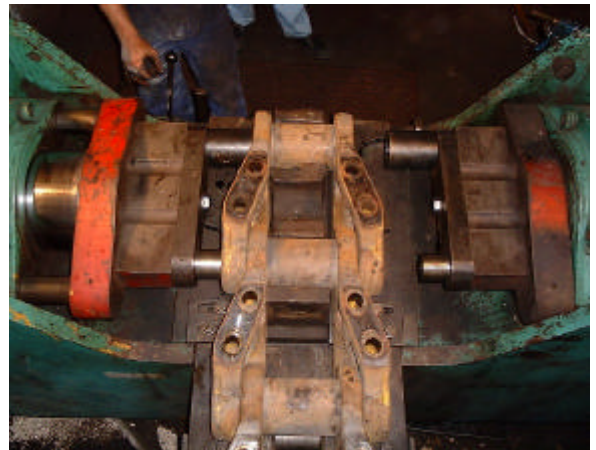
★ Do not give any damage on master link connecting surface.



**Regular link disassembly**

4) Check alignment between center of pushing tools and pin and bushing, then push pin and bushing out at the same time. Banging sound will be occurred at breakage of edge ring, which is normal.

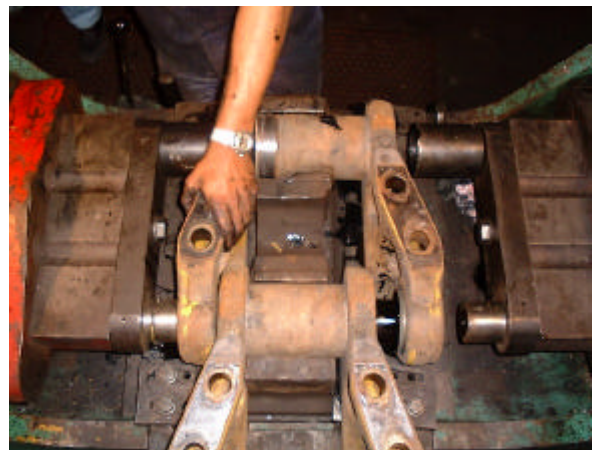
★ Press fit portion of bushing and pin nor link bore will be damaged if it was misaligned.



**Required Link Press Capacity**

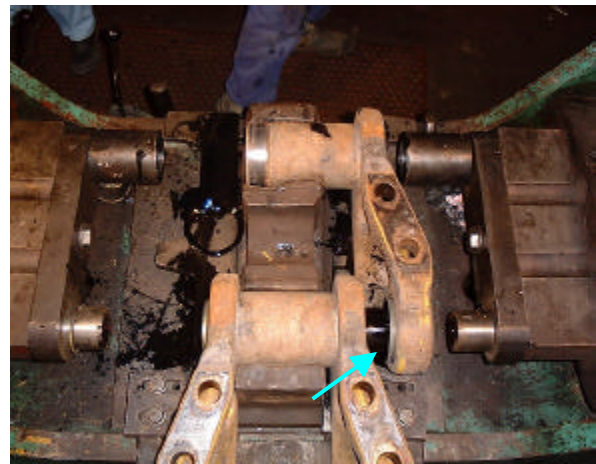
Model	Press capacity
D475A and up	300 ton and up
D375A and below	200 ton and up

5) Take a disassembled link out

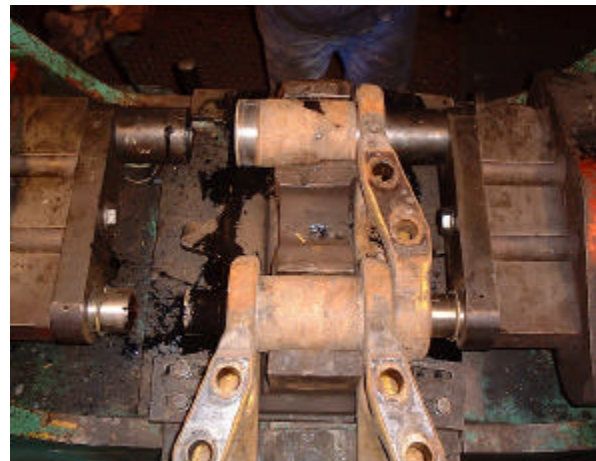


6) Removal of pin and bushing from the other side.

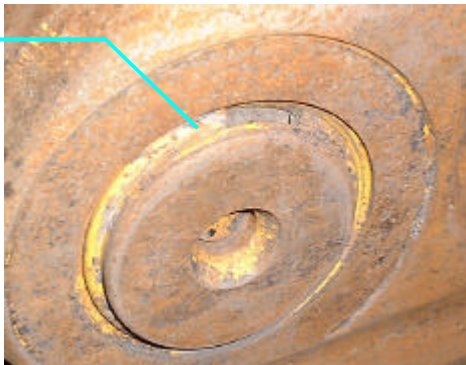
- ★ Be careful of seal assembly falling off from link counterbore not to be damaged when pin is pushing out from the other side.



7) Removal of pin and bushing from the other side.



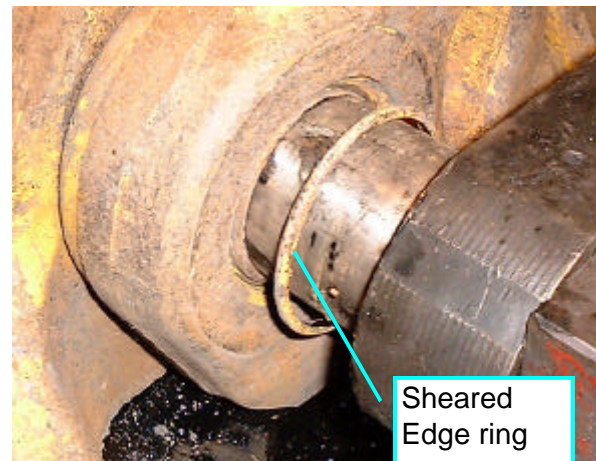
Wedge ring



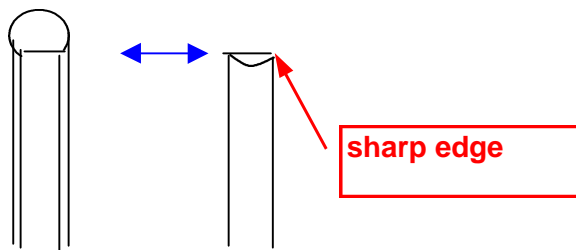
**Wedge ring breakage by shearing**

Wedge ring put in the pin groove is sheared off by press force with large banging sound.

- ★ Be careful to handle sheared ring which may cut finger by sharp edge.

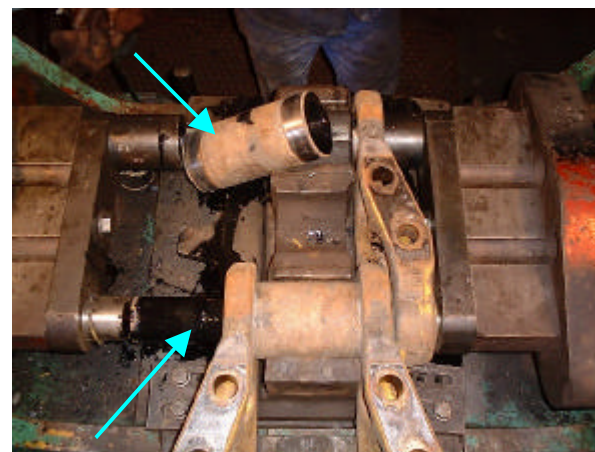


Sheared Edge ring



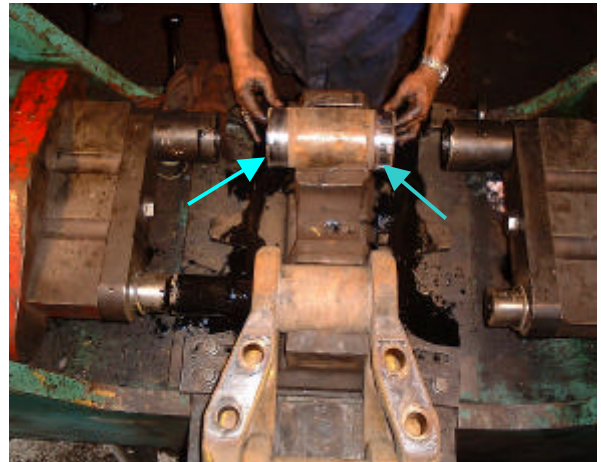
8) A pair of pin and bushing came off from link.

- ★ Be careful not giving any damage on bushing end face where contact seal lip during disassembly.



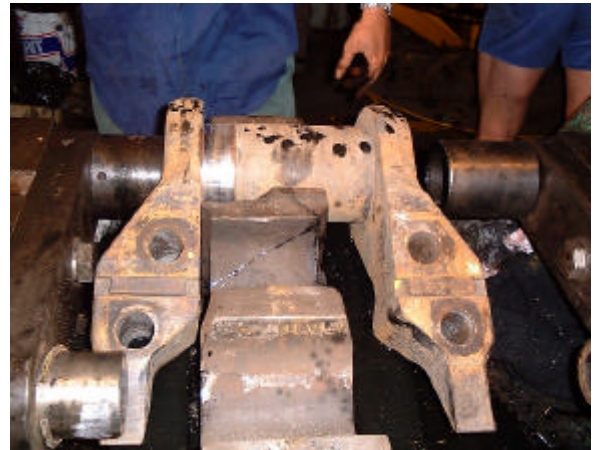
9) Check bushing at press fit portion and seal contact surface.

Repeat same steps up to the last set of link.

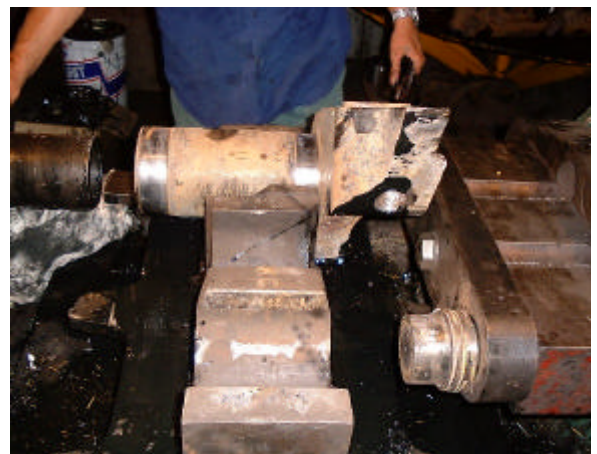


10) Removal of the last bushing from master link.

★ Do not give any damage on master link mating surface.



same as above.



**Arrangement of removed links (example)**

Put removed pairs of links on the round table in order.



Preparation of pins, bushings and spacer rings cleaning (example)

Put all removed pins, bushing and spacer rings in the net case for parts washing by degreaser.

★ Punch small plug into pin oil hole with tool (R1) before cleaning pins.



Preparation of pin, bushing and spacer rings cleaning (example)

Put all removed pins and bushing in the net case for parts washing by degreaser.



Parts cleaning (example)

Put the parts in parts washing tank.



Parts cleaning

Fluid is "Multi-Purpose Degreaser" of Castrol and it is heated and stirred by air to remove coated oil on the parts.



Parts cleaning

Finish parts cleaning with Steam high pressed gun.

- ★ Stand pins as small plug hole lower side to drain cleaning fluid from inside afetr finish cleaning.
- ★ Be careful not giving any damage at bushing end face during handling.



Seal cleaning

When seals are reused, wash seal by soft brush to avoid damage of seal lip area with **Kerosene**.

- ★ Use only Kerosene. Do not use any other fluid that may damage rubber seal material.



Multi-Purpose Degreaser of Castrol can be used as "oil & grease remover" (exsample)



### Inspection

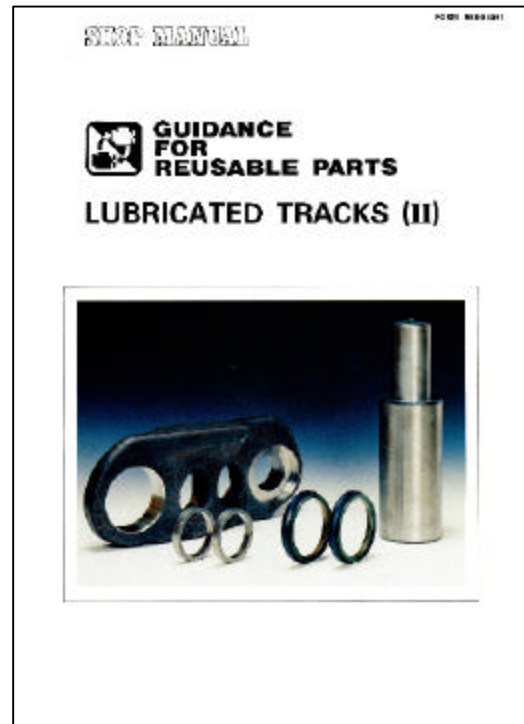
Check the following items to determine if the parts can be reused as lubricated track or as a grease-filled track. Carry out comprehensive check to determine if the link assembly can be rebuilt as a lubricated track or as a grease-filled track.

- ★ When making judgements about reuse of parts, see "**Guidance for Reusable Parts - Lubricated Tracks ( II )**".

Check the parts visually for damage, and carry out a color check or use flaw detector to check parts that are suspected of being damaged. Any parts that is cracked must not be used again,so scrap it.

### ★ Precautions for storage

- 1) To prevent rust of the counterbore portion of the link, Leave the seal installed to the link and be carefull not to damage the seal lip during storage if seal are reused as grease-filled track.
- 2) Coat the pin and bushing press-fitting portion, shoe mating surface, and master link mating surface of the link with rust prevention oil to prevent rust.
- 3) Coat the whole circumference of the pins, bushing, and spacer with rust prevention oil to prevent rust, and be particularly careful not to damage the end face of the bushing during storage.





**REWORK****1. Link**

- 1) Wipe oil and dirt off from Links and check damage visually.



- 2) Maintain press-fitting bore surface with sand grinder if it is rough or if dirt remained.



- 3) Maintain rough surface of pin and bushing bore if it is necessary with sand grinder.

Make press-fitting surface smooth.

★ Be careful, press-fitting force maybe drop if surface was grind excessively.



- 4) Take dirt off from link counter bore with sand grinder.



Remove dirt off from seal ring counter bore with sand grinder.

- ★ Dirt may enter the edge of counter bore and remain. It must be removed completely.



5) Make master link mating surface smooth with sand grinder.

- ★ Do not damage the mating surface and thread.



6) Remove dirt and rust on shoe mating surface with sand grinder.



## 2. Bushing

Make bushing press-fitting portion smooth with sand grinder if it is required.



**3. Pin**

1) Make pin press-fitting portion smooth with sand grinder if it is required.



2) Remove remaining liquid gasket and dirt from Wedge ring groove on pin with wire brush.



**4. Shoe**

Make shoe mounting surface smooth with sand grinder.



**5. Pushing tool maintenance**

Maintain pushing tool deformation if it is required.

★ Maintenance of pushing tool will cause keeping proper protrusion of pin and bushing at assembly.



**Tool**

Sand grinder for maintaining of link bores and press- fitting portion of pin and bushing.



Wire brush for removing dirt from link bores.  
(normally sand grinder is recommended)



Wire brush for removing remained liquid gasket  
and dirt from edge ring groove on pin



Sand grinder for maintaining pin and bushing  
press-fitting portion and link and shoe mounting  
surface.



## ASSEMBLY

### Preparation for assembly

- 1) Adjust the dimension of link press pushing tool to have protrusion of bushing and pin in the specification.

In case pin end face is worn, adjust pushing tool by adding wear amount of the pin end to be specified dimension.

(Refer "Press Jig dimension on the last part of page)

- 2) Adjust relief pressure of link press not to exceed press-fitting force **(P4)** over the specification.
- 3) In case large plug are removed, wash oil hole with tool **(R2)**, and put large plug with tool **(R3)**

★ The symbols in the each discription of works can be referred " PARTS STANDARD VALUE" table and "ASSEMBLY TOOL" table in this last part of manual.

Example: P4, R2,-----

### 1. Master Link assembly (bushing side)

- 1) Align link press push tool center with bushing center properly.

- ★ Bushing center becomes lower after 180 degree turn so re-centerize with pushing tool is required.
- ★ outer diameter should be measured at disassembly to estimate alignment change.

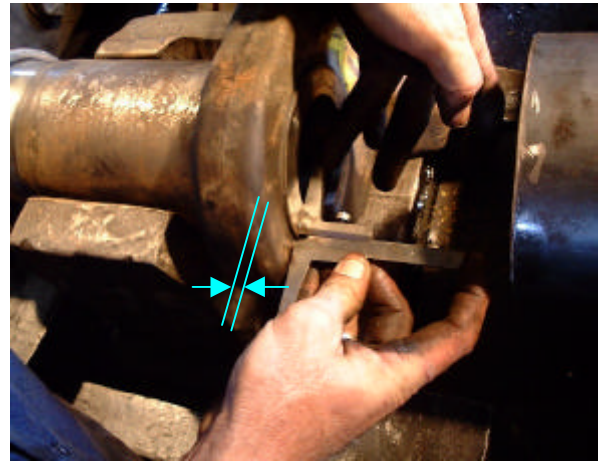


- 2) Set a link and press bushing in the link.

Target bushing press-fitting force **(P2)** should be be in the specification shown in the "Parts standard table".



- 3) Check bushing protrusion (**L5**) in the specification with depth gauge, which is shown in the "Parts standard table".



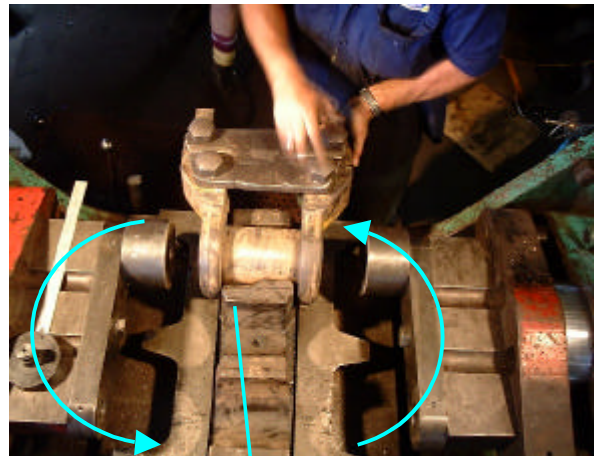
- 4) Set an other side link and align parallels with press fitted one, and press fit it.

★ Link shoe mounting face must be parallel, otherwise it will be difficult to connect master links and install shoe.



- 5) Check shoe bolt pitch with shoe bolt pitch gauge.

Refer dimension (**L9, L10 & L11**) in the "Parts standard table".

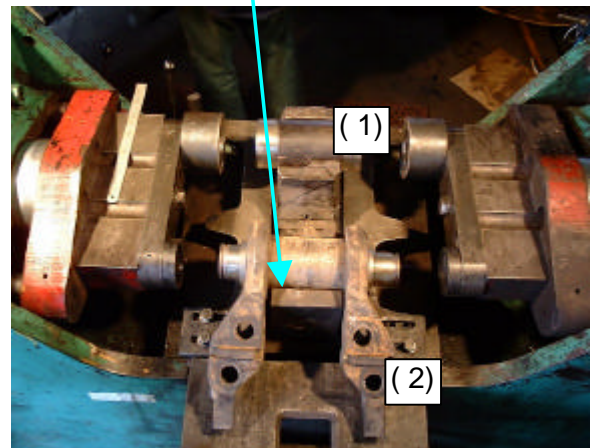


## 2. Regular Link assembly

- 1) Turn master link sub-ass'y 180 degree. Put a bushing(1) on a press jaw, and put a pin(2) in a bushing.

★ Turn bushing 180 degree as worn side comes upper side which is link shoe mating side.

Reverse left and right ends of pin as oil branch hole facing link tread side.



2) Put spacer rings on pin from both side.



3) Apply lubricated oil at the bushing end face, which is filled in the pin.

★ Use Gear Oil SAE GO #90



4) Coat bushing end surface with lubricated oil.

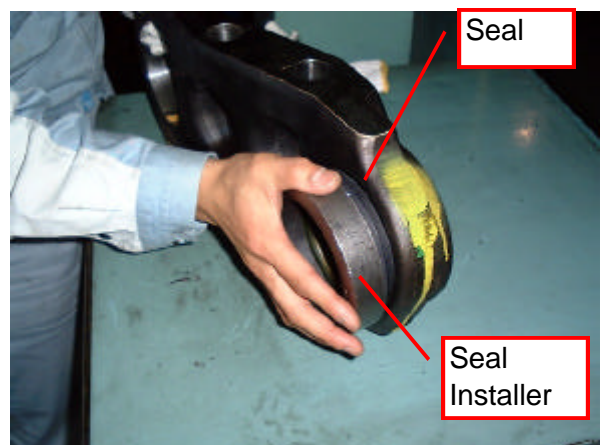
★ Do not forget to coat bushing end face with oil to keep seal properly.



5) Put seal in the link counter bore with seal installation tool (R6).

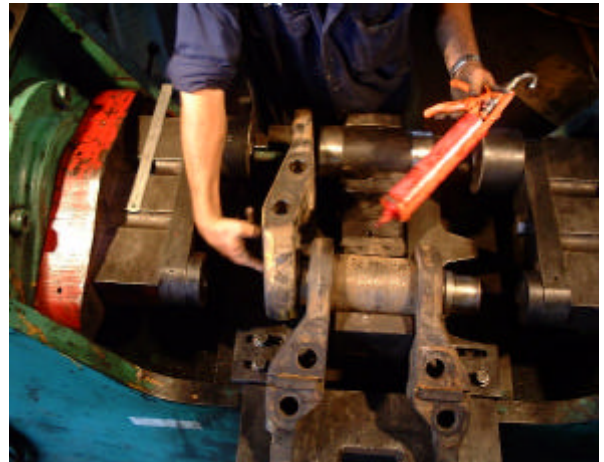
★ Seal can be installed by hand without using tool, but it maybe come out at link assembly.

★ Seal need to be changed with new one at bushing turn.

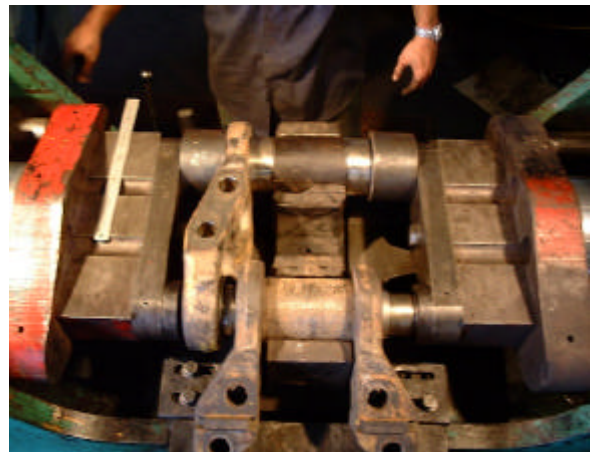


- 6) Set a link, and coat link pin press-fitting bore with liquid gasket.  
(P/No.198-32-19890)

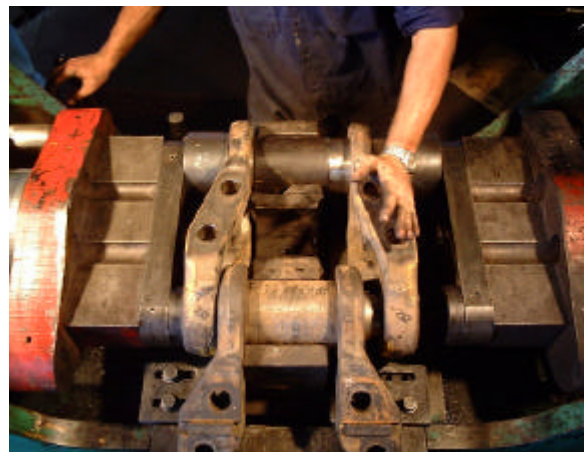
★ Do not put liquid gasket on seal lip.



- 7) Check alignment between pushing tool center and bushing/pin center, then press fit.

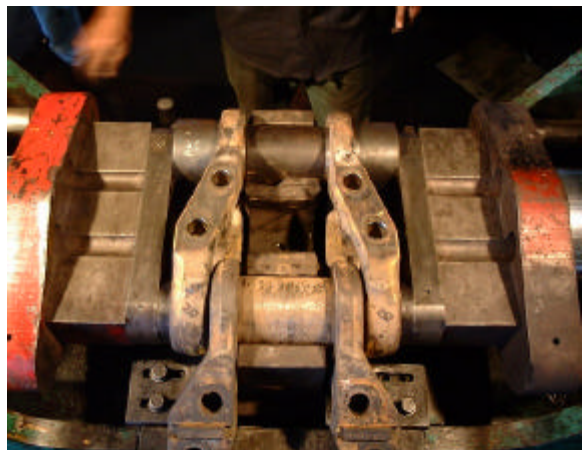


- 8) Set the other side link and check alignment between pushing tool center and bushing/pin center and press fit.



- 9) Press fit link completely with certain press-fitting force (P4).

★ Do not exceed press-fitting force larger than the target.

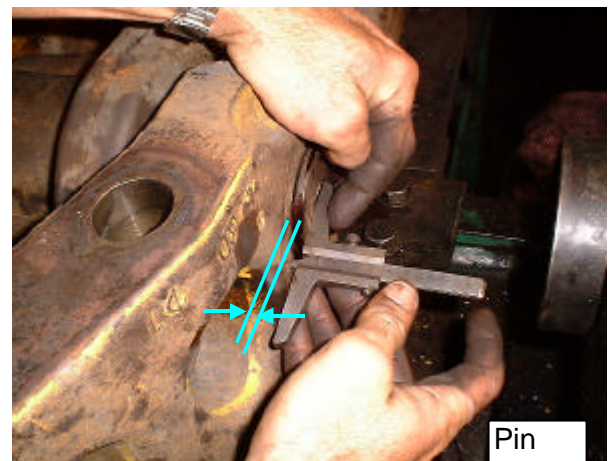
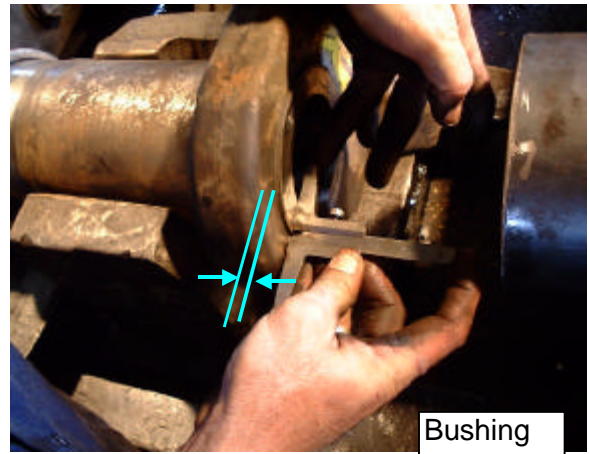




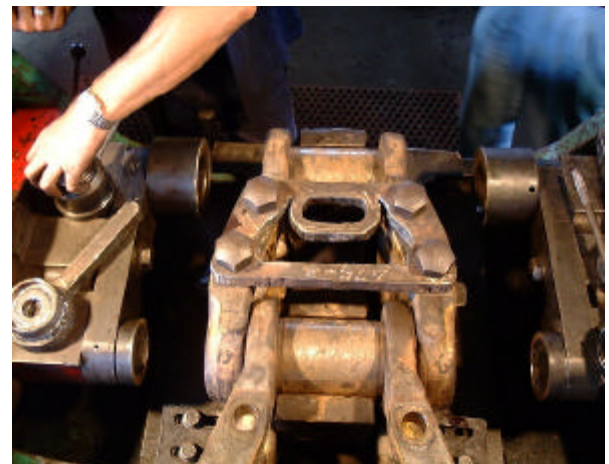
10) Check protrusion of bushing and pin from link with depth gauge. (L4, L5)

★ It should be done on both side on the first three(3) set of Links at least.

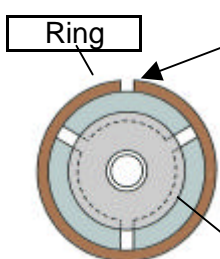
Protrusion of bushing and pin on the both side should be in the specification. And it should be even on both side. Otherwise, edge ring might not be fit in the groove on the pin properly.



11) Check shoe bolt pitch with shoe bolt pitch gauge. (L6, L7 & L8)  
After that check link rotation manually.



12) Wedge ring installation  
Set wedge ring on ring installation tool. (R7 & R8)

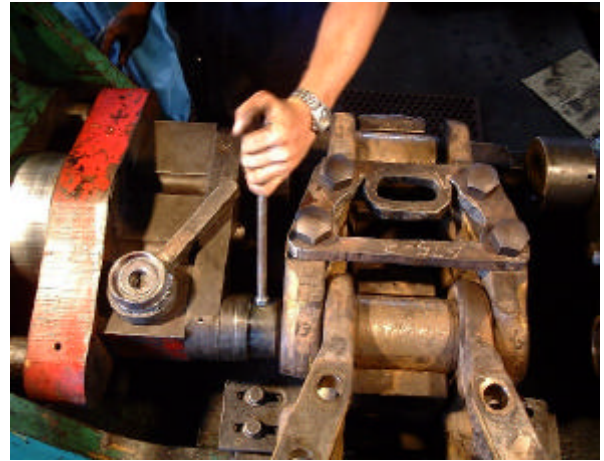


★ The open end of ring should be set at center of three split tool. The ring may not be inserted pin groove properly in case the open end of ring is not at center of tool as shown in the drawing on the left.

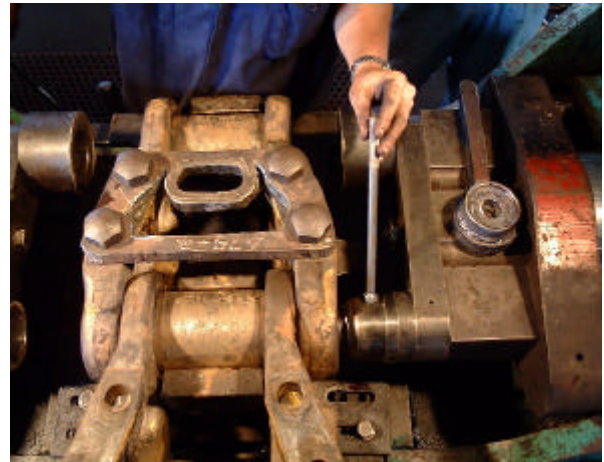


- 13) Align the tool center with plug hole center and push the tool gently until click sound is noticed.

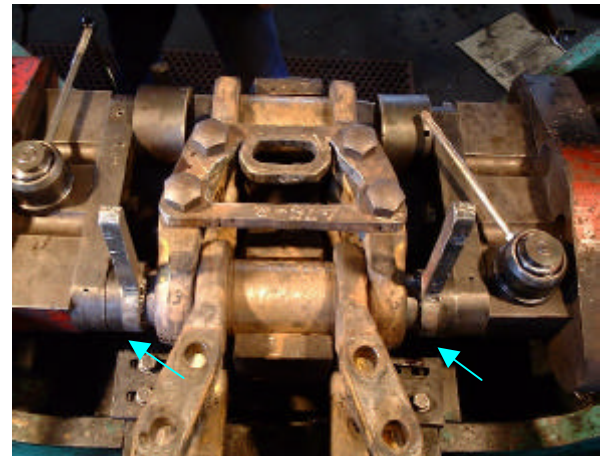
★ A click sound is noticed when wedge ring slides tool off and fit on the pin.  
Size of protruded center of installation tool for large and small plug side are different.



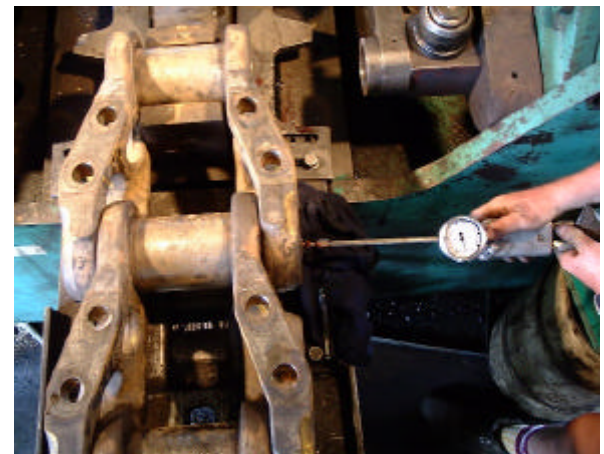
- 14) Do same thing on the other side.



- 15) Set secondary ring pushing tool (R9) on both side, and push rings in the pin groove completely with maximum press force (P3).



- 16) Check sealing performance  
Remove the air from inside the pin through small plug hole using vacuum pump (R4) at the vacuum of 680 - 710 mmHg (91-95 kPa) for 5 seconds.

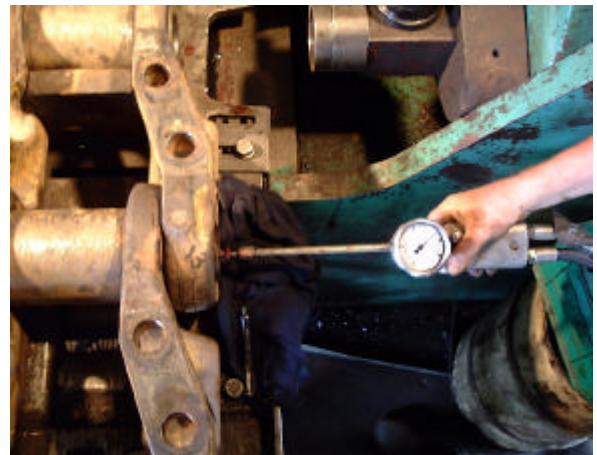


- 17) If the vacuume pressure was dropped, seal did not fit properly. Then reassembling and seal inspection are required.



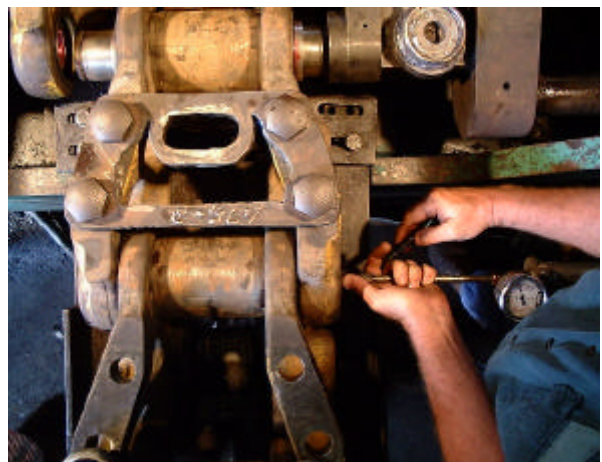
- 18) Fill specified lubrication oil in the pin after no air leakage is confirmed.

Fill oil up to 2-3 kg/cm<sup>2</sup> (196-294 kPa)



- 19) After completion of filling with oil, install the small plug with pushing tool (R5) to specified depth (L13).

- ★ Be sure oil comes out from hole when installing plug. Refill oil if oil does not come out.
- Coat outside of circumference of the small plug with lubricated oil before.

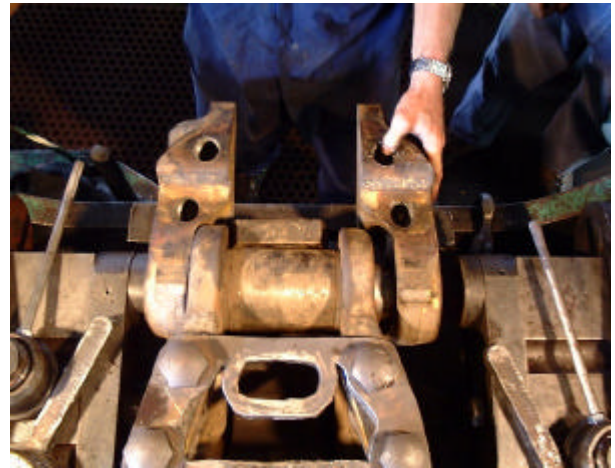


### 3. Master Link assembly (pin side)

- 1) Set and press fit master link.



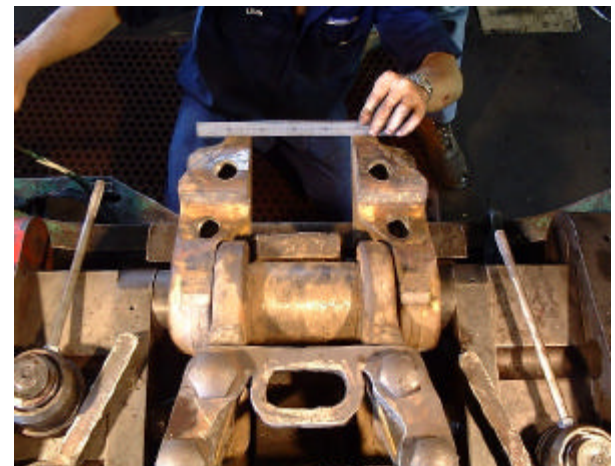
2) Set the other side link and press-fit it.



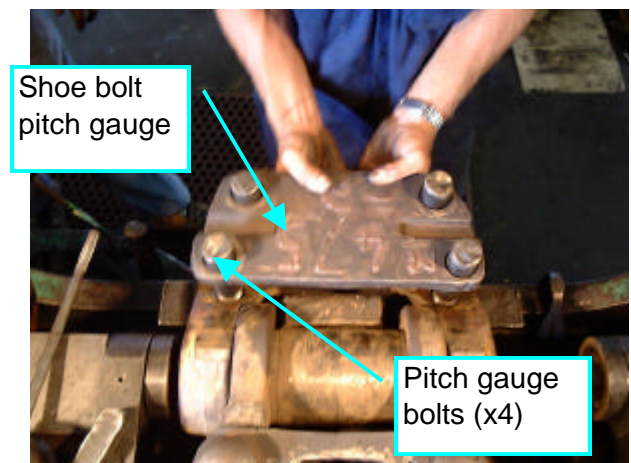
3) Check protrusion of pin end from link surface on both side. (L4)



4) Confirm both links are parallel with straight edge.



5) Screw gauge bolts in bolt holes and check shoe bolt pitch with pitch gauge. (L9, L10, L11)



- 6) Set wedge ring in the pin groove with installation tool. **(R7)**



- 7) Set wedge ring in the pin groove with installation tool. **(R8)**



- 8) Push ring in the pin groove completely with pushing tool maximum **(P3)** ton press force.



#### **4. Shoe installation**

- 1) Coat shoe bolt with disulfide molybdenum grease to avoid seizure.



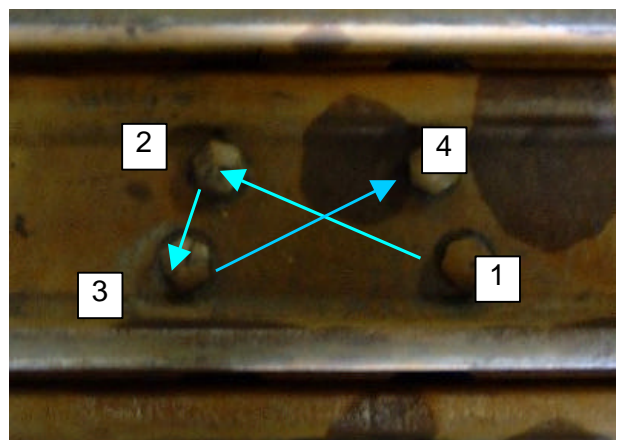
- 2) Set bolt with nut.  
Screw bolts several turn in nuts by hand.



- 3) Tighten the bolts with shoe nut runner to the targeted torque. **(S1)**

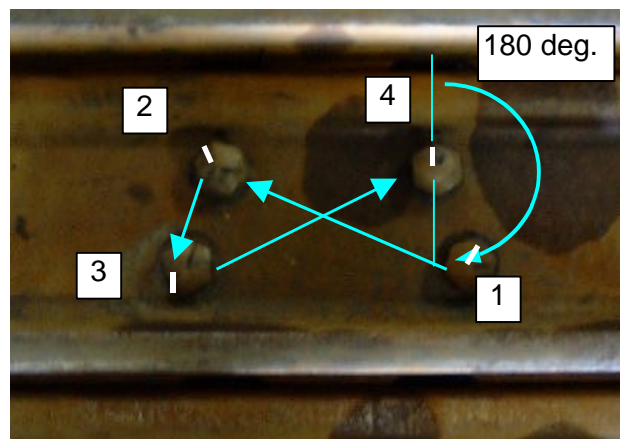


★ Bolts should be tightened with the order mentioned in the picture.



- 4) Retighten bolts by angle (S1) according to same tightening order mentioned in the above.

★ Mark bolt head to ease tighten it by angle.



**5. Master Link connection and shoe installation (in the field)**

- 1) Clean shoe mounting surface and keys before shoe and bolt installation.



- 2) Apply Anti-seize on neck of master bolts.



- 3) Screw master bolts in the links by hand up to mating surface to be completely contacted, and tighten temporally with portable impact wrench and tighten with shoe bolt impact wrench as same manner as regular shoe bolts. Then tighten by angle as well.

**(S2)**



**6. Pin oil level check (if required)**

In case oil level filled is not sure, put small plug temporarily after filling oil, and take the following actions.

- 1) Set assembled link ass'y(or track ass'y) on ground and stand it small plug side upward. And keep it over 30 minutes for oil down.



2) Remove small plugs which were plugged temporarily.



3) Measure oil level with gauge. **(L15)**  
And keep oil level record for refill.

It can be used welding rod or wire as a gauge.



4) Refill oil if it was lower than standard level.

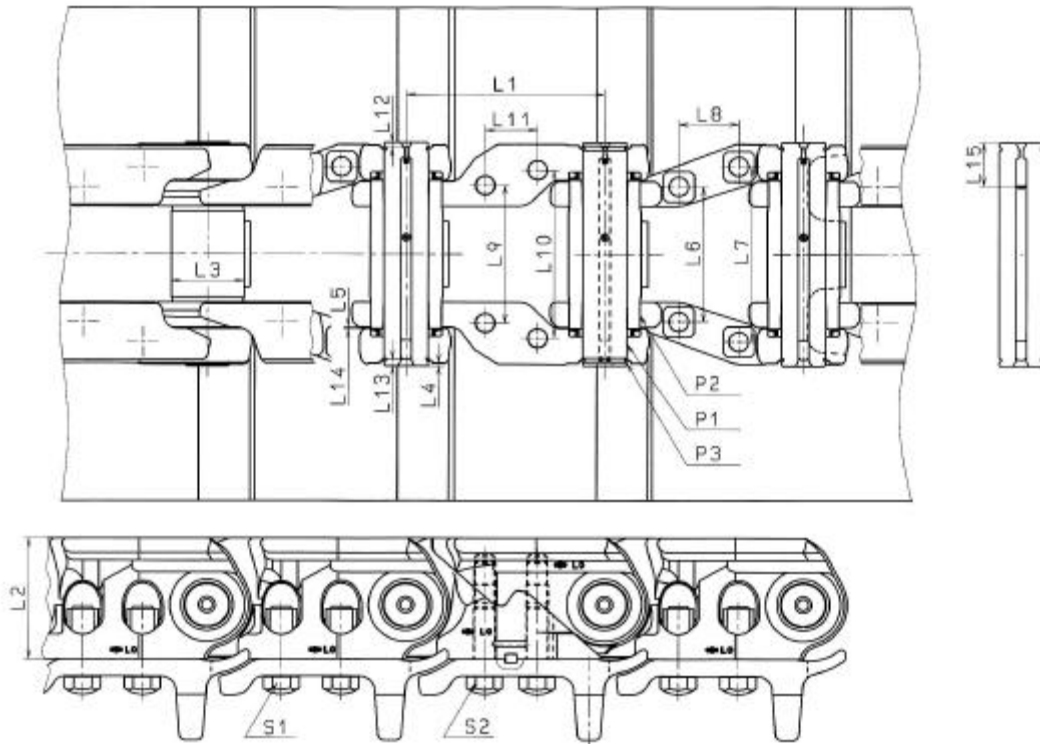


5) Put small plugs in the pin with push tool.**(R5)**



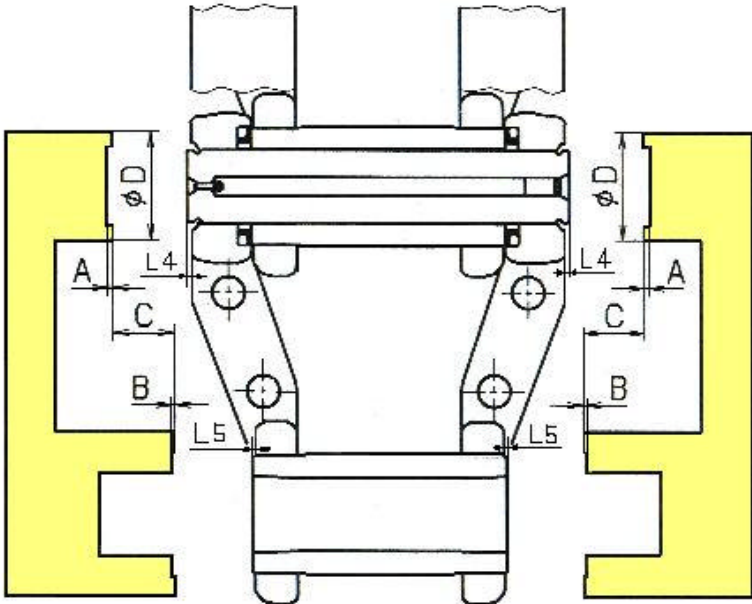


## STANDARD VALUE TABLE



	No.	Name		D475A-3
Dimension	L1	Link pitch	mm	317.5
	L2	Link hight(New)	mm	199
		Link hight(Wear limit)	mm	181
	L3	Bushing dia.(New)	mm	116
		Bushing dia.(Normal Wear limit)	mm	107.5
		Bushing dia.(Impact Wear limit)	mm	110
	L4	Protrusion of Pin from Link	mm	4.6±0.2
	L5	Protrusion of Bushing from Link	mm	2±0.3
	L6	Bolt pitch(Regular)	mm	222
	L7		mm	288
	L8		mm	96
	L9	Bolt pitch(Master)	mm	226
	L10		mm	276
	L11		mm	84
	L12	Depth of Small plug	mm	7.5±1
L13	Depth of Large plug	mm	10±1	
L14	Endplay	mm	0 ~ 0.5	
L15	Oil level	mm	55±15	
Force	P1	Pin press-fitting force	ton	40±6
	P2	Bushing press-fitting force	ton	32±7
	P3	Ring press force	ton	45±5
	P4	Press-fitting force	ton	130
S	S1	Bolt size(Regular)	mm	33x2
		Initial torque(Regular)	kgm	80±8
		Additionaly-tighten angle(Regular)	°	180±10
	S2	Bolt size(Master)	mm	33x2
		Initial torque(Master)	kgm	100±10
		Additionaly-tighten angle(Master)	°	180±10

**PRESS JIG**

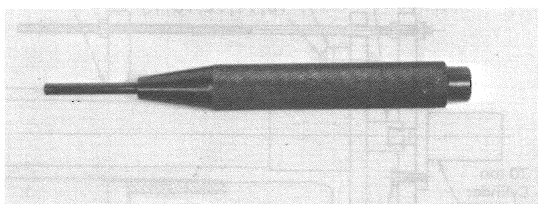


	D475A-3
A(=L4)	4.6
B(=L5)	2
C	59.1
D	110

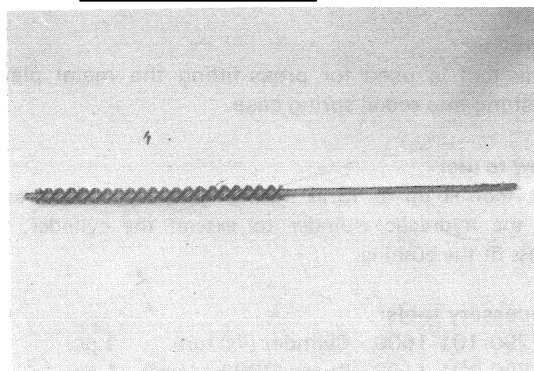
**TOOLS**

No.	Name	Parts Number D475A-3	Q'ty	Remarks
<b>R1</b>	Push Tool	791-646-7531	1	Small plug removing
<b>R2</b>	Brush	791-660-7460	1	Pin hole
<b>R3</b>	Push Tool	791-646-7900	1	Large plug installing
<b>R4</b>	Pump	791-601-1000	1	
<b>R5</b>	Push Tool	791-932-1110	1	Small plug installing
<b>R6</b>	Installer	791-632-1010	1	Seal
<b>R7</b>	Installation tool	791-685-5700	1	Small plug side
<b>R8</b>	Installation tool	791-685-5600	1	Large plug side
<b>R9</b>	Pushing tool	791-685-5750	2	

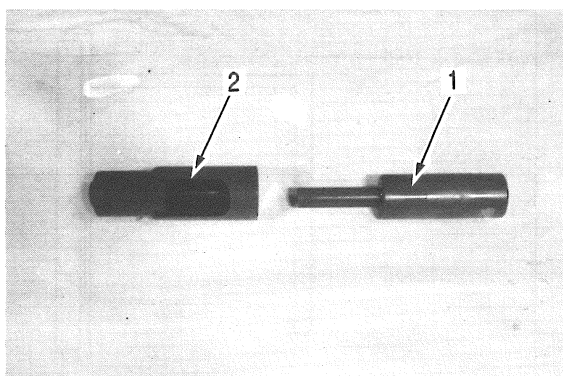
**R1** 791-646-7531



**R2** 791-660-7460



**R3, R5** 791-646-7900  
791-932-1110

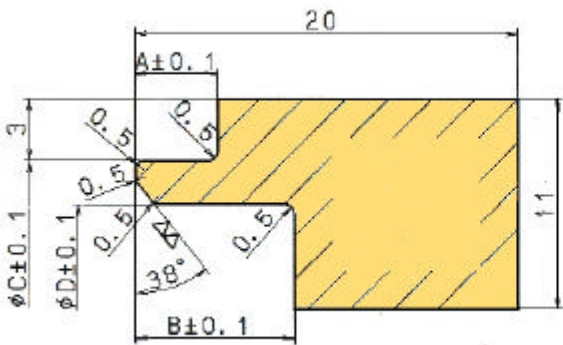
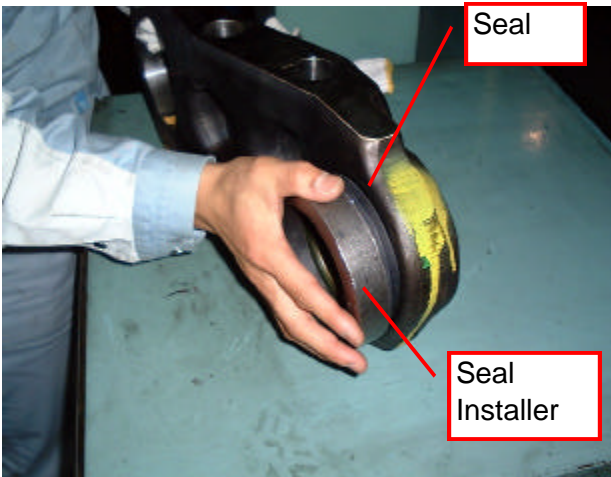


**R4** 791-601-1000

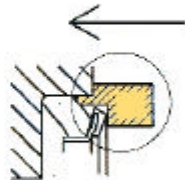


**R6 Seal Installer**

791-632-1010

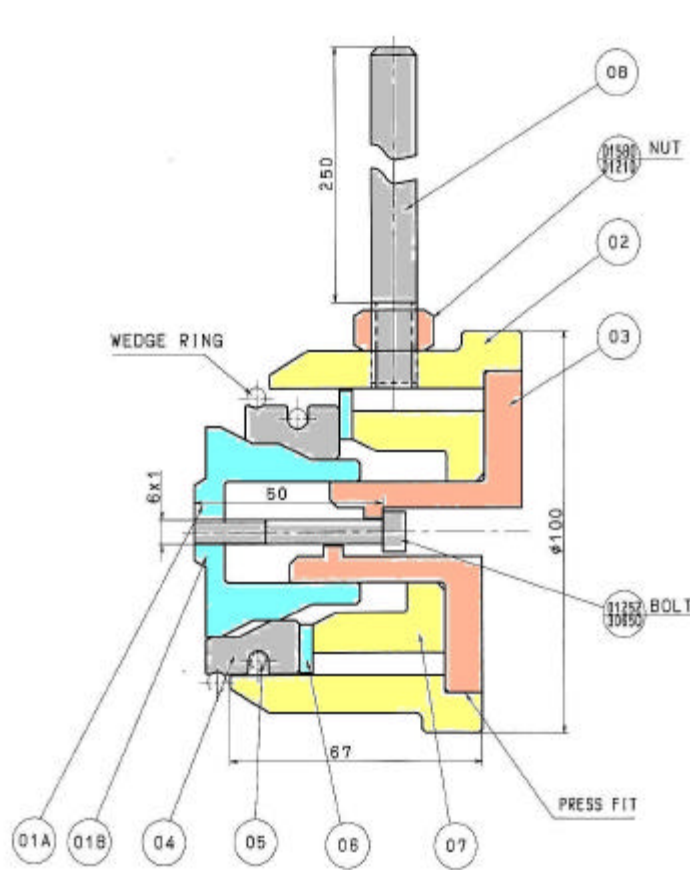
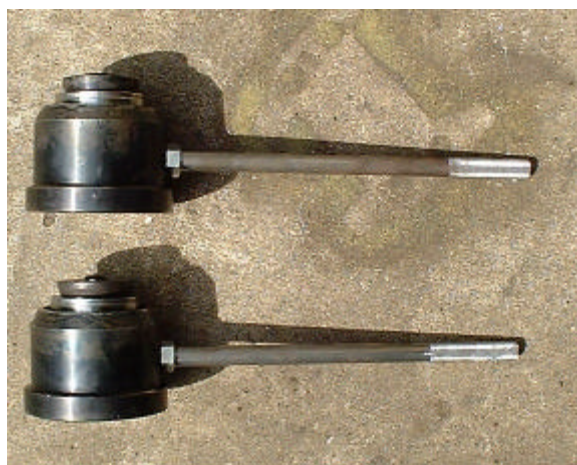


DIRECTION TO PUSH IN



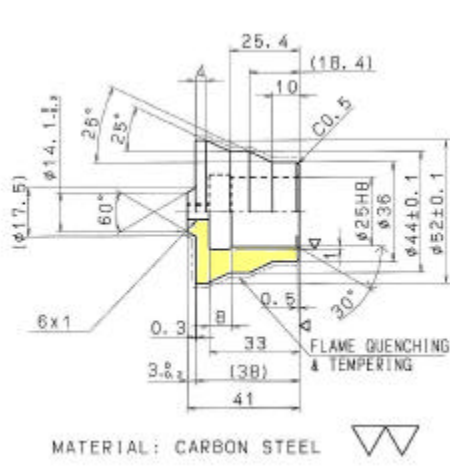
	D475A-3
A	4.3
B	8.7
φ C	113.5
φ D	108.9

**R7,R8**      **Wedge ring installer**

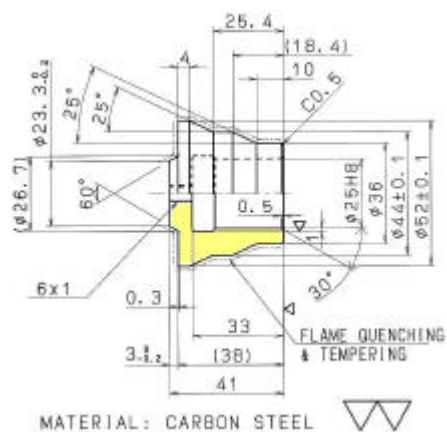


**R8 is same as R7 except 01.**

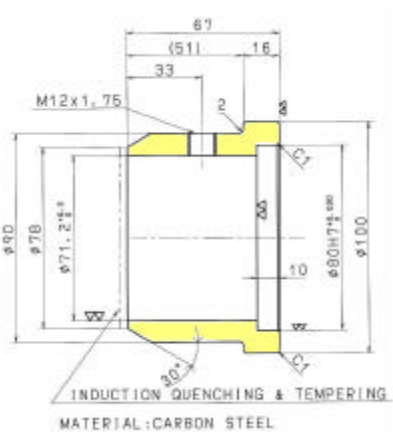
**R7-01**



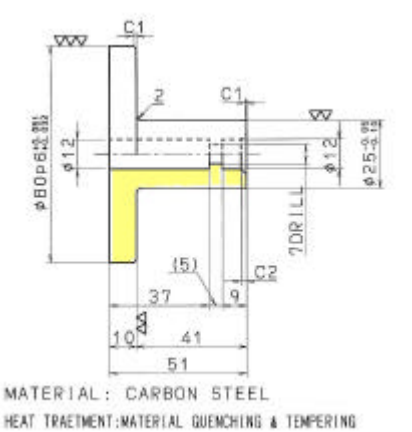
**R8-01**



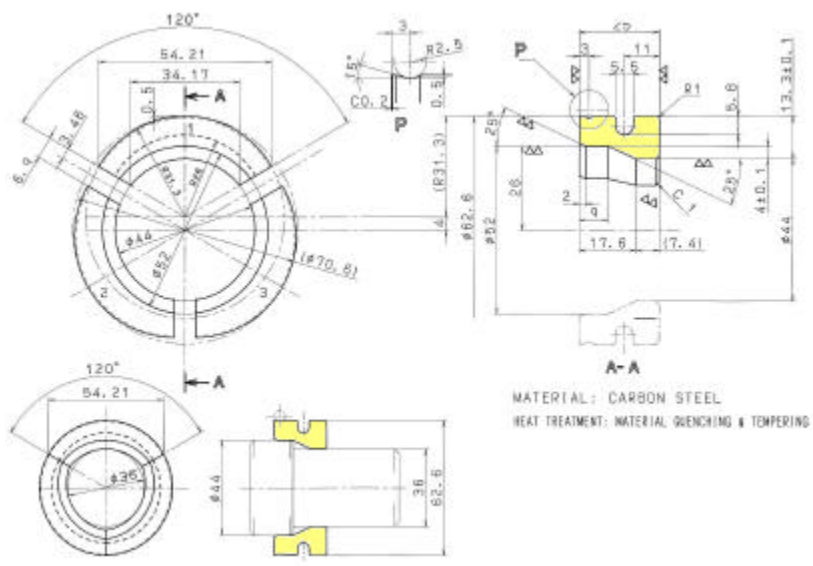
**R7,8-02**



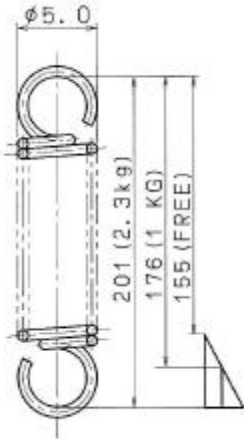
**R7,8-03**



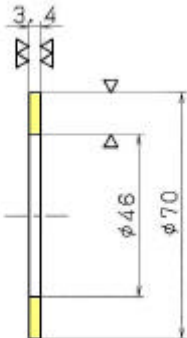
**R7,8-04**



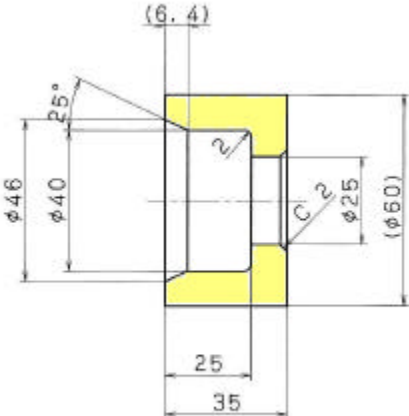
**R7,R8-05**



**R7,8-06**

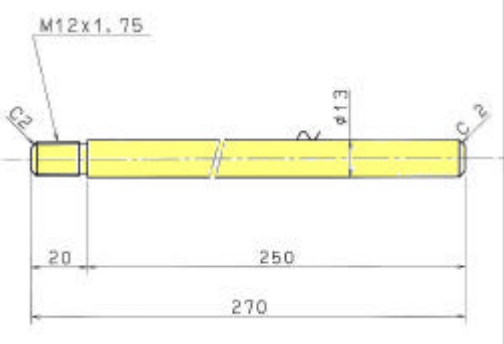


**R7,8-07**

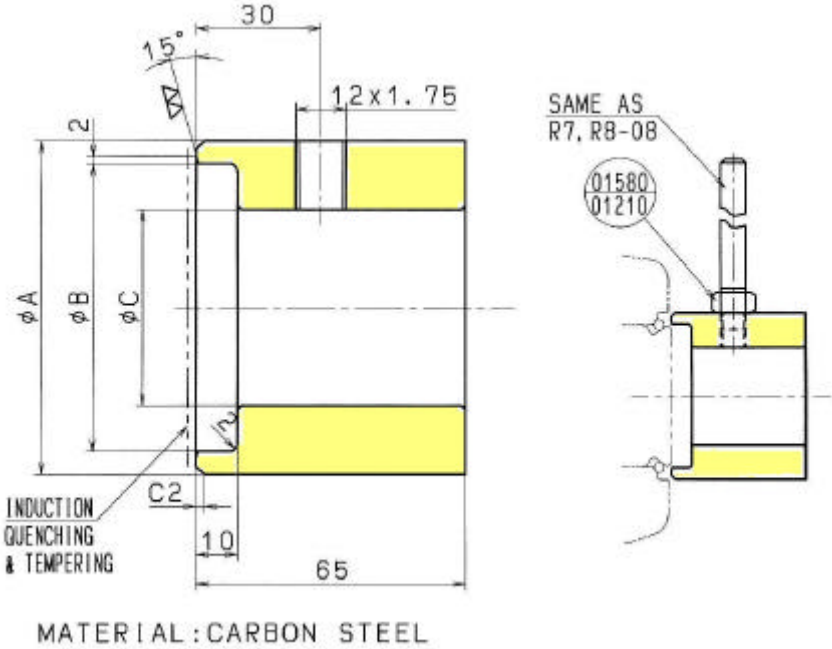


MATERIAL : URETHANE (HS A90)

**R7,8-08**



**R9 Wedge ring pushing tool**

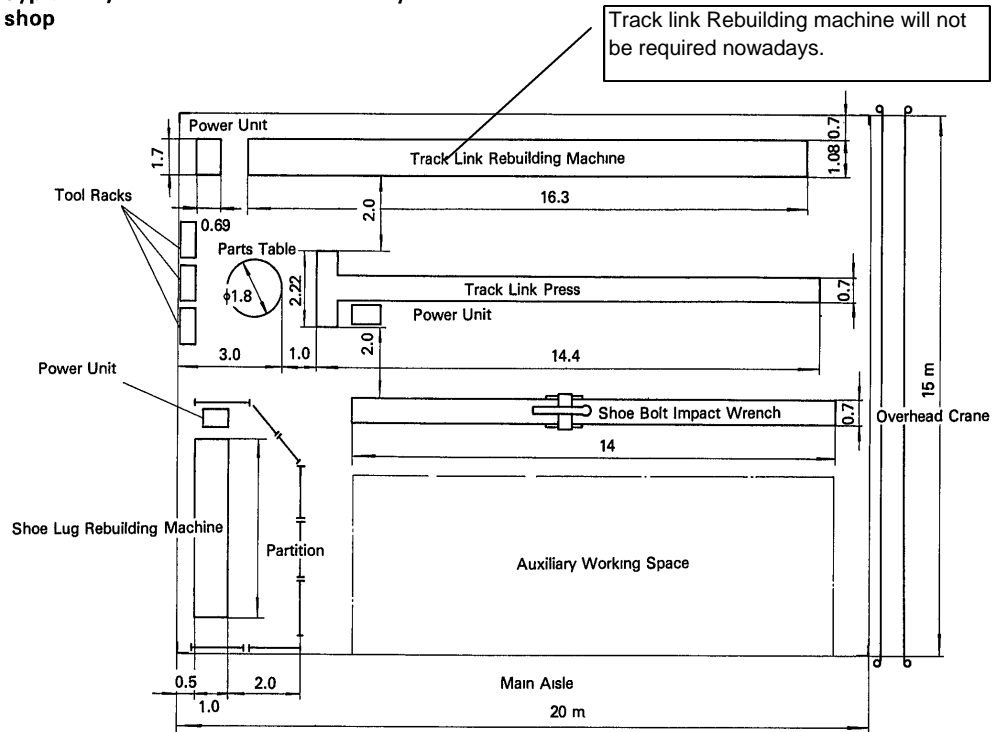


	D475A-3
φ A	82
φ B	70.6
φ C	48



# TRACK SHOP LAYOUT

Typical layout of track shoe assembly rebuild shop



Track link Rebuilding machine will not be required nowadays.

