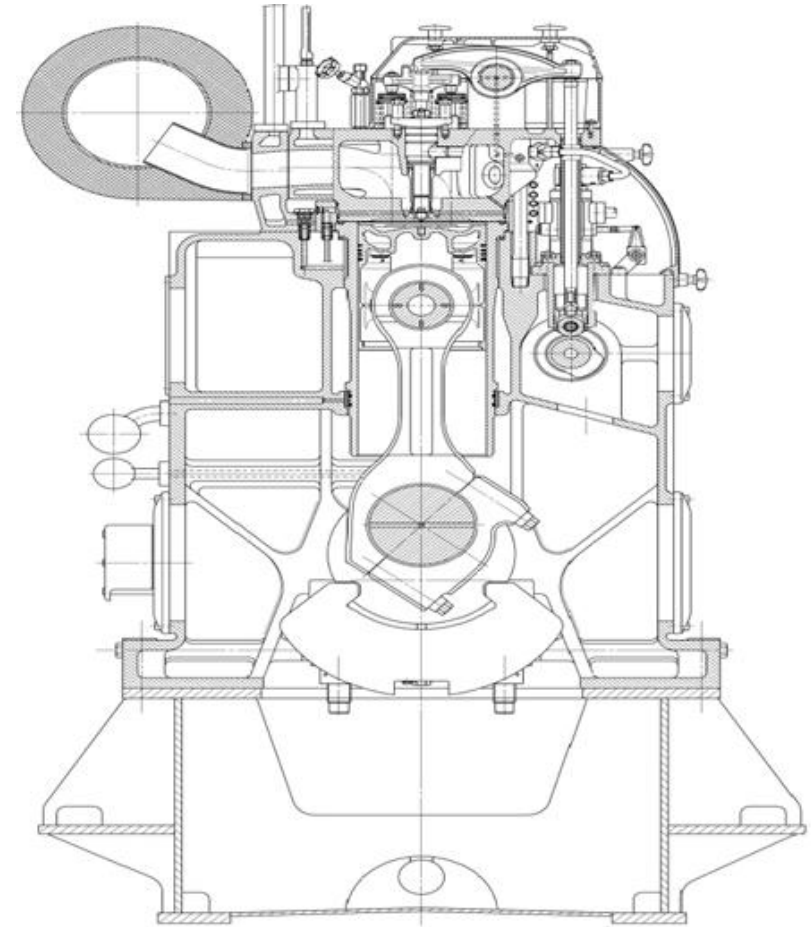
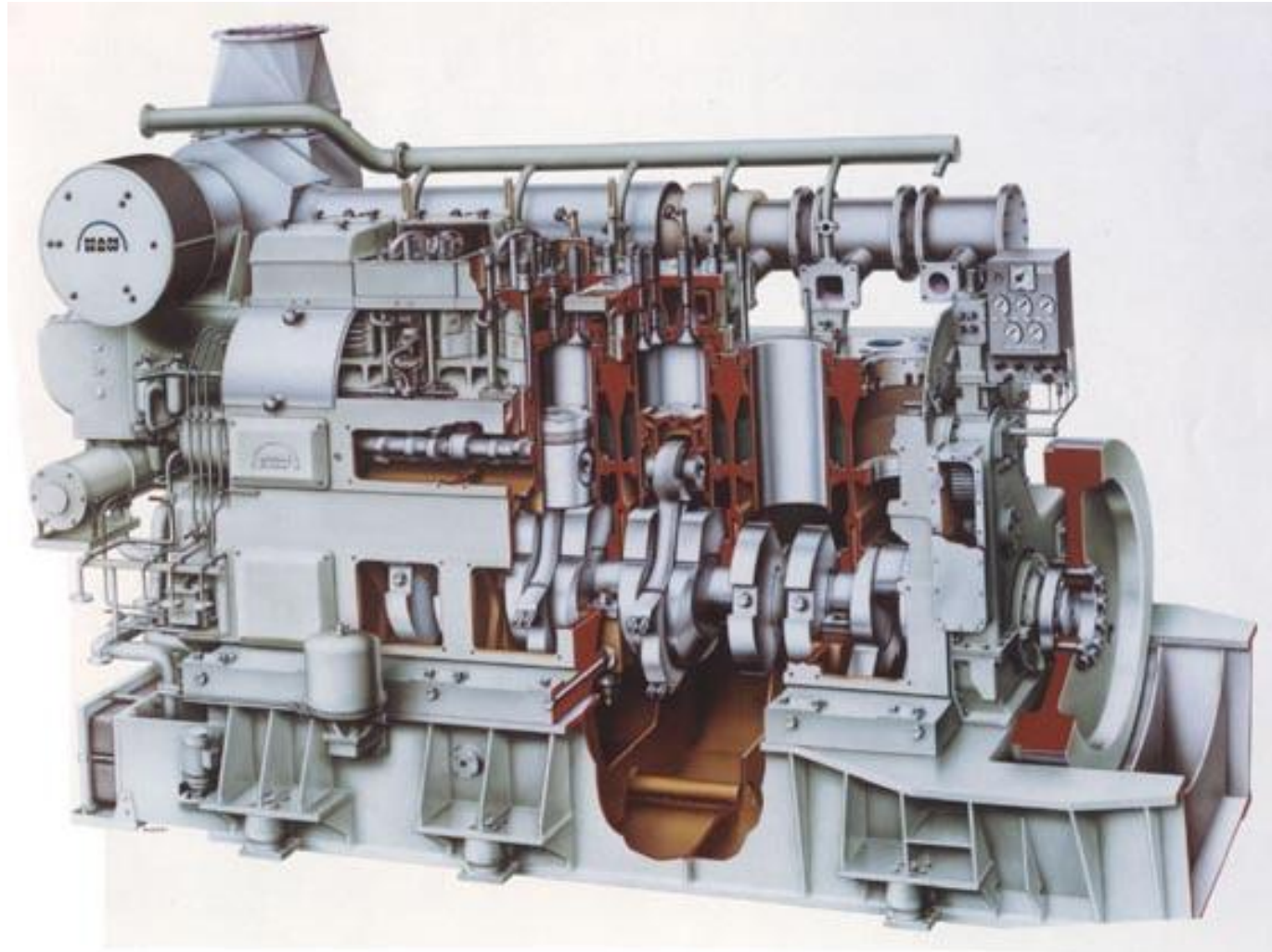


L28/32-L23/30H Piston, Connecting Rod and Cylinder Liner



L28/32-L23/30H Piston and Conrod



L28/32-L23/30H Piston, Connecting Rod and Cylinder Liner



Piston:

The piston, which is oil-cooled and of the mono bloc type made of nodular cast iron, is equipped with 3 compression rings and 1 scraper ring.

Piston Pin:

The piston pin is fully floating which means that it can turn freely in the pin bosses of the piston as well as in the connecting rod bush, kept in place by two circlip.

Connecting rod:

The connecting rod is die-forged.

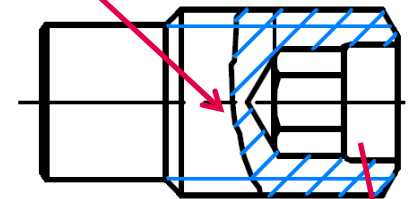
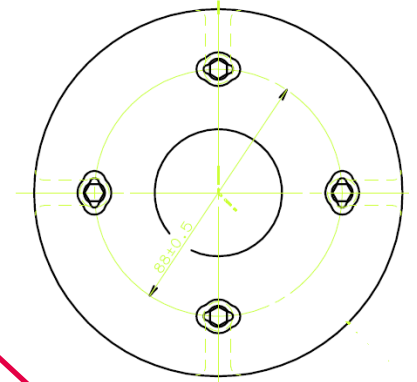
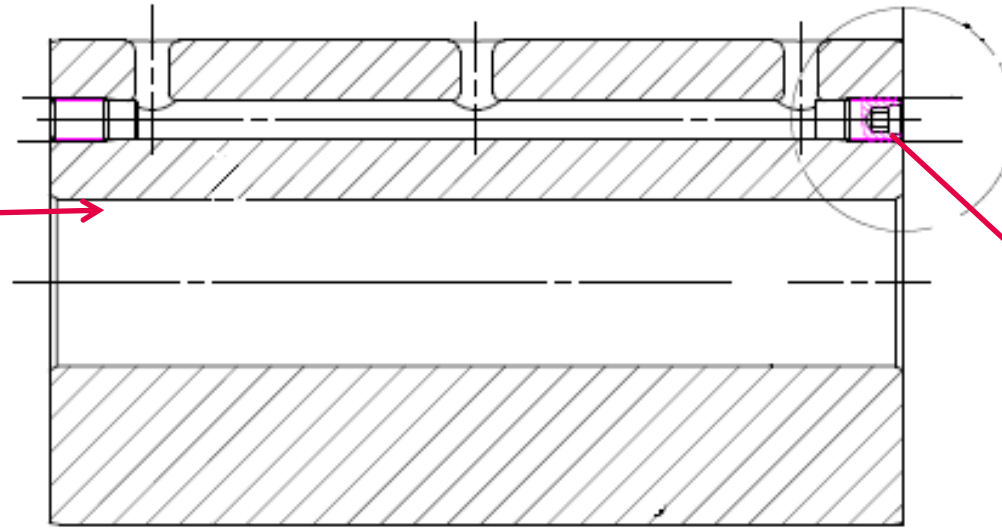
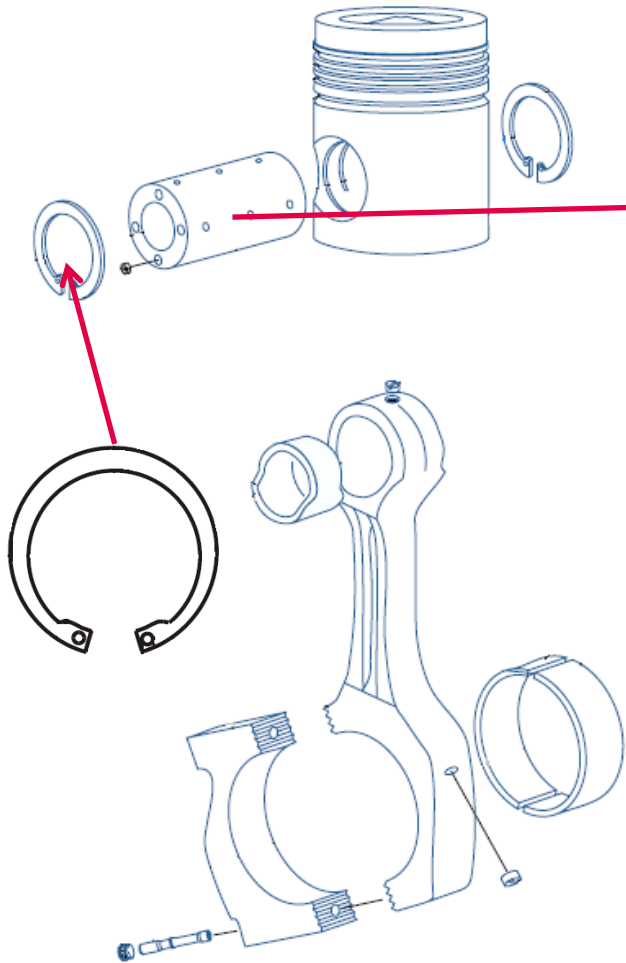
Cylinder liner:

The cylinder liner is made of fine-grained, pearlite cast iron and is fitted in a bore in the engine frame.

L23/30H-L28/32H-V28/32S Piston



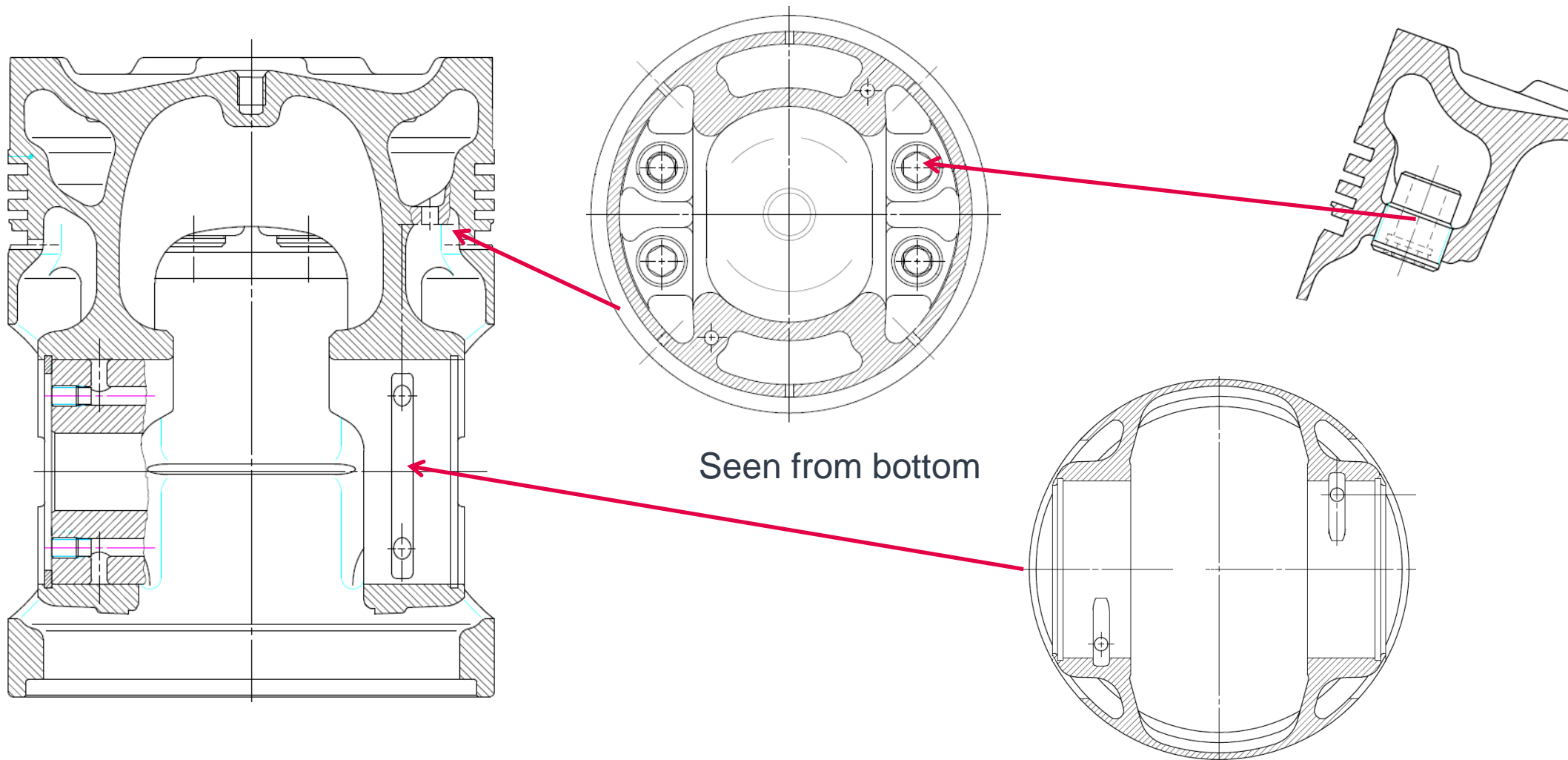
L28/32-L23/30H Piston, Connecting Rod



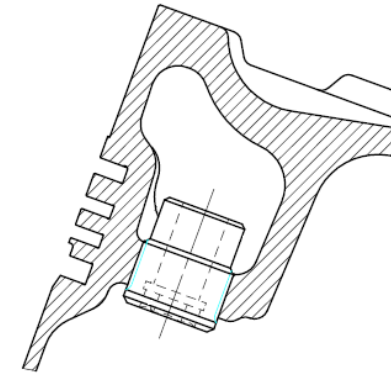
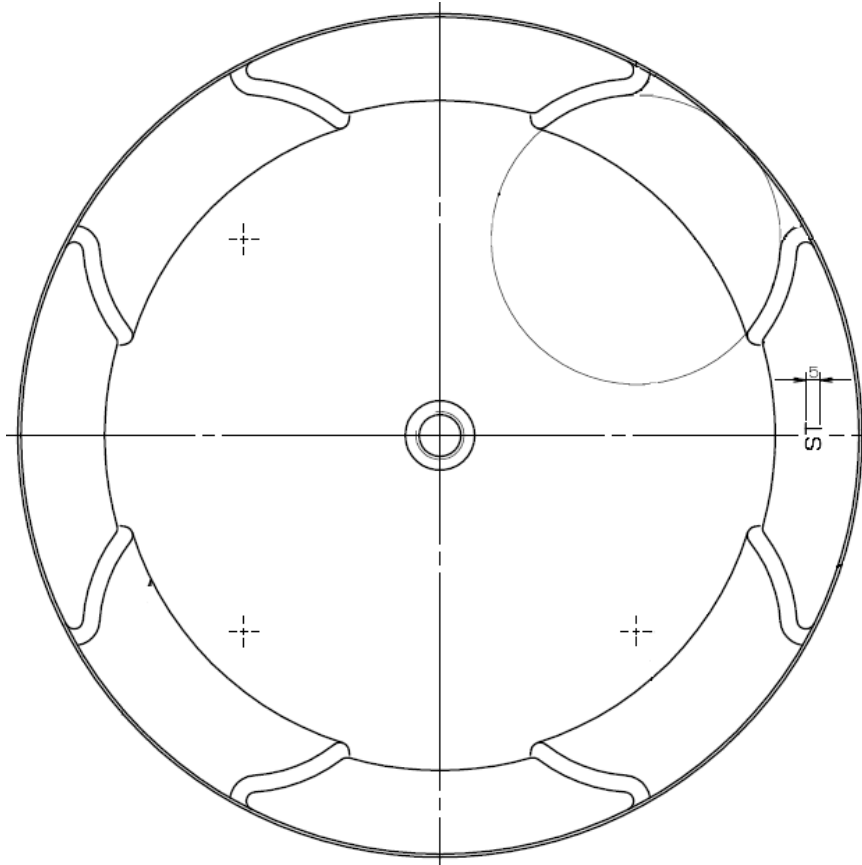
The surface is carbonized

Threads in the piston pin and screw plugs degreased.
Screw plugs screwed in with Loctite 648
and caulked with special tool not later than 10 minutes after.
After a hardening time of at least 6 hours checked for tight fit.
Test moment = 40 Nm.

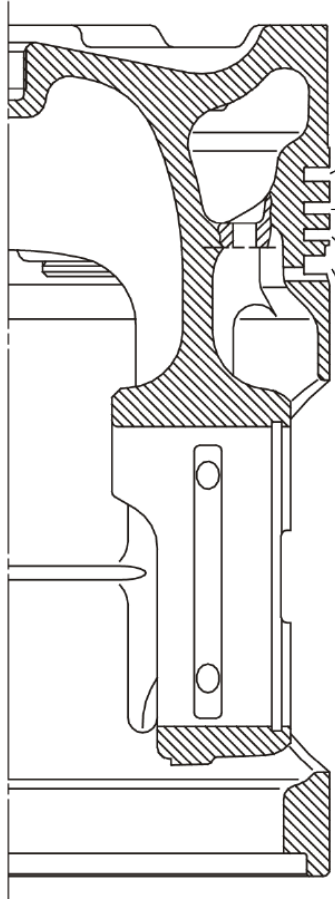
L28/32-L23/30H Dismounting of Piston and Connecting Rod



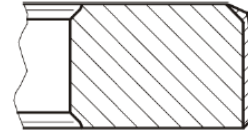
L28/32-L23/30H Piston, Connecting Rod



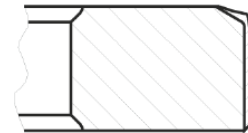
L28/32-L23/30H Piston rings



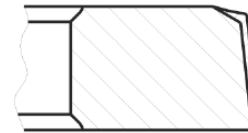
Piston Ring No 1:
marked with ident. no
"GOE CK36 TOP, 1678571-4".



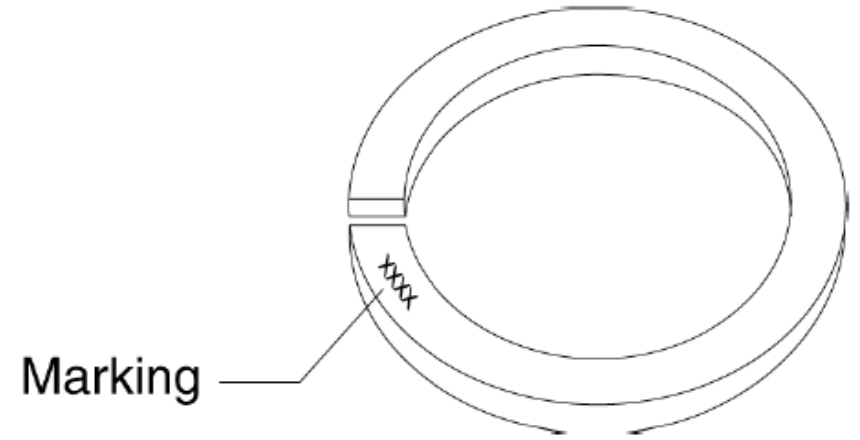
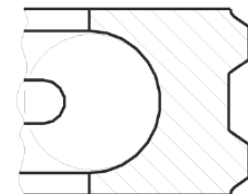
Piston Ring No 2:
marked with ident. no
"GOE TOP, 1678572-6".



Piston Ring No 3:
marked with ident. no
"GOE TOP, 1678573-8".



Scraper ring:
marked with ident. no
"GOE, 1678575-1".

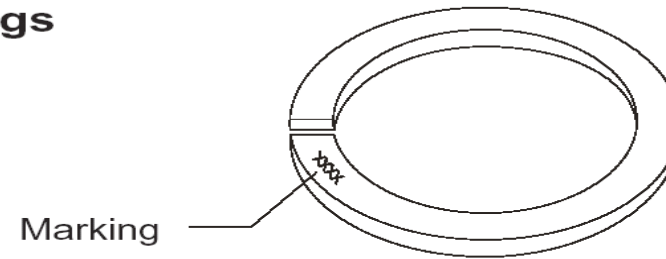


Identification marks to face upwards against the piston crown when mounted.

L28/32-L23/30H Piston and Connecting rod



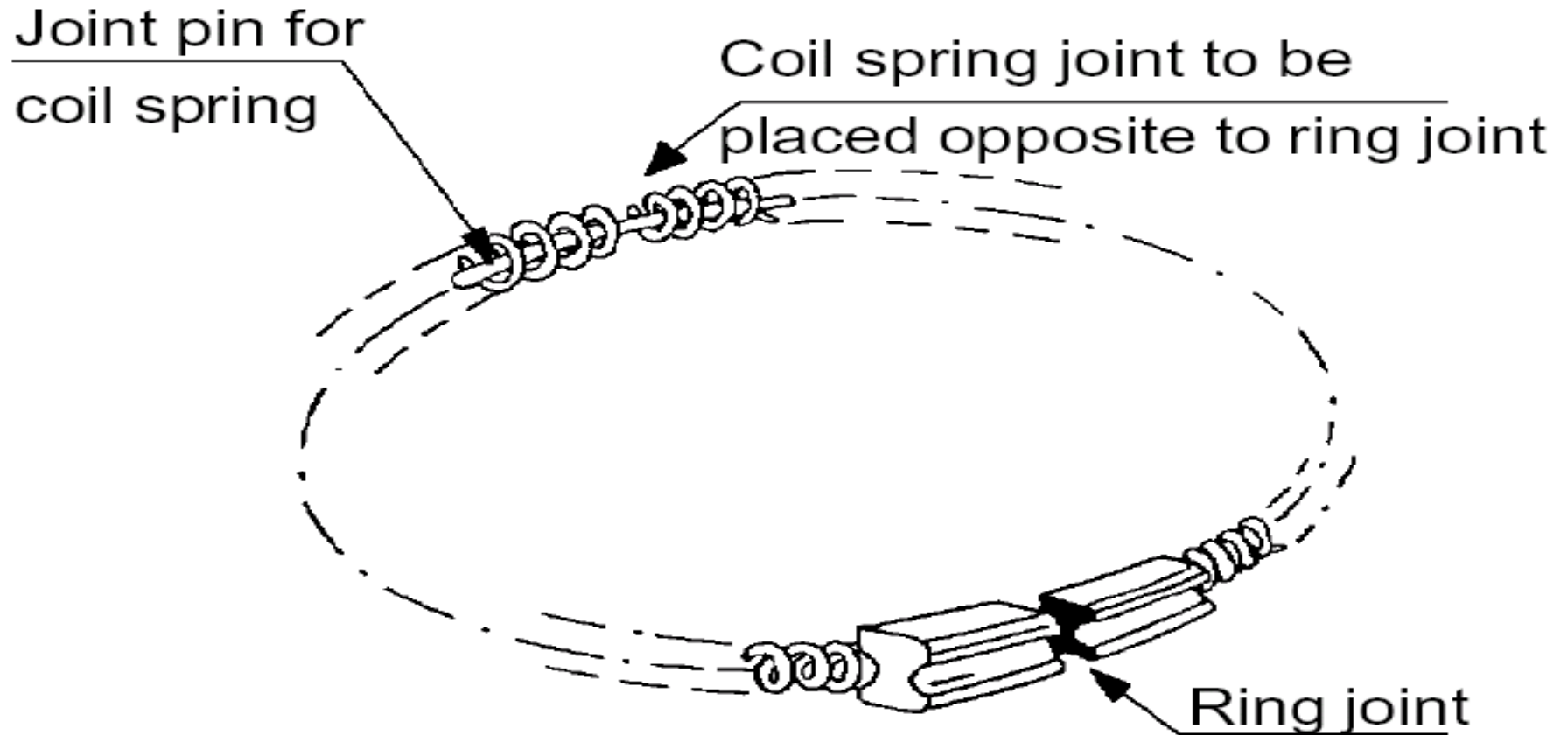
Marking of Piston and Scraper Rings



Identification marks to face upwards against the piston crown when mounted.

Note: The marking may include other figures than mentioned above, for instance trade mark and production codes.

L28/32-L23/30H Piston and Connecting rod



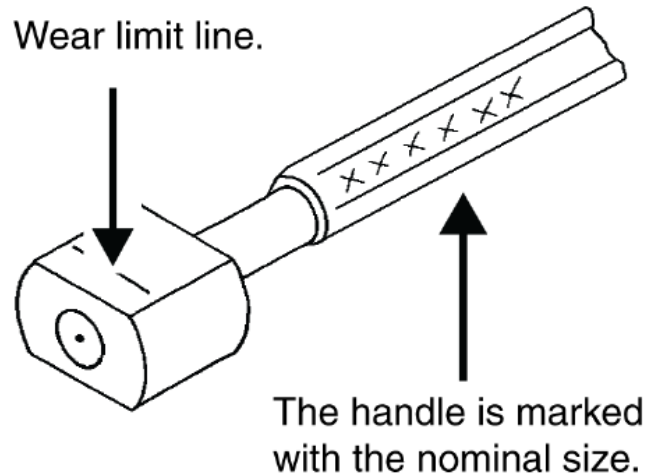
L28/32-L23/30H Piston rings



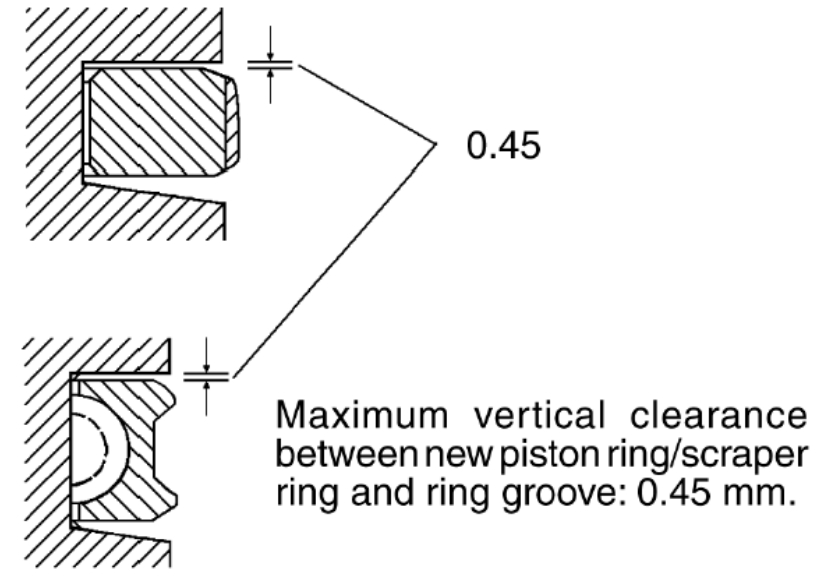
A) Testing Mandrel for Ring Grooves

	Piston scraper Nominal
Piston ring no 1	New
Piston ring no 2	New
Piston ring no 3	New
Scraper ring	New

If the wear limit (2 mm mark) on the testing mandrel is exceeded, the specified max. wear limits are exceeded, and the piston must be scrapped.



B) Clearance Ring/Groove

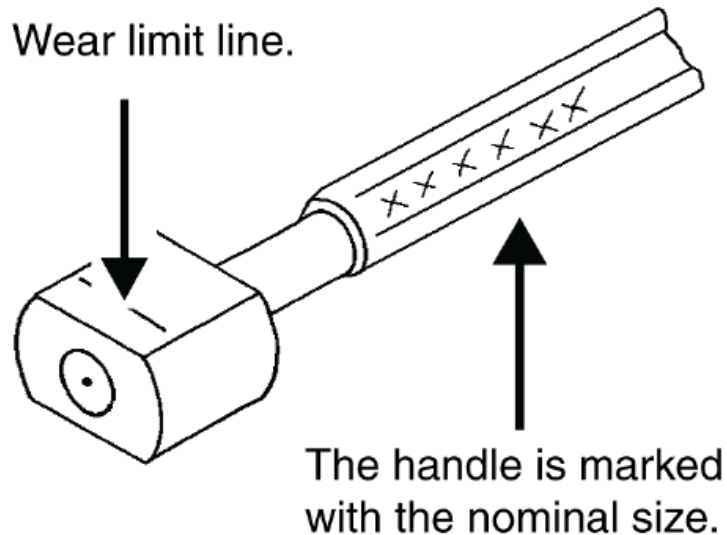


L28/32-L23/30H Piston rings

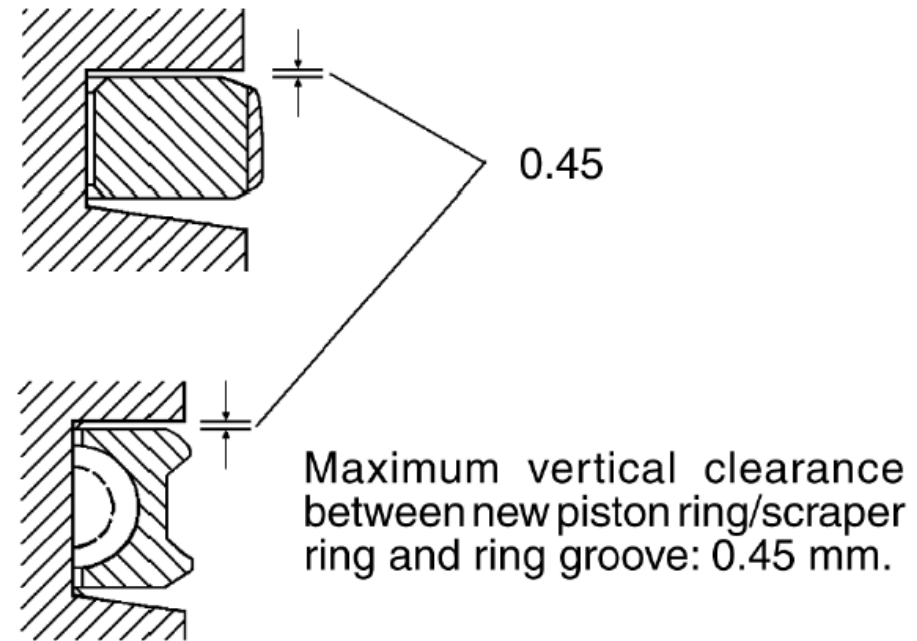


A) Testing Mandrel for Ring Grooves

If the wear limit (2 mm mark) on the testing mandrel is exceeded, the specified max. wear limits are exceeded, and the piston must be scrapped.



B) Clearance Ring/Groove



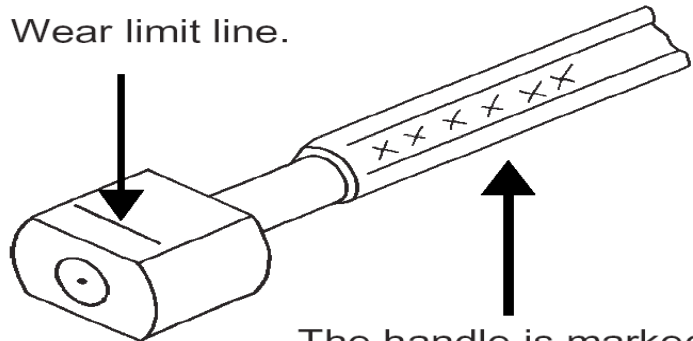
L28/32-L23/30H Piston and Connecting rod



A) Testing Mandrel for Ring Grooves

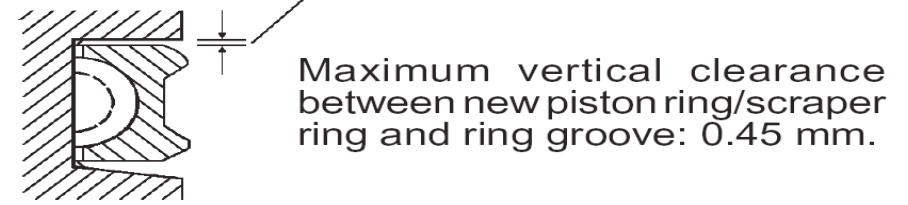
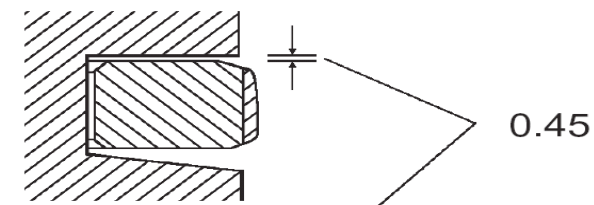
If the wear limit (2 mm mark) on the testing mandrel is exceeded, the specified max. wear limits are exceeded, and the piston must be scrapped.

Wear limit line.



The handle is marked with the nominal size.

B) Clearance Ring/Groove



L28/32-L23/30H Piston rings



Removal of Piston Ring

For removal of piston rings, which are to be used again, and for all mounting of rings, only the special ring opener which prevents local over stressing of the rings should be used.

Straps to expand the ring gap or tools working on the same principle must not be used, as this would result in permanent deformation which might cause blow-by or broken rings.

Inspection of Piston

- 1) Remove the piston and scraper rings.
- 2) Clean and examine the piston rings to determine if reuse is acceptable.
- 3) Clean the piston outside and inside.
- 4) Inspect the piston ring and scraper ring grooves for wear.

The piston has to be scrapped if:

- A) The wear limit on the testing mandrel is exceeded, or
- B) The clearance between the new piston/scraper ring and ring groove is exceeded.

L28/32-L23/30H Piston rings



- Note: At each piston overhaul:
- The piston and scraper ring must be exchanged.
 - The cylinder liner must be honed according to the instructions.

L28/32-L23/30H Connecting rod



Connecting Rod

The connecting rod is die-forged. The big-end has an inclined joint in order to facilitate the piston and connecting rod assembly to be withdrawn up through the cylinder liner. The joint faces on connecting rod and bearing cap are serrated to ensure precise location and to prevent relative movement of the parts.

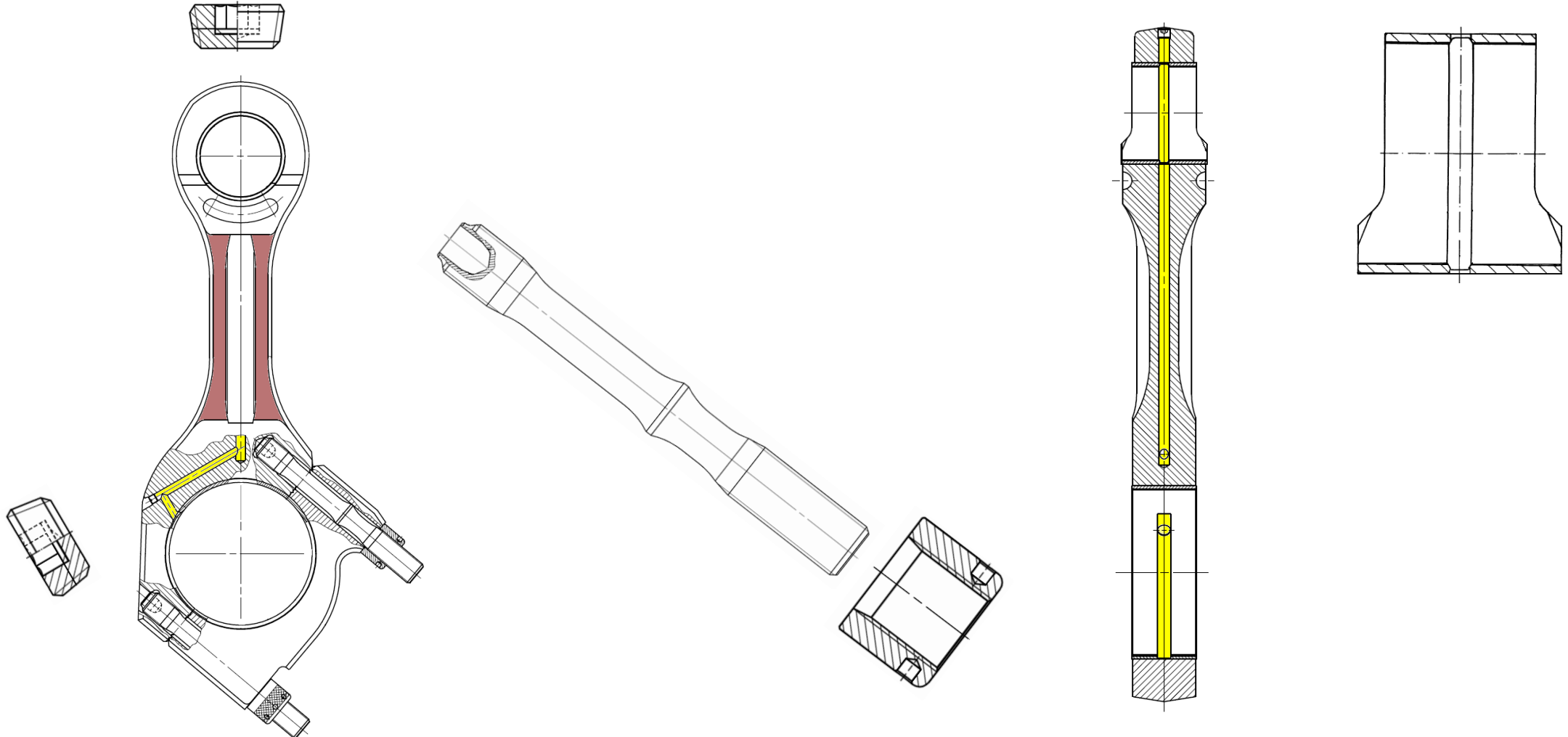
The connecting rod has bored channels for supply of oil from the big-end to the small-end eye.

The big-end bearing is of the trimetal type coated with a running layer.

The bearing shells are of the precision type and are therefore to be fitted without scraping or any other kind of adaption.

The small-end bearing is of trimetal type and is pressed into the connecting rod. The bush is quipped with an inner circumferential groove, and a pocket for distribution of oil in the bush itself and for supply of oil to the pin bosses.

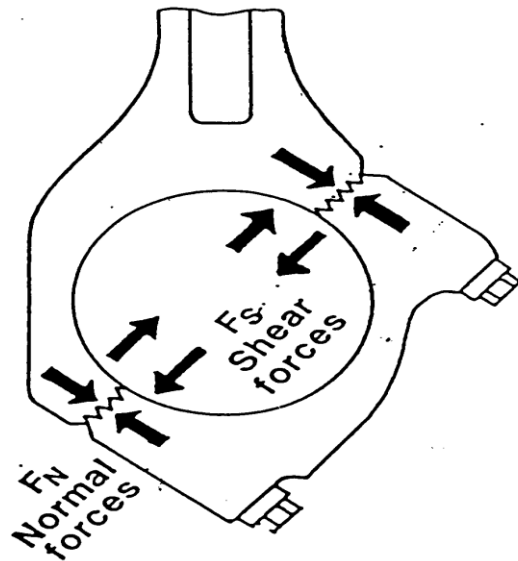
L28/32-L23/30H Connecting rod



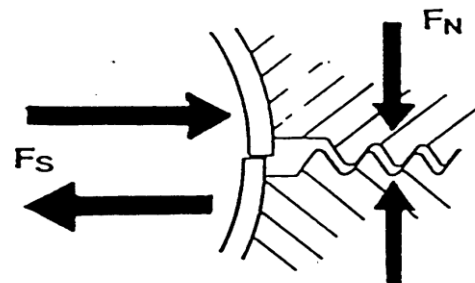
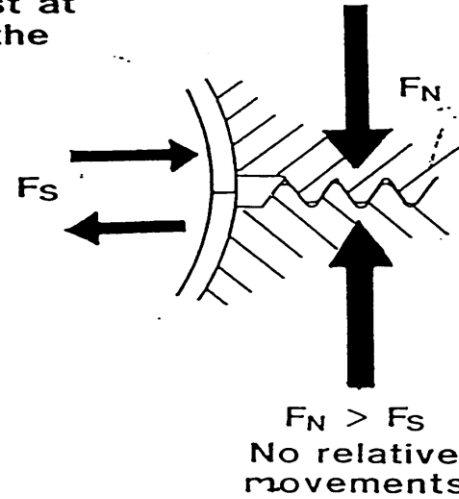
L28/32-L23/30H Piston and Connecting rod



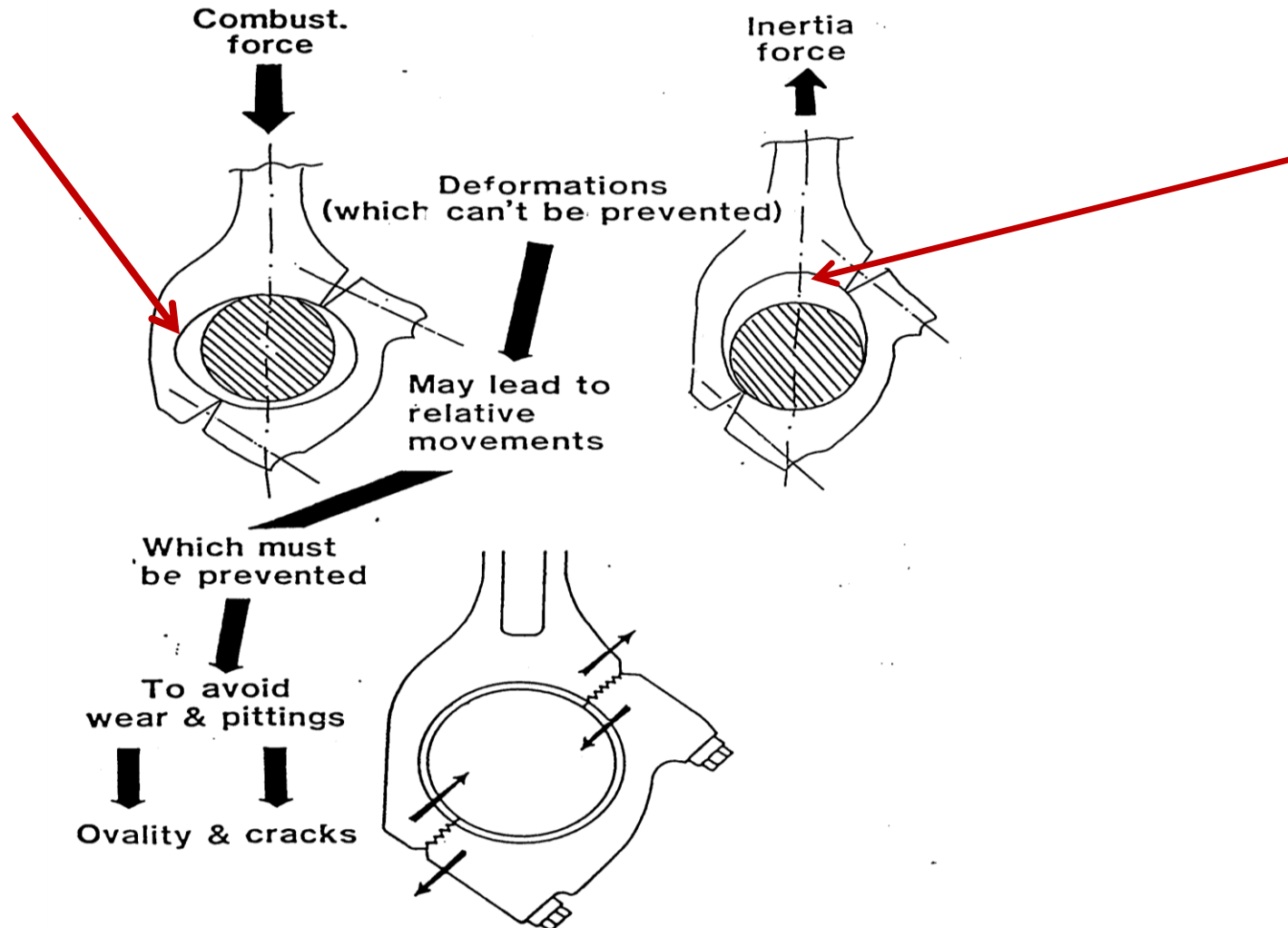
To prevent relative movements the normal forces F_N must at any time be bigger than the shear forces F_s



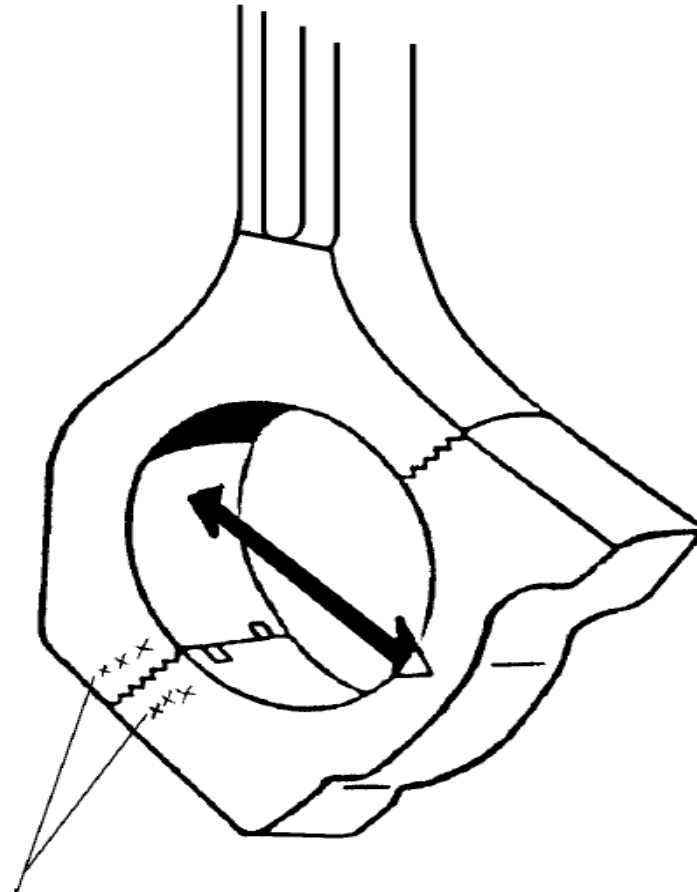
$F_s > F_N$
Relative movements



L28/32-L23/30H Piston and Connecting rod

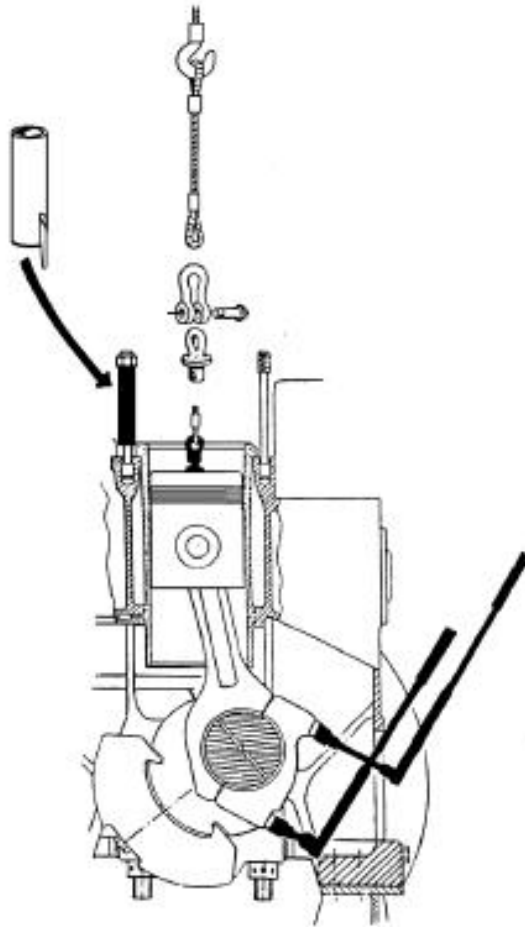


L28/32-L23/30H Piston and Connecting rod

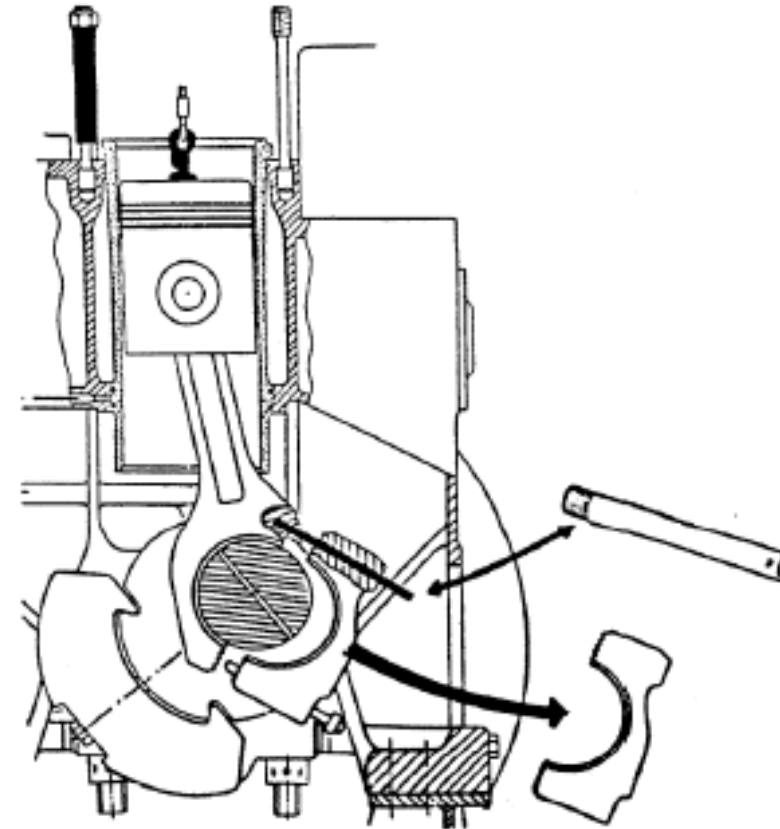


Connecting rod
Ident no.

L28/32-L23/30H Piston and Connecting rod

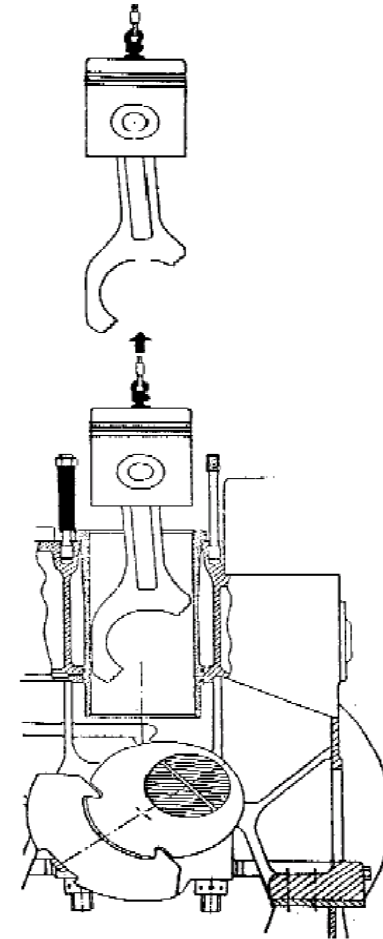
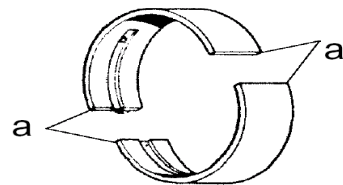
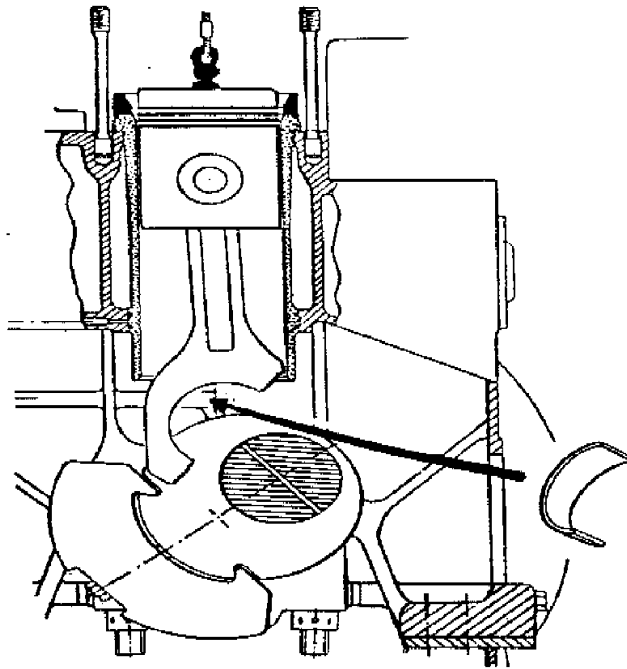


Mounting of tools



Removal of bearing cap

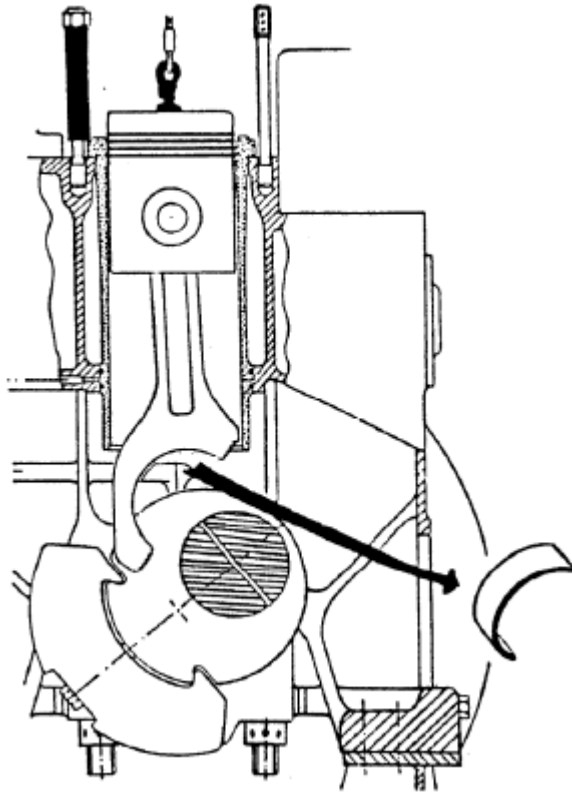
L28/32-L23/30H Piston and Connecting rod



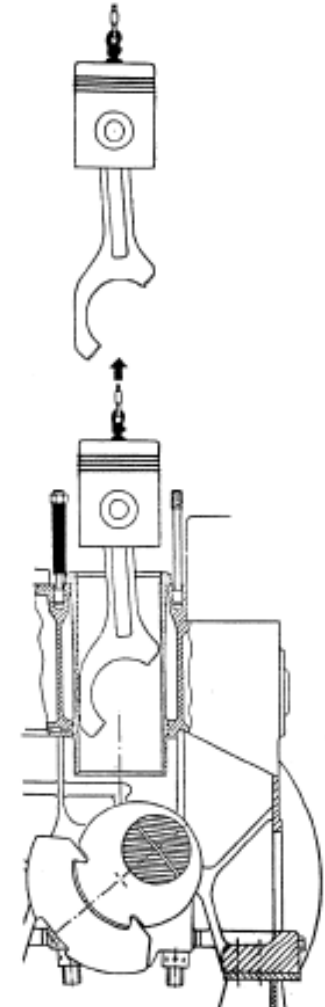
L28/32-L23/30H Piston and Connecting rod



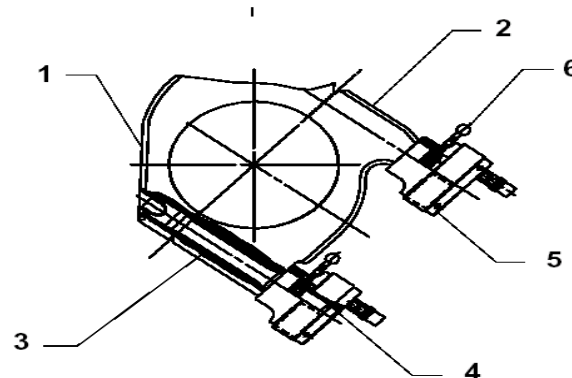
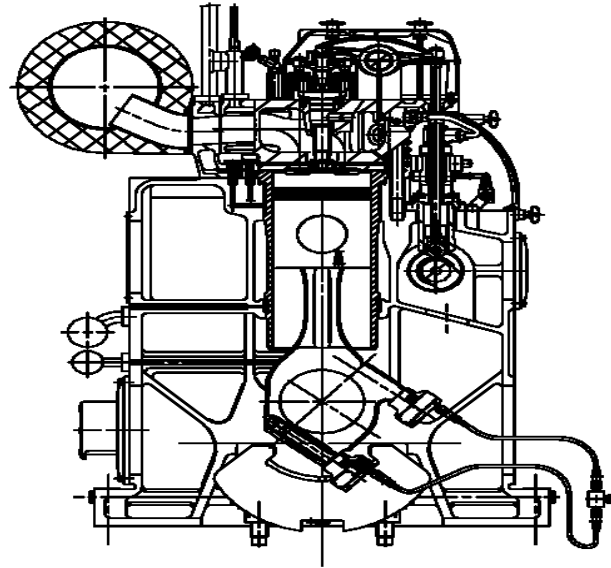
Lift of piston and connecting rod assembly



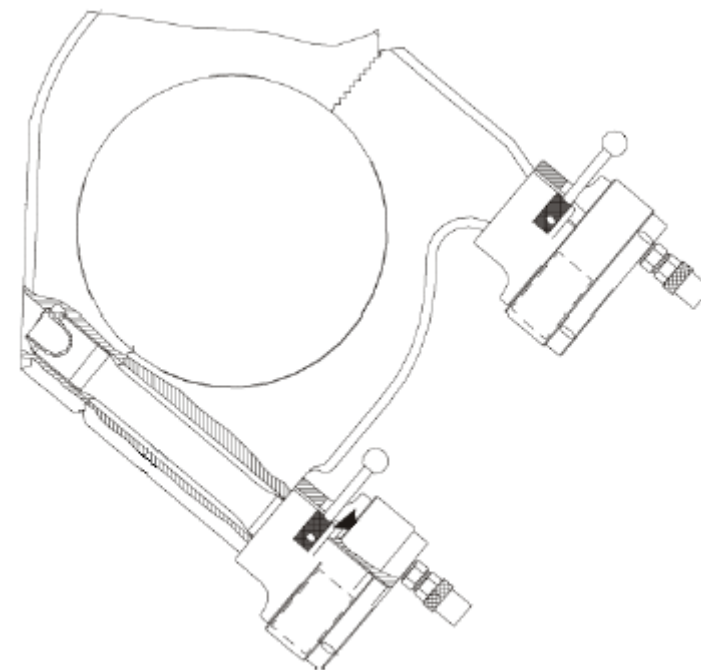
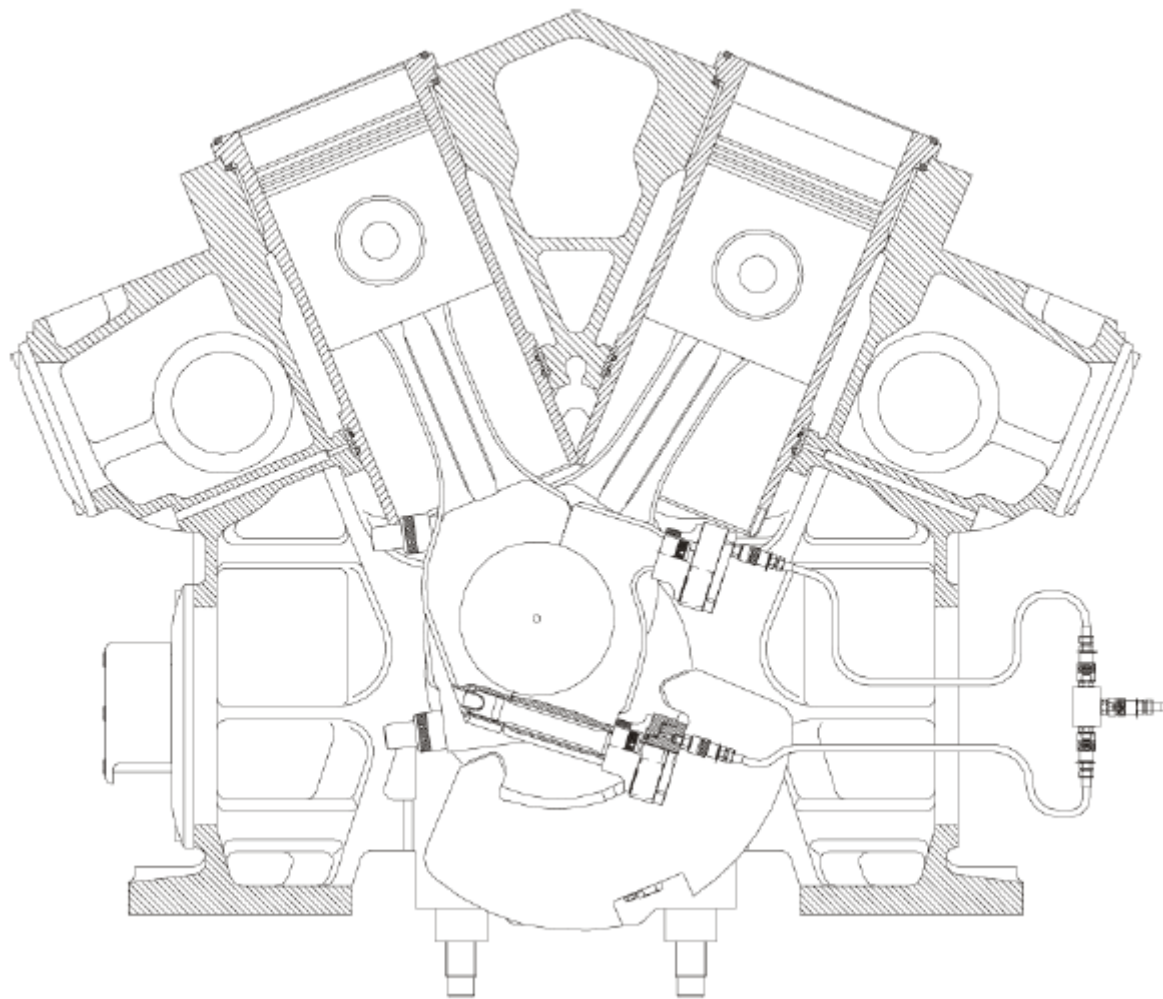
Removal of upper big-end bearing shell



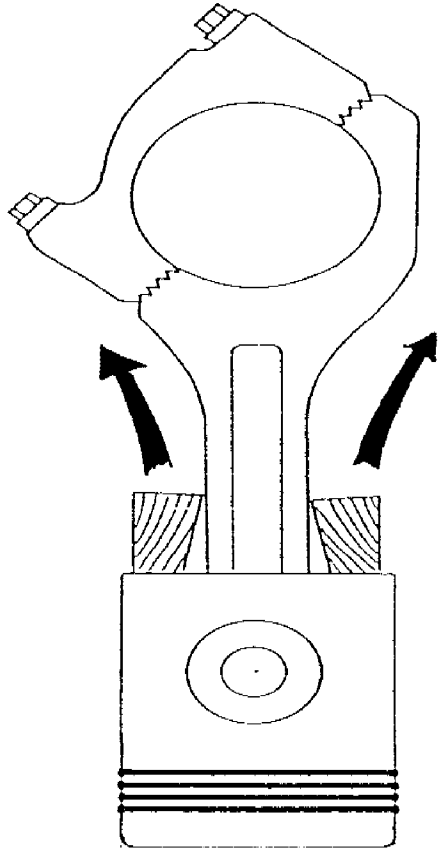
L28/32-L23/30H Piston and Connecting rod



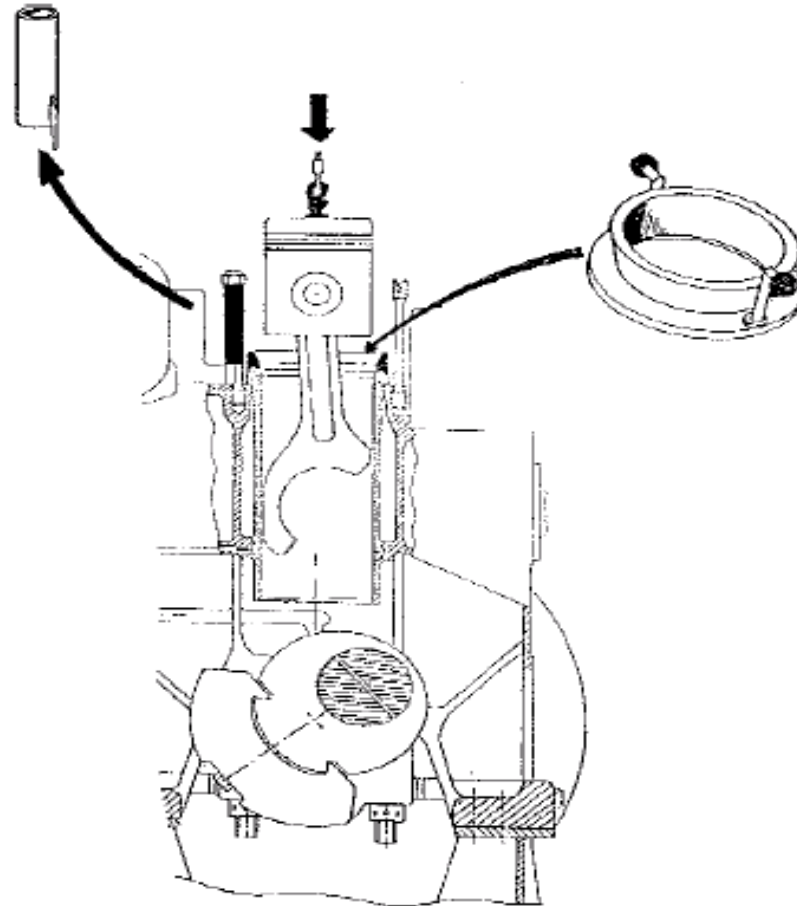
L28/32-L23/30H-V28/32S Connecting rod



L28/32-L23/30H Piston and Connecting rod



L28/32-L23/30H Piston and Connecting rod



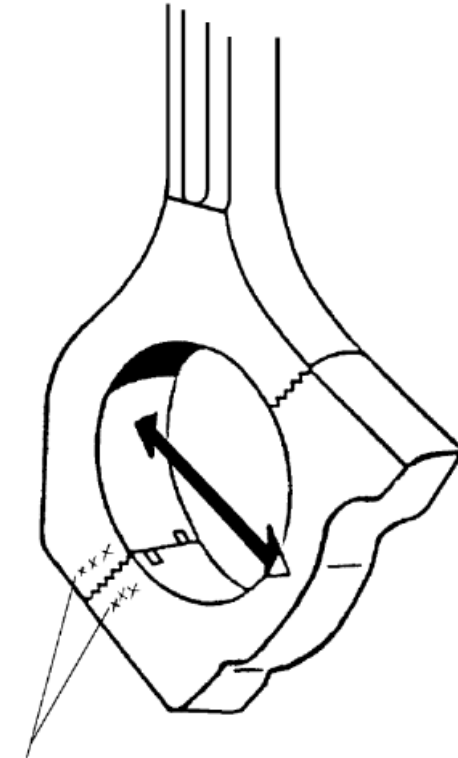
L28/32-L23/30H Piston and Connecting rod



L28/32-L23/30H

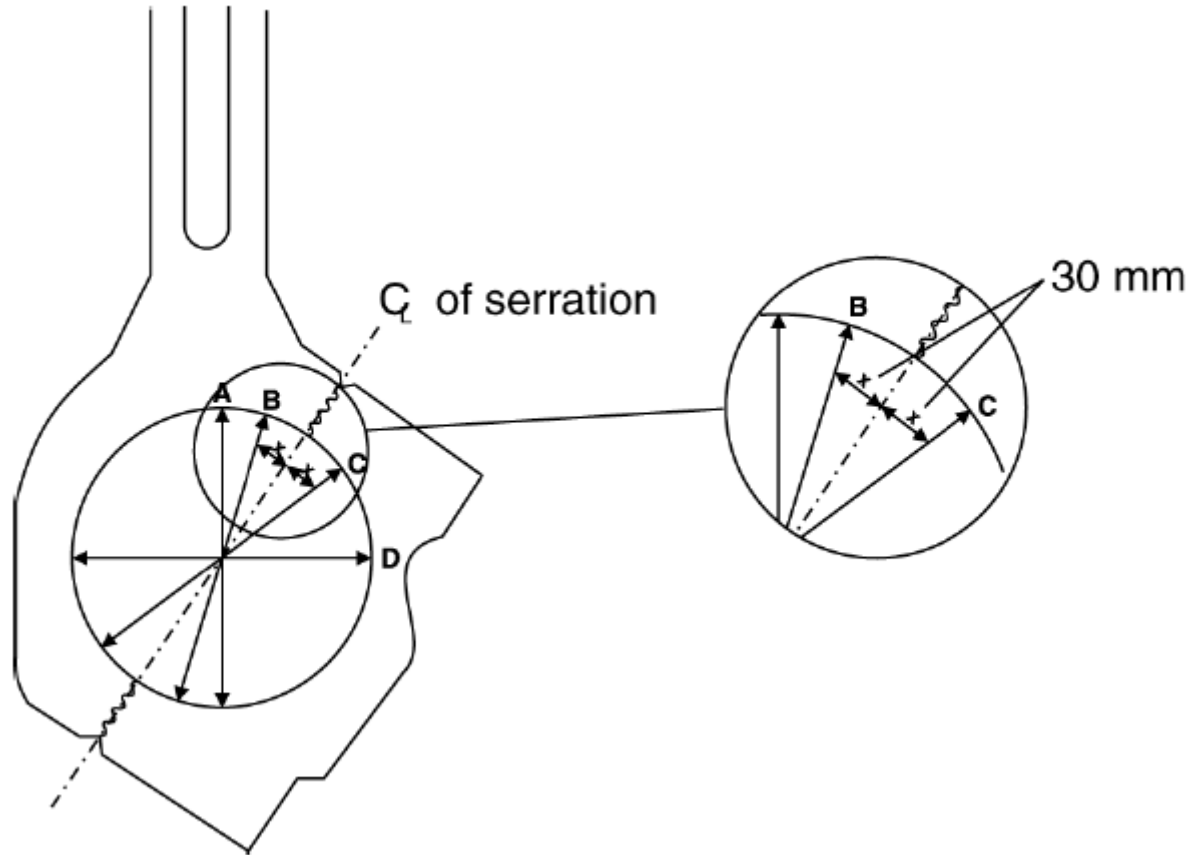


Connecting Rod Inspection for L+V28/32H (SI)				Plant/Ship:	
				Engine No.:	
				Sign.:	
Cylinder no.	1	2	3		
Connecting rod ident no.					
Running hours for connecting rod					
	A	- 0,5	- 3,0		
	B	- 2,0	- 7,0		
	C	- 1,5	- 5,0		
	D	+ 5,0	+ 5,5		
	E	+ 3,0	+ 3,5		
Ovalness: Difference between minimum and maximum.	7,0	12,5			
Condition of serration	<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK		
Tightening for measurement see instruction.	<input type="checkbox"/> Wear	<input type="checkbox"/> Wear	<input type="checkbox"/> Wear		
	<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks		
	<input type="checkbox"/> Corrosion/Pitting	<input type="checkbox"/> Corrosion/Pitting	<input type="checkbox"/> Corrosion/Pitting		
	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark		
	Remarks:	to be reused	to be rejected		



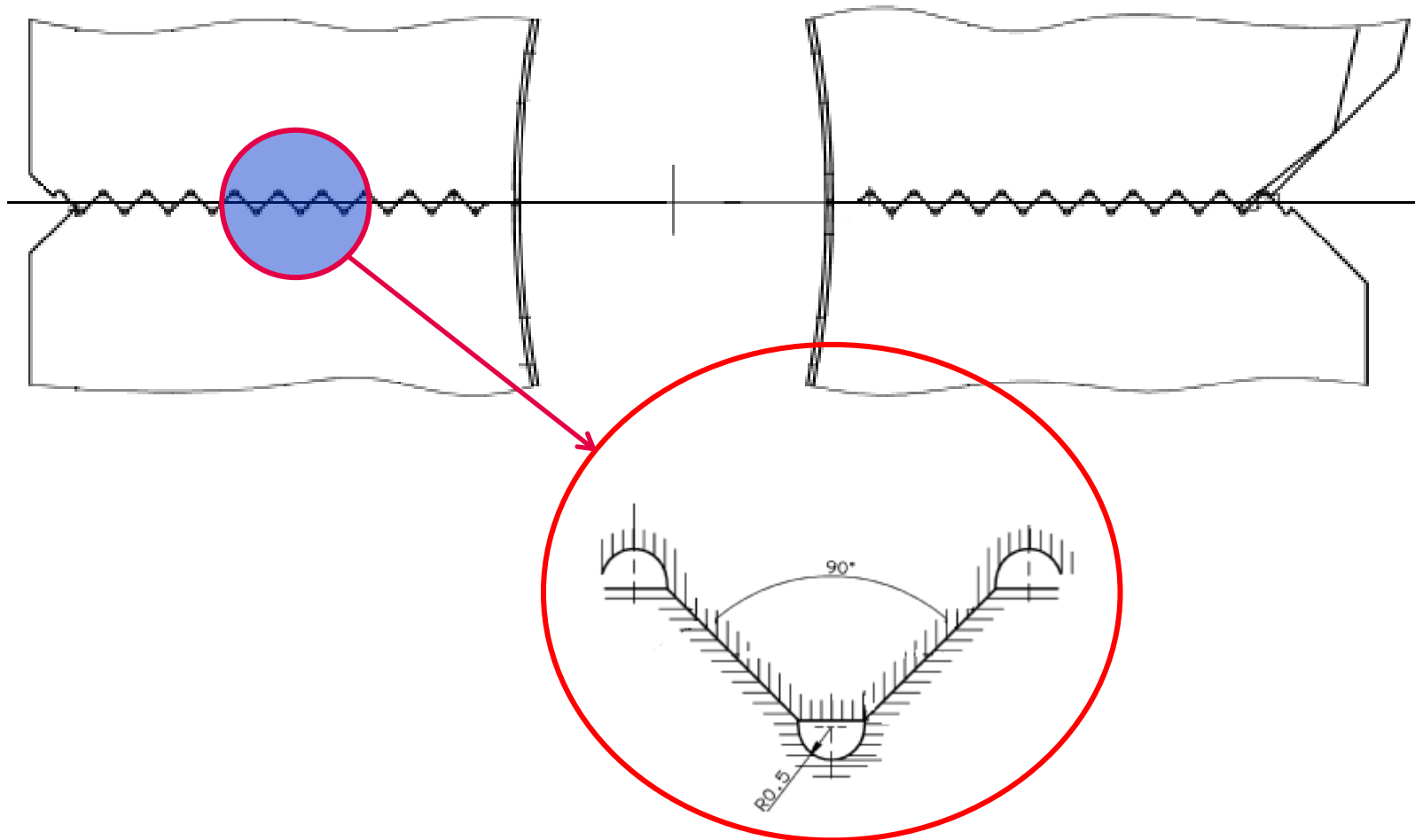
Connecting rod
Ident no

L28/32-L23/30H Connecting rod inspection



- Connecting rod bearing

L28/32-L23/30H Connecting rod




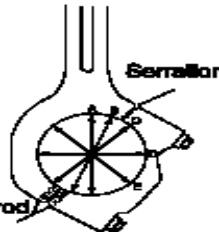
L28/32-L23/30H- V28/32S Connecting rod



L28/32-L23/30H Piston and conrod

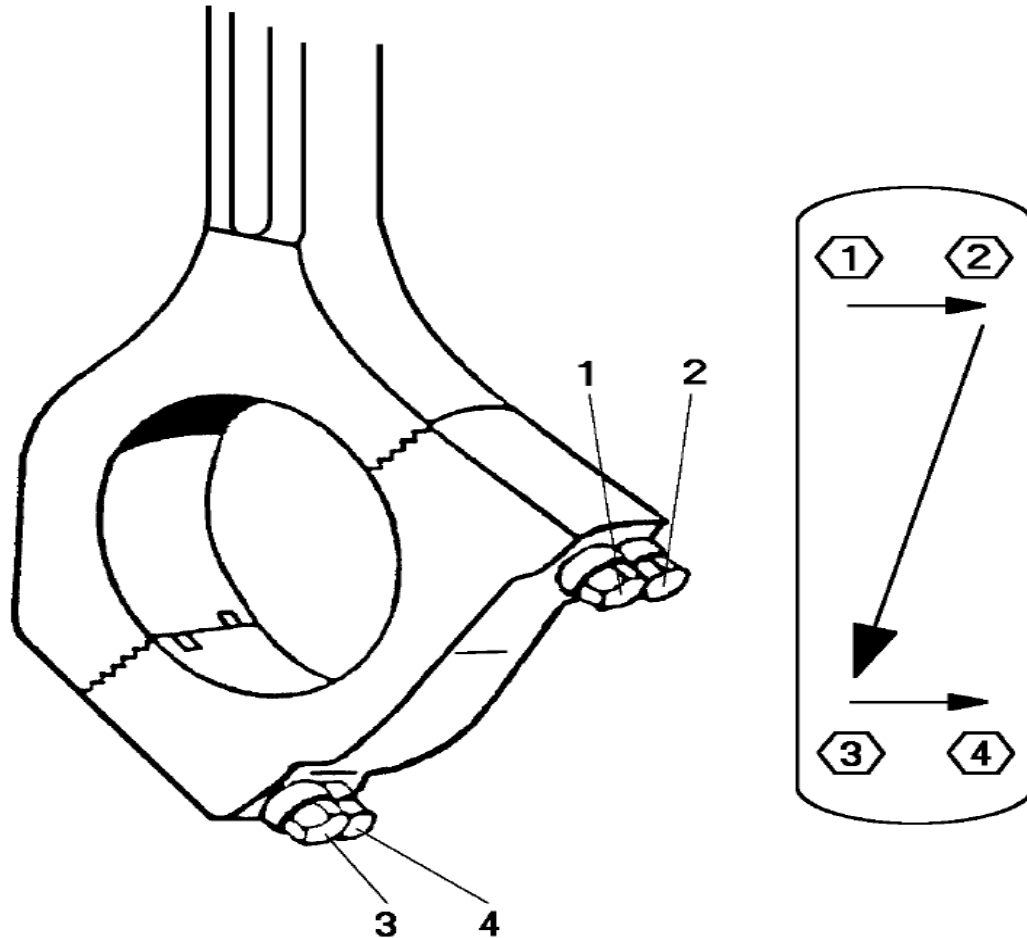


Connecting Rod Inspection for L28/32H

Plant/Ship:				Insp. date.:							
Engine type:		<input type="checkbox"/> Four screw design / <input type="checkbox"/> Hydraulic Tightened		Running hours:							
Engine No.:				Sign.:							
Cylinder No.:		1	2	3	4	5	6	7	8	9	
Connecting rod ident. No.											
Running hours for connecting rod											
 <p>0,01 mm 1/100 mm</p> <p>Nominal diameter Ø242 mm</p>	A										
	B										
	C										
	D										
	E										
Ovalness:	Differende between minimum and maximum										
Condition of serration		<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK	<input type="checkbox"/> Serration OK	
Tightening for measurement see instructions.		<input type="checkbox"/> Wear	<input type="checkbox"/> Wear	<input type="checkbox"/> Wear	<input type="checkbox"/> Wear	<input type="checkbox"/> Wear	<input type="checkbox"/> Wear	<input type="checkbox"/> Wear	<input type="checkbox"/> Wear	<input type="checkbox"/> Wear	
 <p>Serration</p> <p>Connecting rod Ident. No</p>		<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks	<input type="checkbox"/> Cracks	
		<input type="checkbox"/> Corrosion/ Pitting	<input type="checkbox"/> Corrosion/ Pitting	<input type="checkbox"/> Corrosion/ Pitting	<input type="checkbox"/> Corrosion/ Pitting	<input type="checkbox"/> Corrosion/ Pitting	<input type="checkbox"/> Corrosion/ Pitting	<input type="checkbox"/> Corrosion/ Pitting	<input type="checkbox"/> Corrosion/ Pitting	<input type="checkbox"/> Corrosion/ Pitting	<input type="checkbox"/> Corrosion/ Pitting
		<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark	<input type="checkbox"/> Impact mark
Remarks:		Remarks:	Remarks:	Remarks:	Remarks:	Remarks:	Remarks:	Remarks:	Remarks:	Remarks:	

10021-1 EX0H5810P1999-02-10(26)

L28/32-L23/30H Piston and Connecting rod

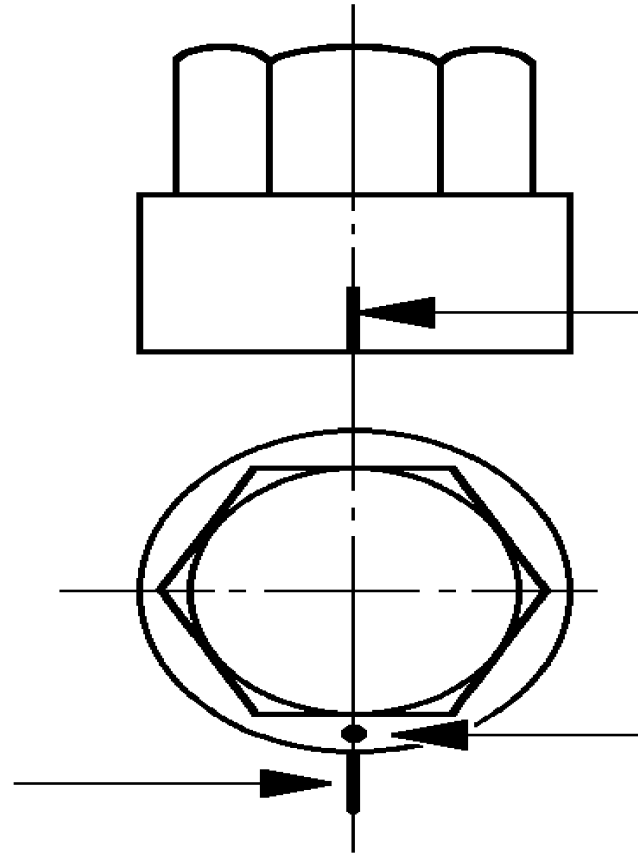


Tightening order

L28/32-L23/30H Piston and Connecting rod



Coinciding
mark on
bearing cap



Mark on
screw collar

L28/32-L23/30H Piston and Connecting rod



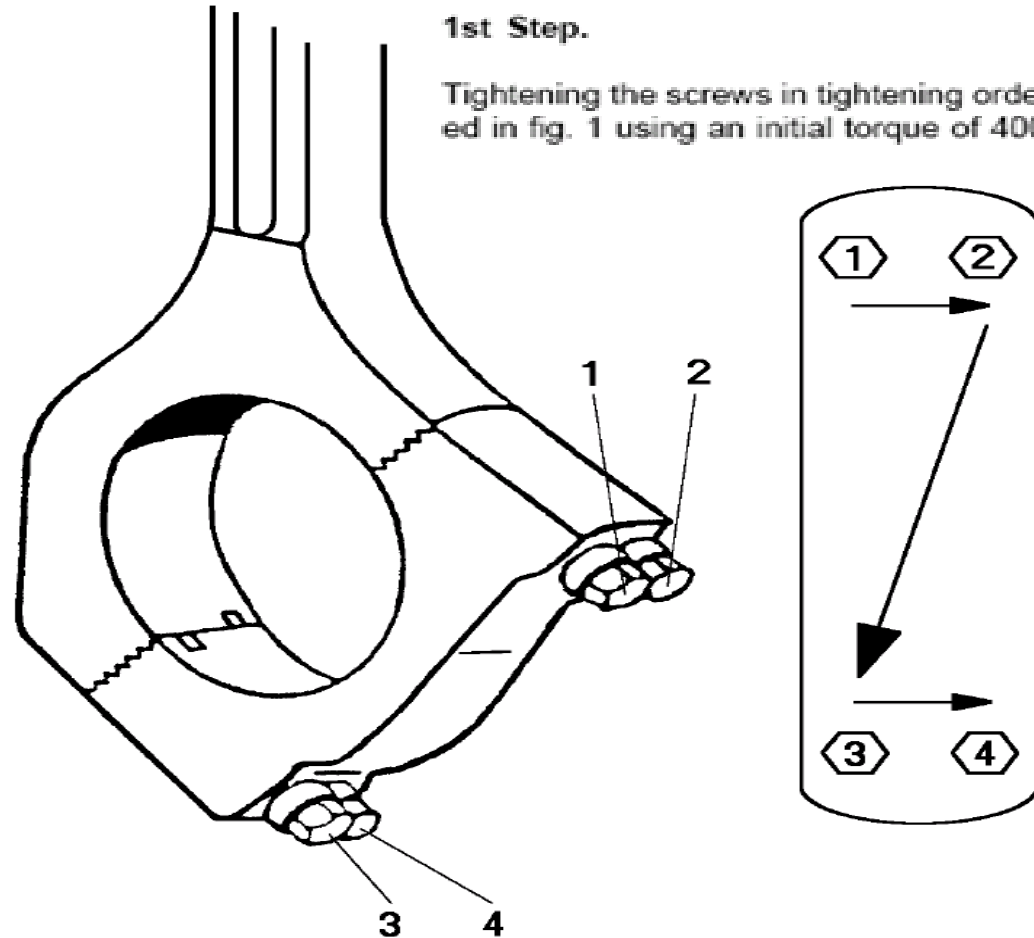
Marking of connecting rod screws

L28/32-L23/30H Piston and Connecting rod



1st Step.

Tightening the screws in tightening order as illustrated in fig. 1 using an initial torque of 400 Nm.



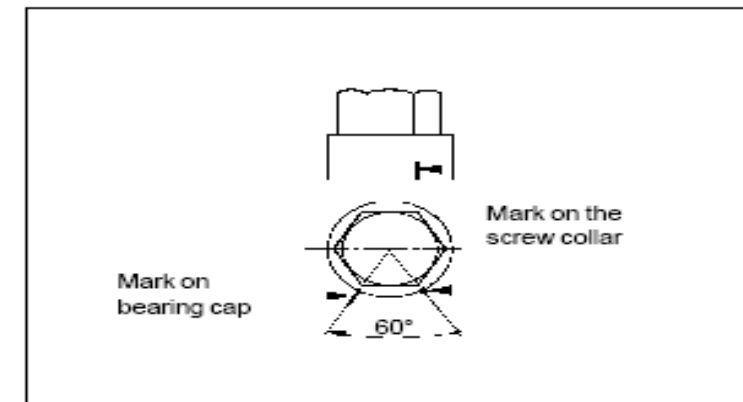
2nd Step.

Once more tightening the screws in prescribed tightening order, still using a torque of 400 Nm.

3rd Step.

Mark the four screws and the bearing cap felt-tippen as illustrated in fig. 2.

Tightening order by turning through a $60^\circ \pm 2^\circ$ angle i.e. until the marks on screws collar and connecting rod coincide radially.



L28/32-L23/30H Piston and Connecting rod



4th Step.

Check the screw tightening in prescribed order using a torque of 700 Nm.

Proper tightening condition is present, if the screws are not turned further during this test.

5th Step.

Check that the bearing can easily be moved on the journal.

Check of Connecting Rod Screws, Tightening Condition:

Check of the tightening condition of connecting rod screws has to be executed within a short running period after remounting/mounting of the connecting rod.

This check can be fulfilled after only a few running hours at max. rpm at full load but has to be fulfilled not later than 200 running hours after starting up.

The tightening condition is checked with a torque of 700 Nm executed in prescribed screw tightening order, see fig. 1.

Proper tightening condition is present if the screws are not turning further during the test.

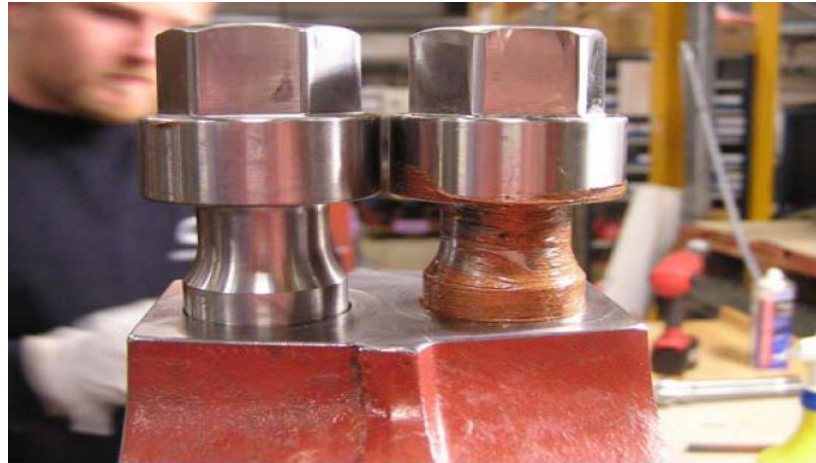
L28/32-L23/30H Piston and Connecting rod



Tightening according to procedure
400 Nm
60 deg



L28/32-L23/30H Piston and Connecting rod



L28/32-L23/30H Piston and Connecting rod

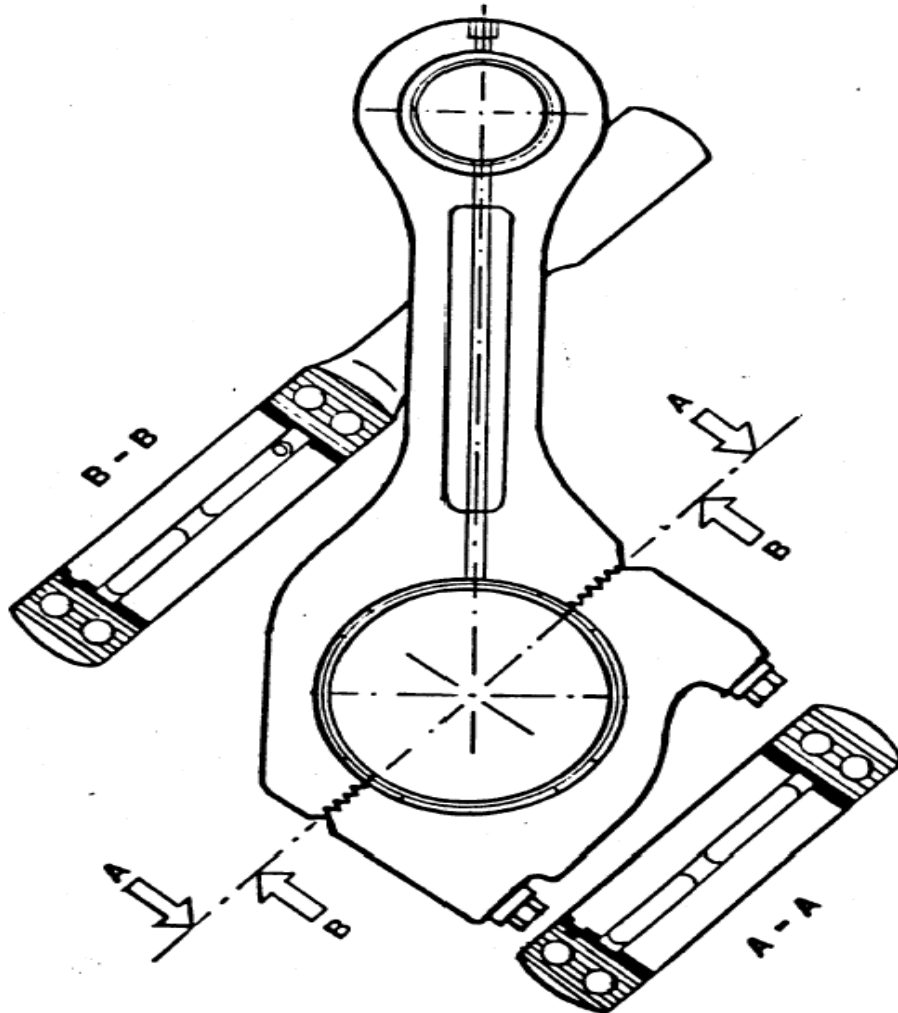


No seizure on the heads of the screw nor on the cap

L28/32-L23/30H Piston and Connecting rod



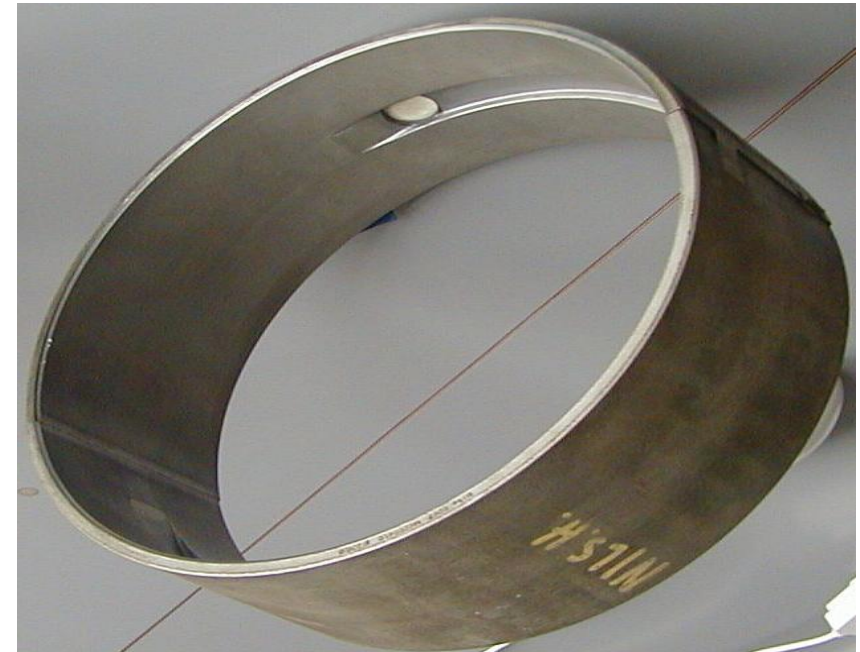
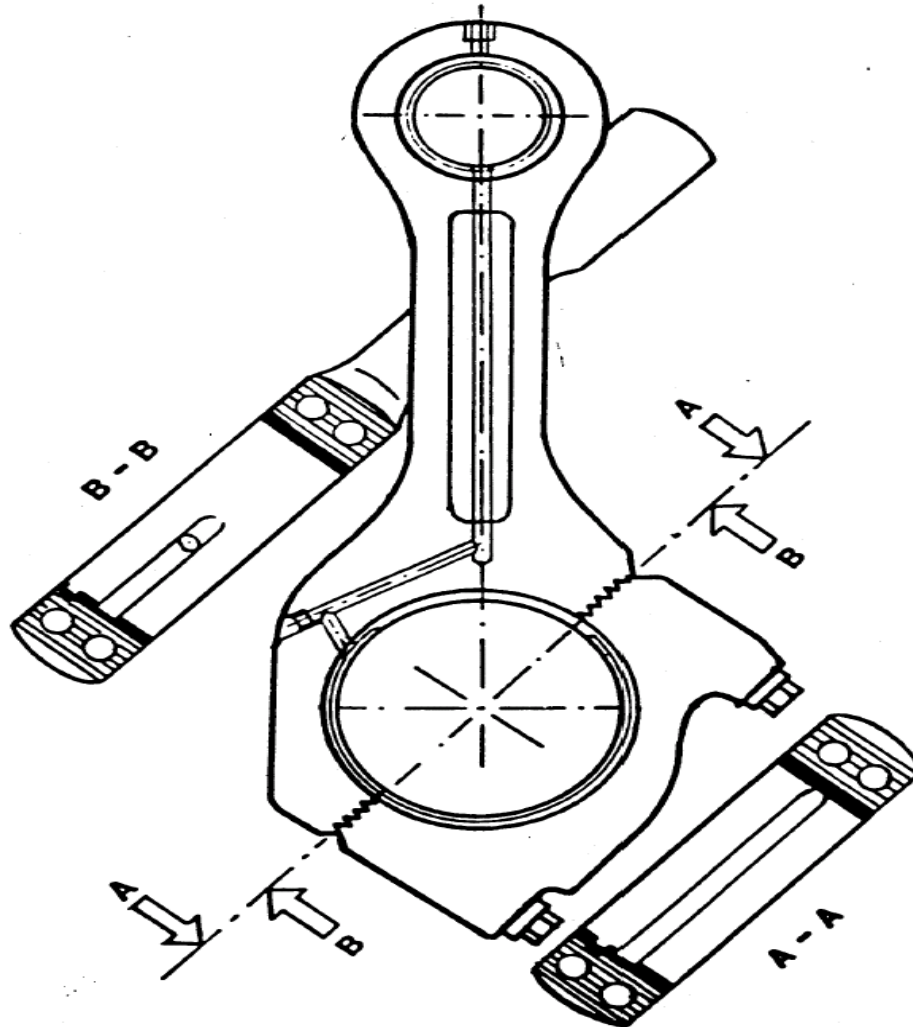
Bearing System no. 1



L28/32-L23/30H Piston and Connecting rod



Bearing System no. 2



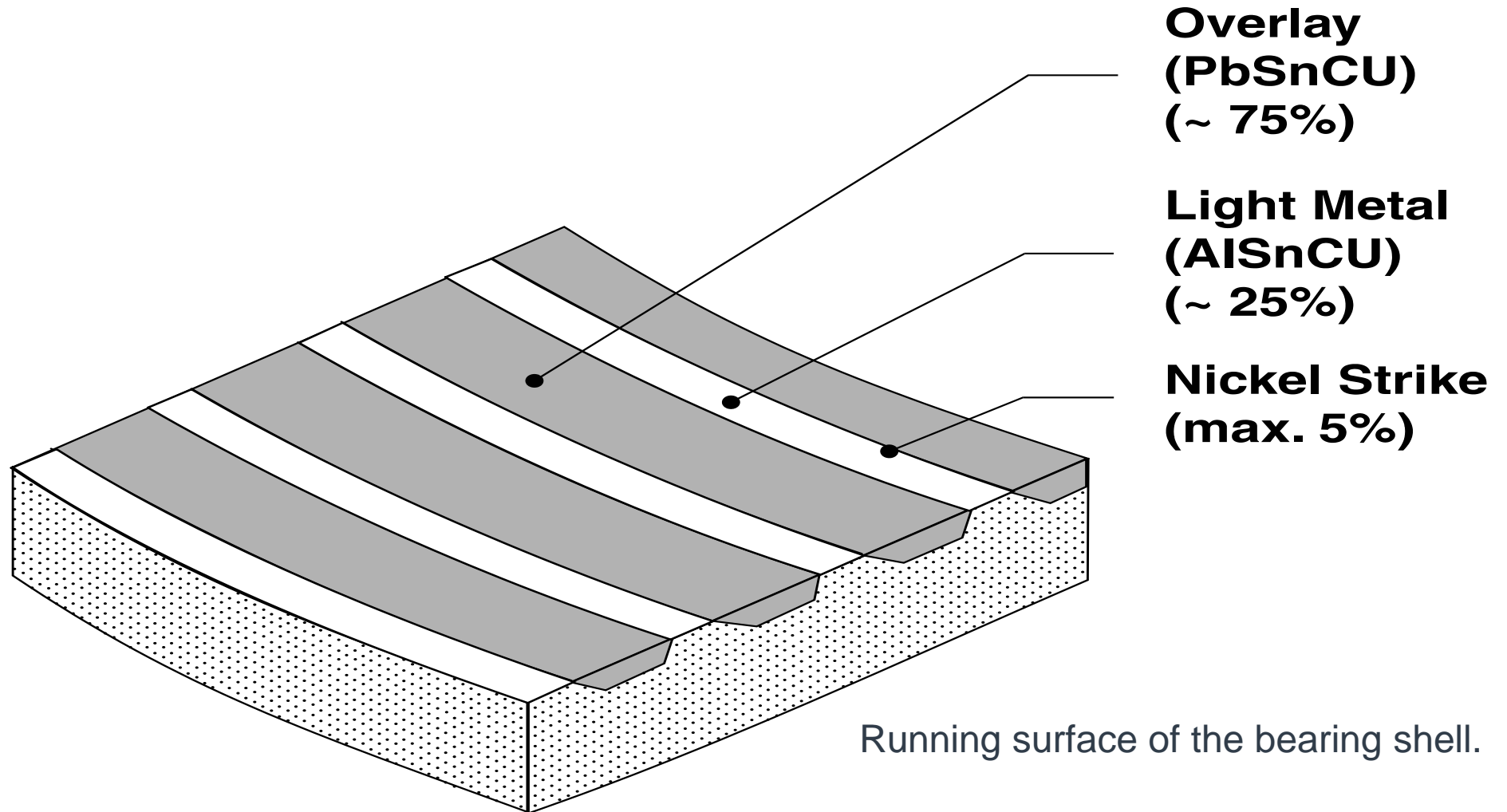
L28/32-L23/30H Piston and Connecting rod



Comparison of Bearing System no. 1 and no. 2



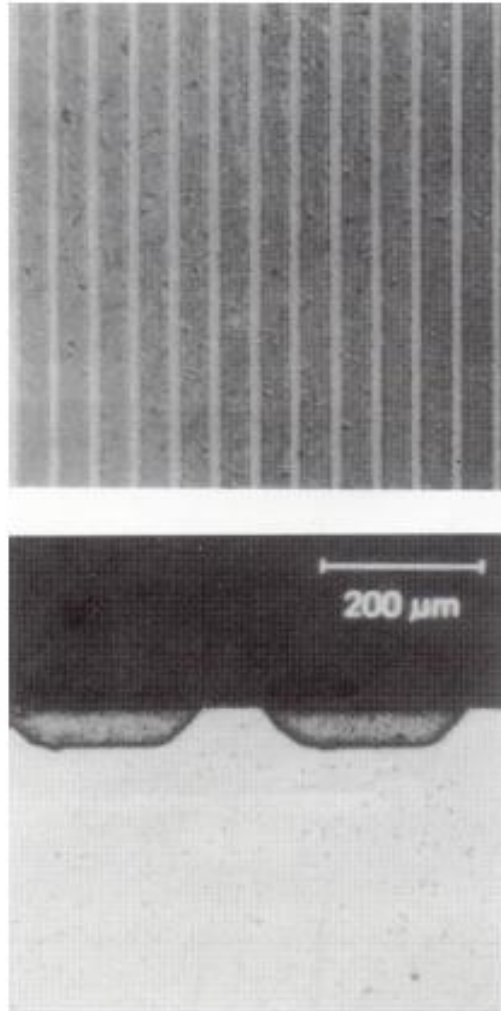
L28/32-L23/30H Piston and Connecting rod-bearing shell



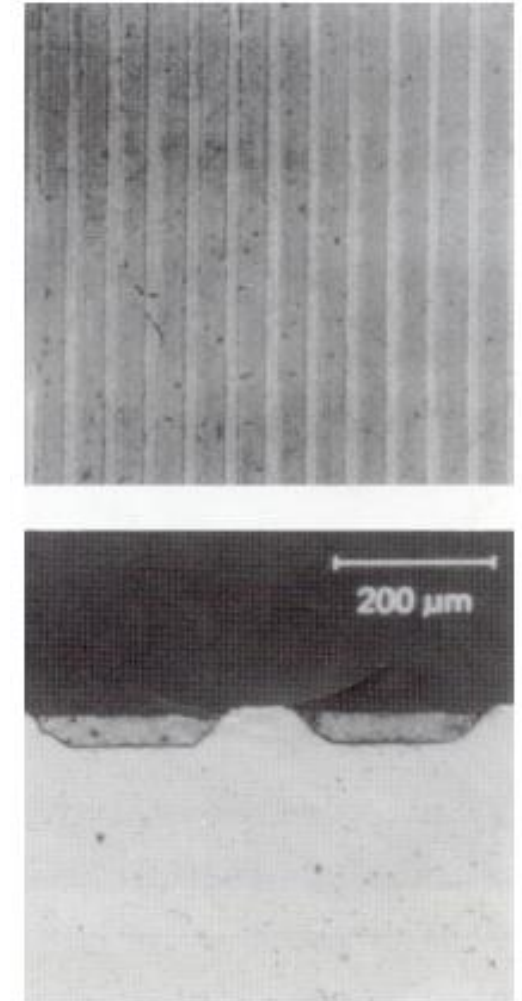
L28/32-L23/30H Piston and Connecting rod-bearing shell



Condition: The slot geometry corresponds to a new bearing shell. The overlay in the slots is fully preserved, Dark spots are mainly oil coke remains.
Valuation: The ratio between light-alloy metal and overlay is 75 % to 25 %.
Re-use!



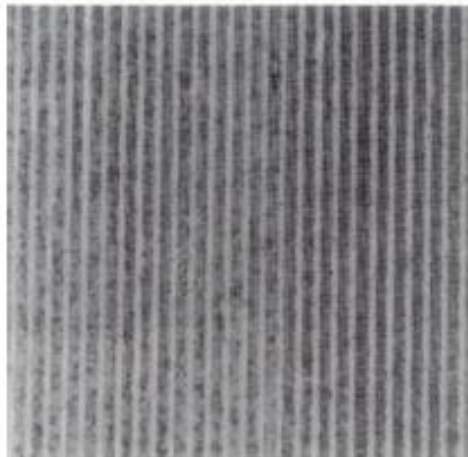
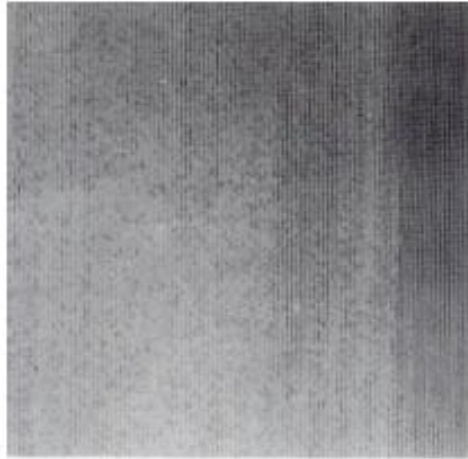
Condition: The overlay is equally worn, approx. 0.005 mm in the slots. The light-alloy strips show no wear, see fig. 3. Dark spots are mainly oil coke remains.
Valuation: Due to worn running surface the light alloy strips are slightly widened. Re-use



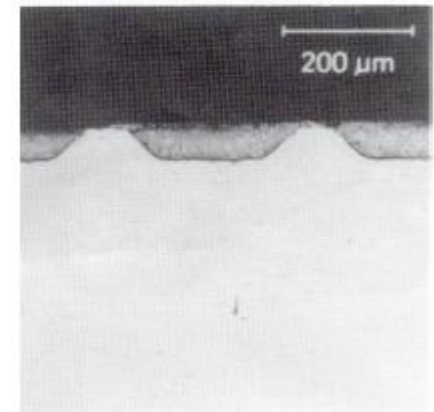
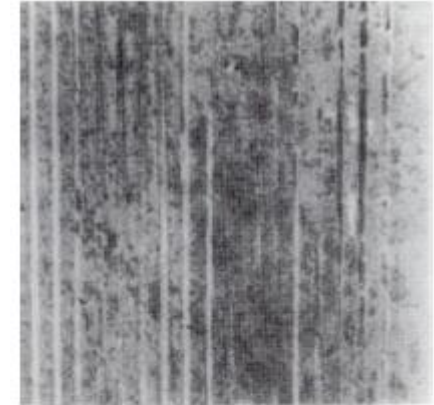
L28/32-L23/30H Piston and Connecting rod-bearing shell



Condition: Small particles all over the overlay. The light- alloy metal shows no changes of importance,
Valuation: Re-use of the shell, as the particles are wedged in the slots.



Condition: The overlay has been dragged and smudged over the light- alloy metal. These are only partly visible.
Valuation: Re-use of the shell.

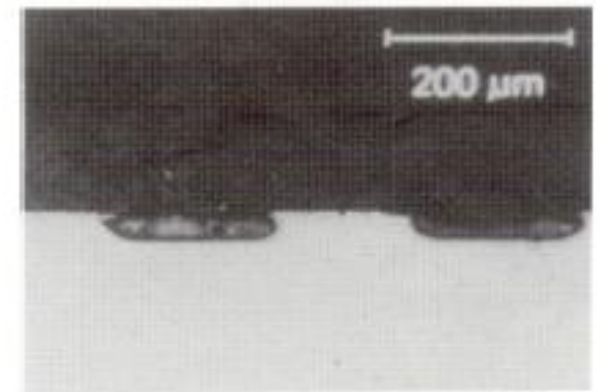
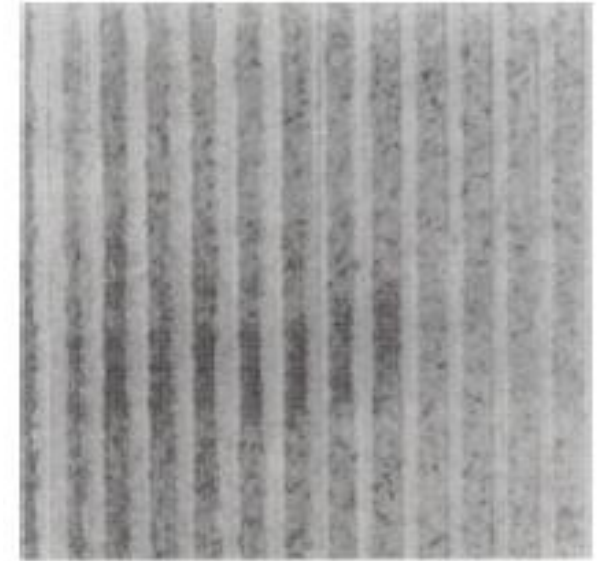
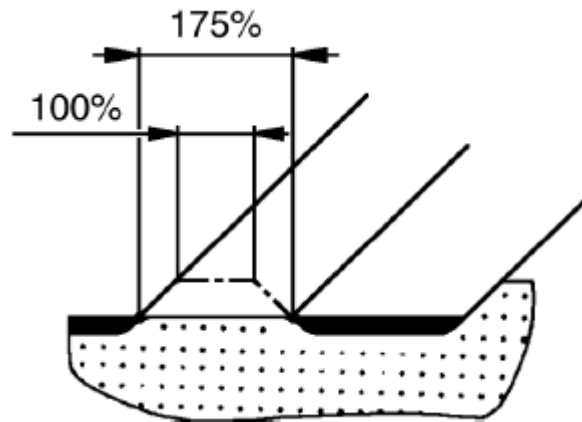


L28/32-L23/30H Piston and Connecting rod-bearing shell

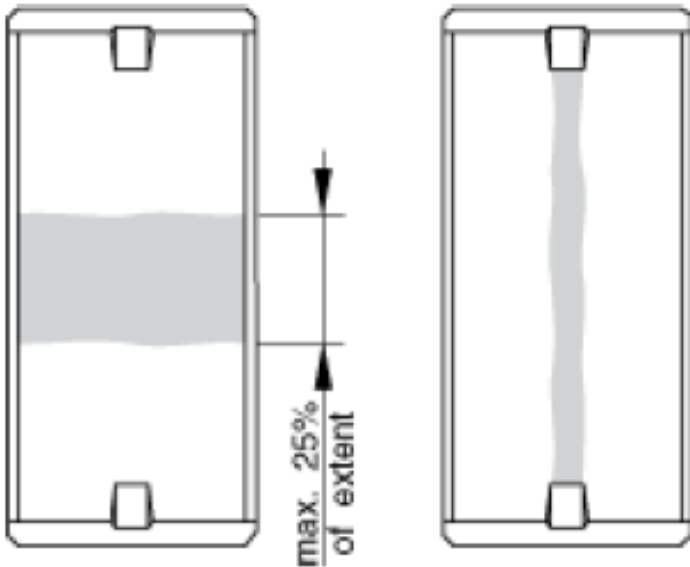


Condition: The bearing shell is locally so worn, that the ratio between the light-alloy metal and the overlay is 1:1. The width of the light-alloy metal has increased from 100 % (new bearing shell) up to 175 %. In the slots some overlay is still left,

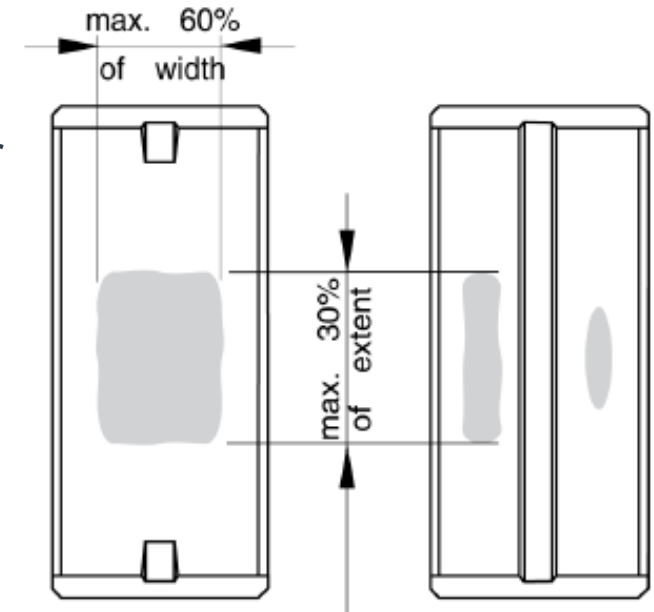
Valuation: The bearing can operate with wear of the below listed size, see fig. 8 og 9. If the wear limits are exceeded the bearing shells must be exchanged due to safety precautions.



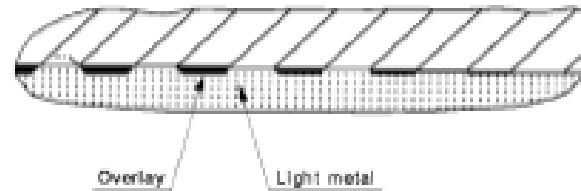
L28/32-L23/30H Piston and Connecting rod-bearing shell



Valuation: The bearing can operate with wear of the shown size. If the wear limits are exceeded the bearing shells must be exchanged due to safety precautions.



L28/32-L23/30H Piston and Connecting rod-bearing shell

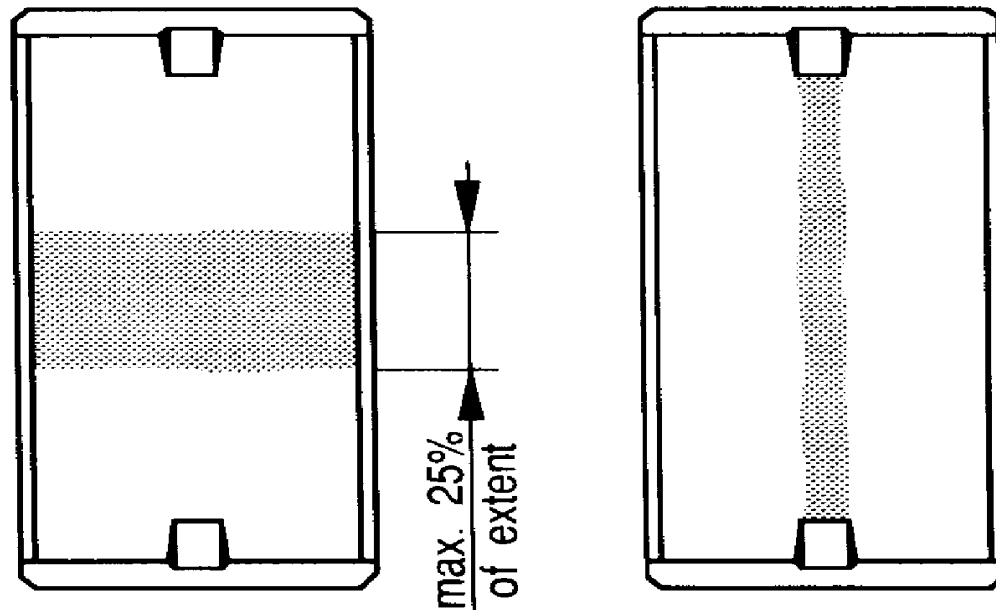


The slots are locally totally leveled as shown above

L28/32-L23/30H Piston and Connecting rod-bearing shell



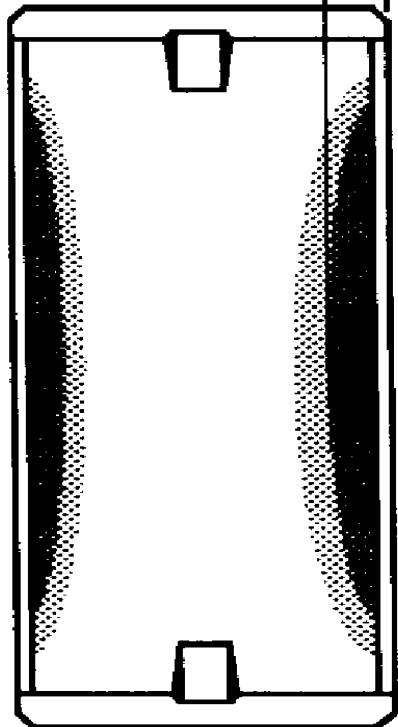
The bearing can operate with wear of the below listed size. If the wear limits are exceeded the bearing shells must be exchanged due to safety precautions.



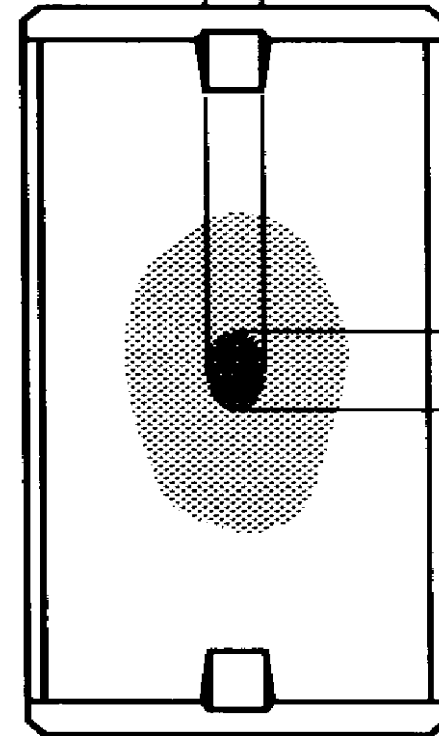
L28/32-L23/30H Piston and Connecting rod-bearing shell



max. 10% of width or
max. 5 mm



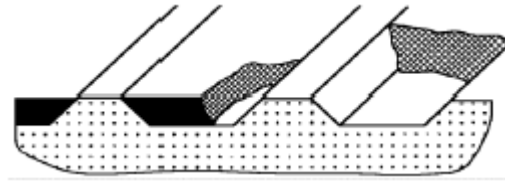
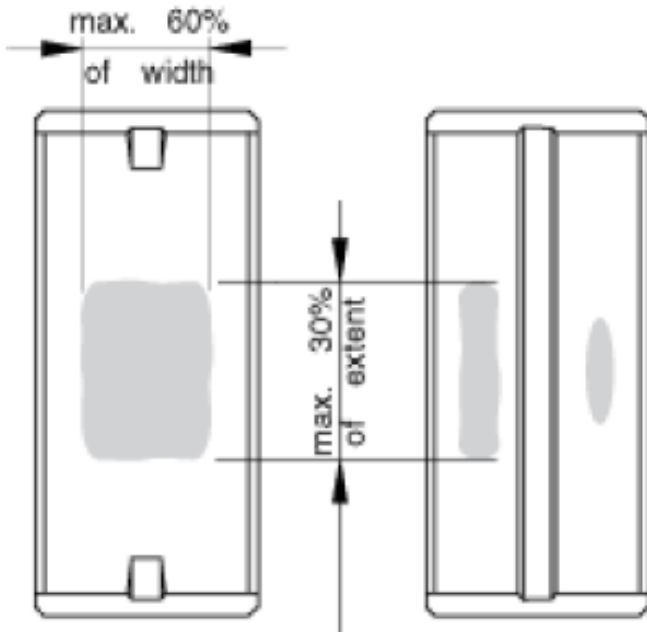
max. 10% of width



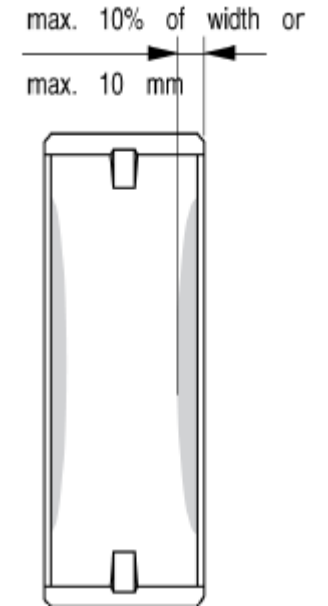
max. 5%
of extent

If the limits shown above are exceeded the bearing shells must be exchanged.

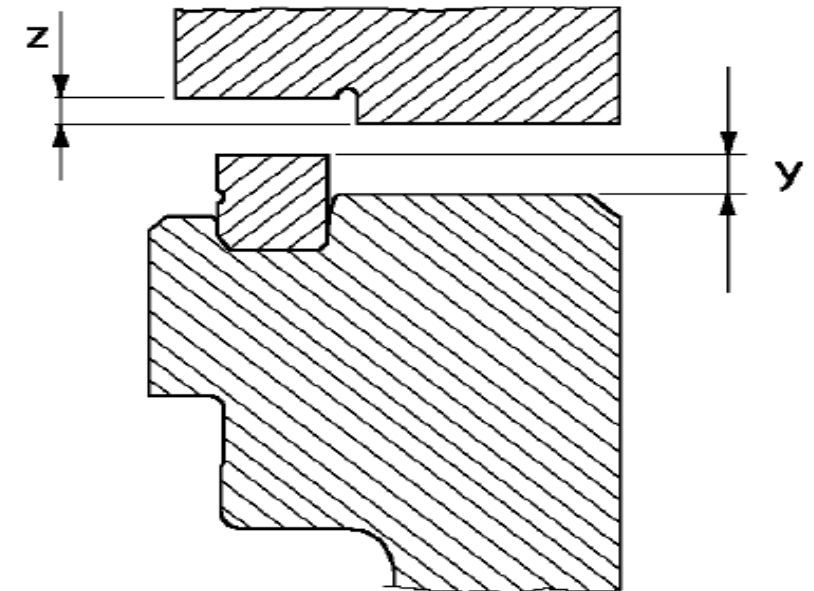
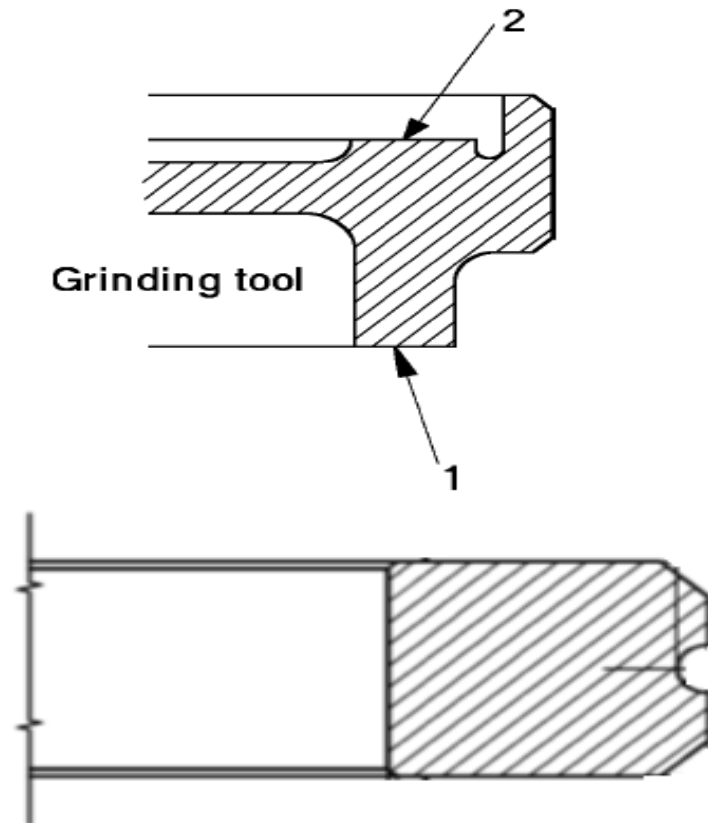
L28/32-L23/30H Piston and Connecting rod-bearing shell



Condition: Breakage in the overlay due to local overload, as shown.
Valuation: If the limits as shown are exceeded with totally or partially empty slots, the bearing shells must be exchanged.

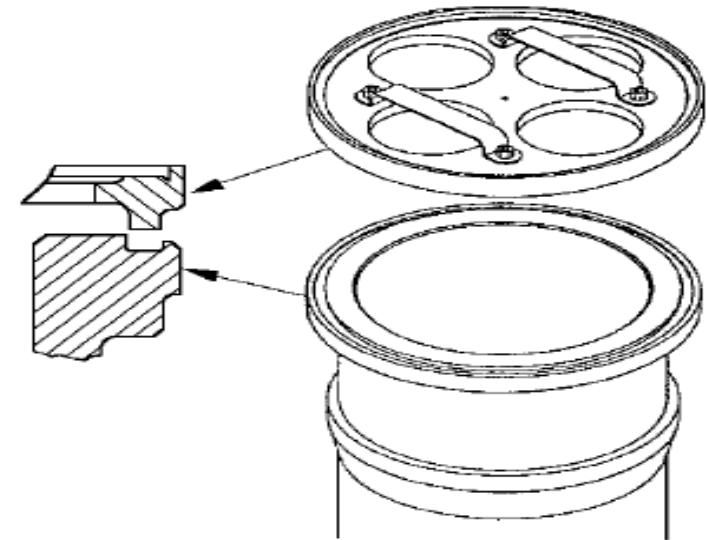
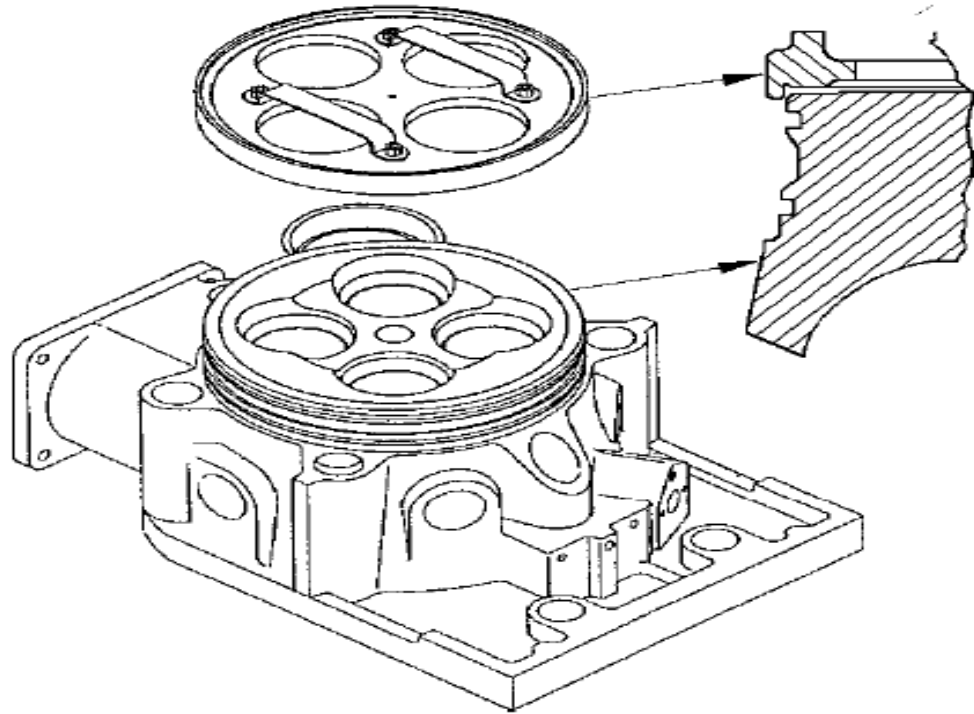


L28/32-L23/30H Liner with cooling water jacket

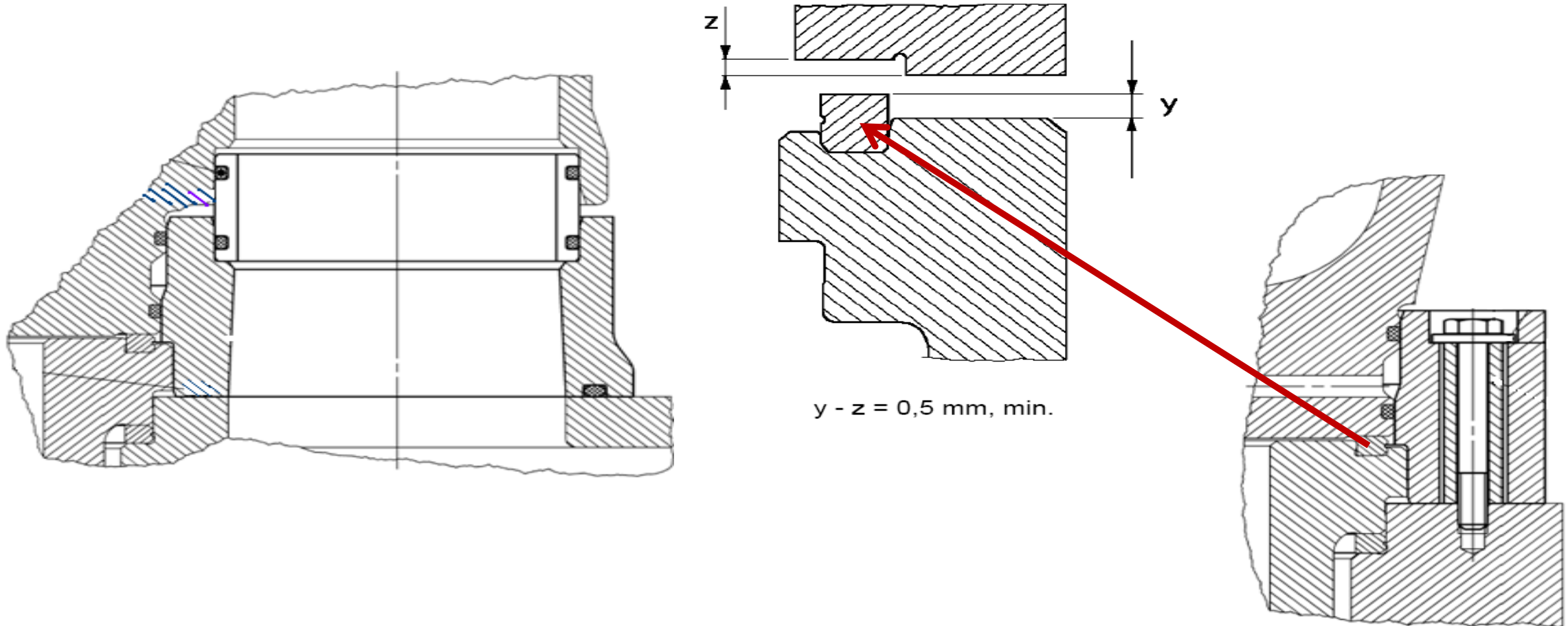


$$y - z = 0,5 \text{ mm, min.}$$

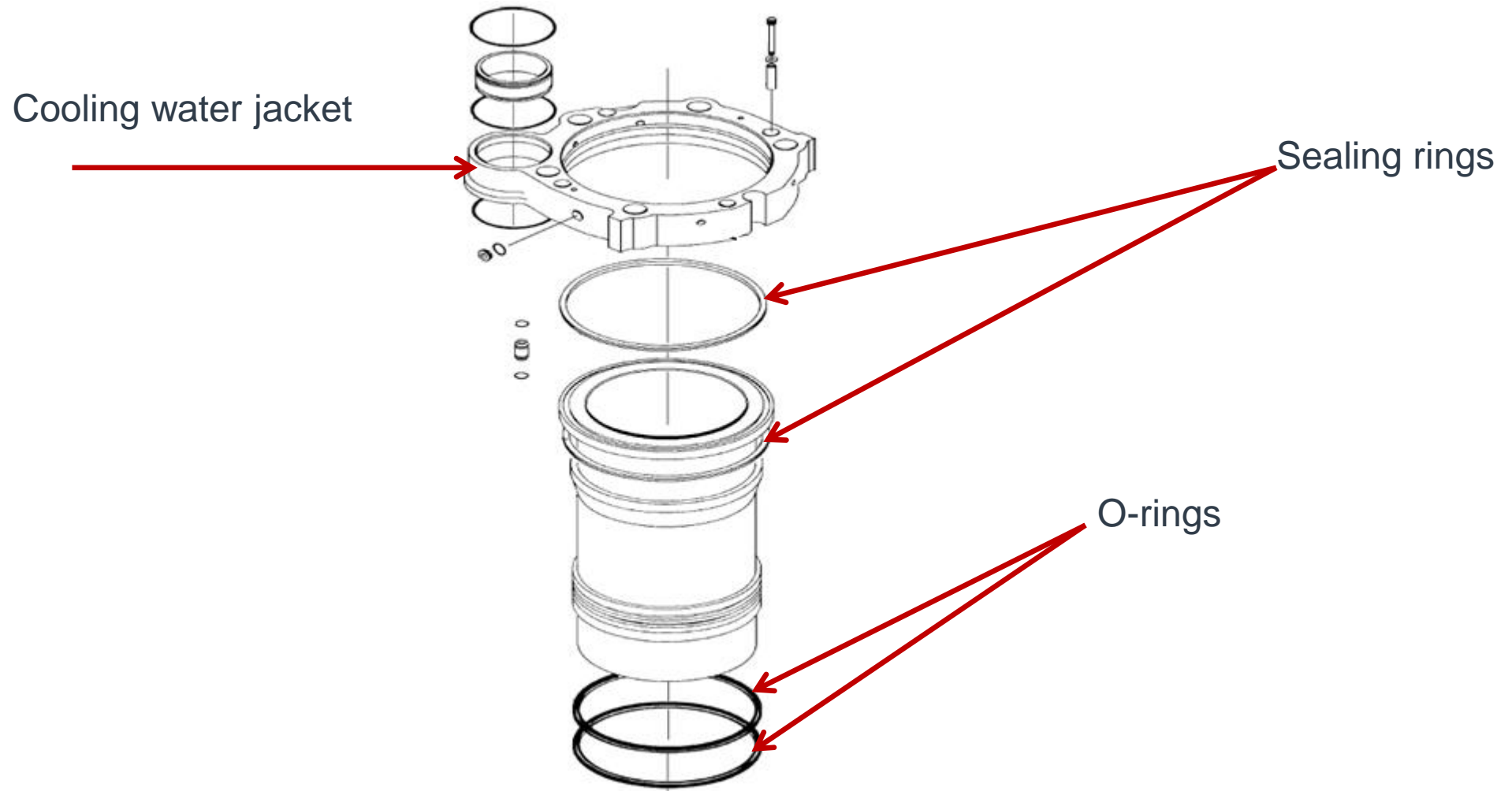
L28/32-L23/30H Liner with cooling water jacket



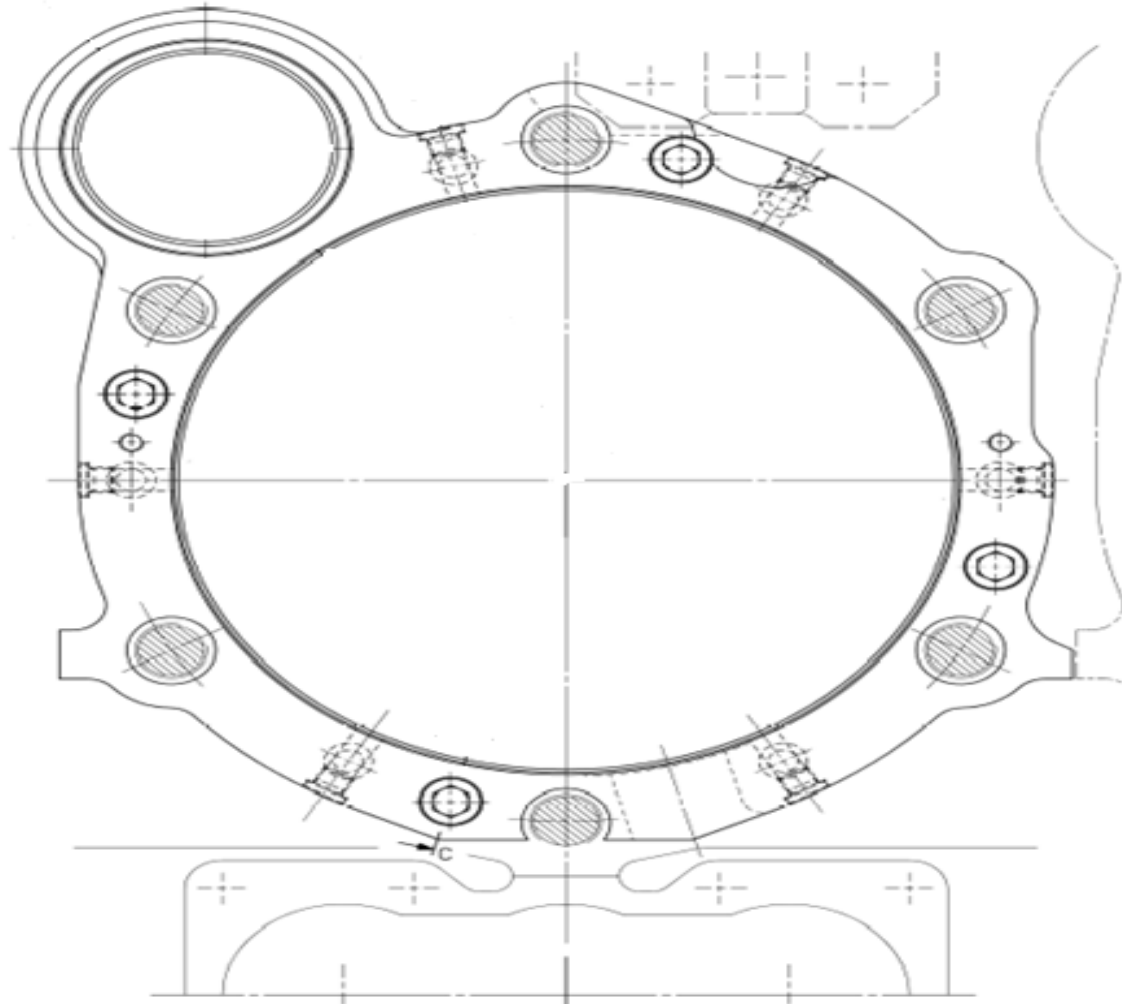
L28/32-L23/30H Liner with cooling water jacket



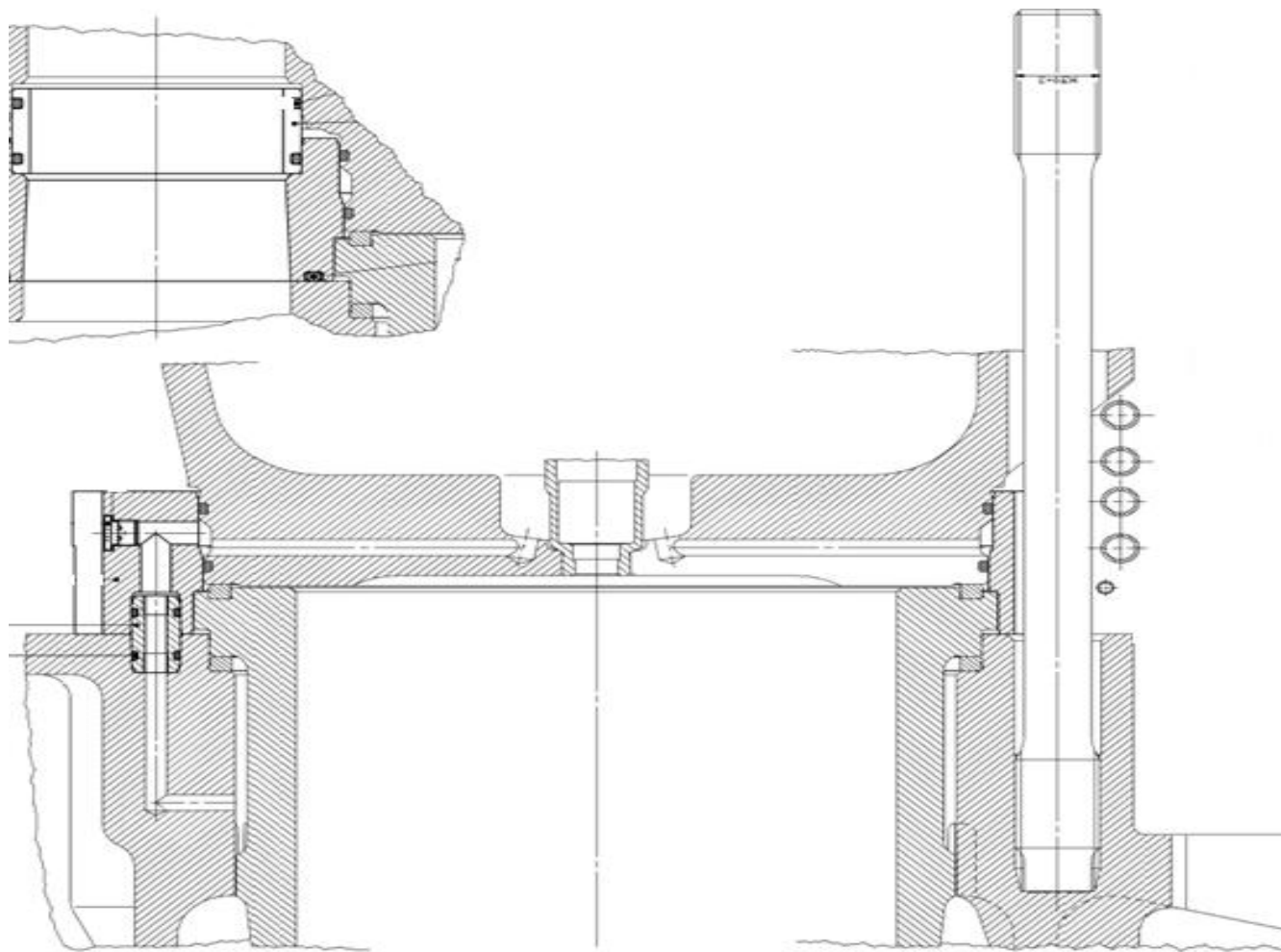
L28/32-L23/30H Liner with cooling water jacket



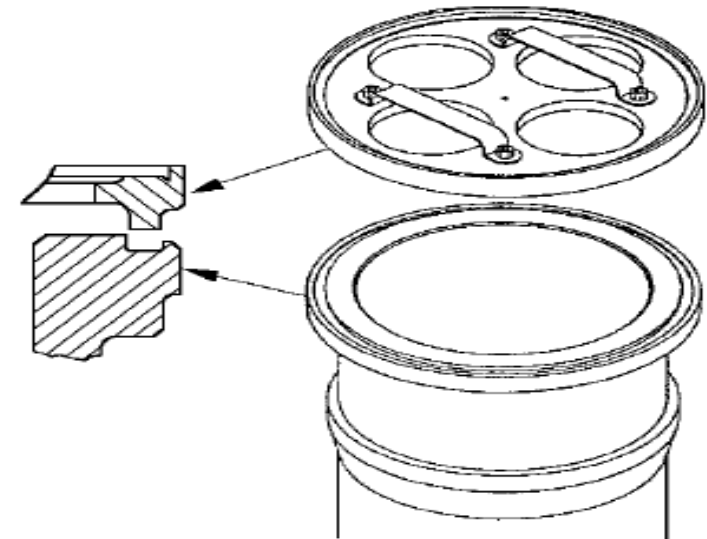
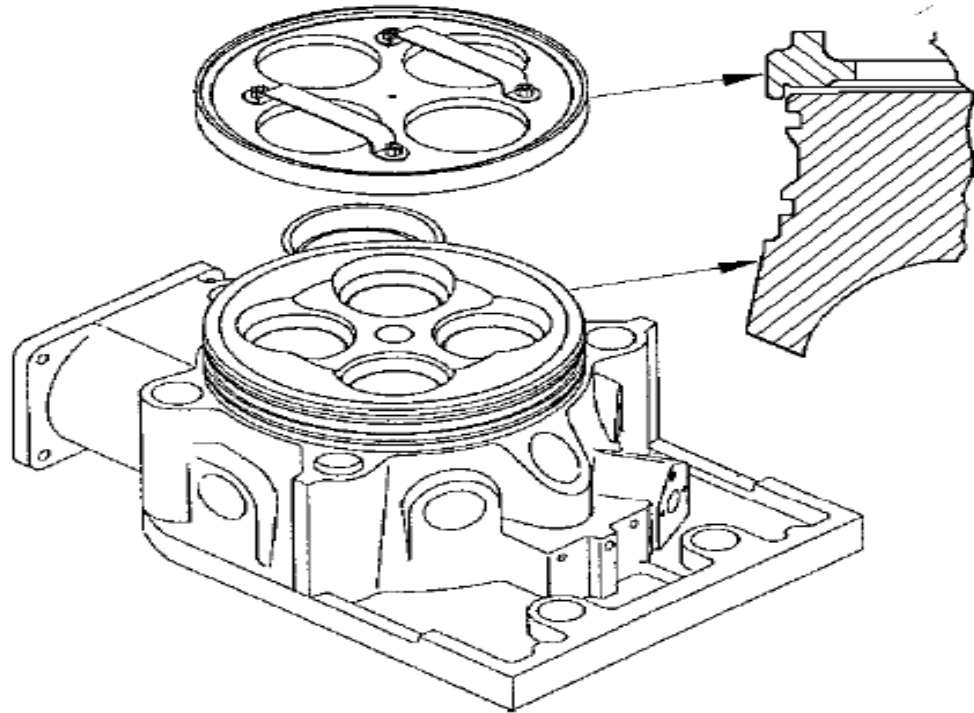
L28/32-L23/30H Liner with cooling water jacket



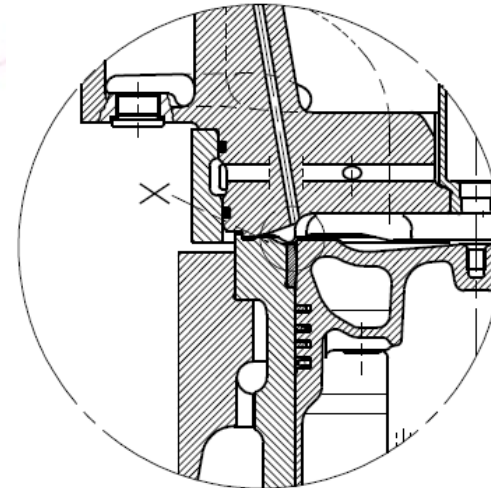
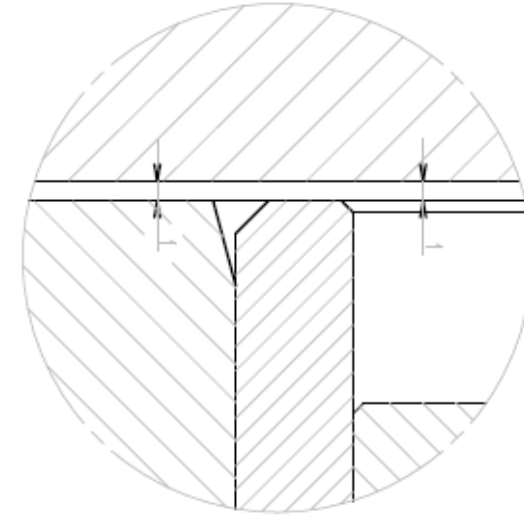
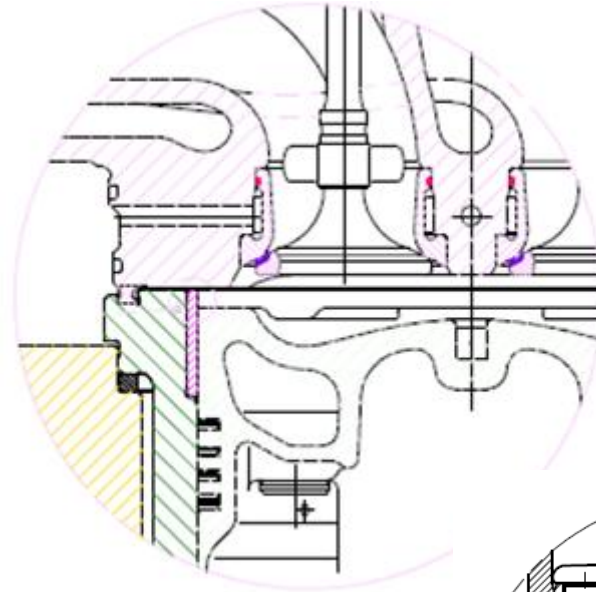
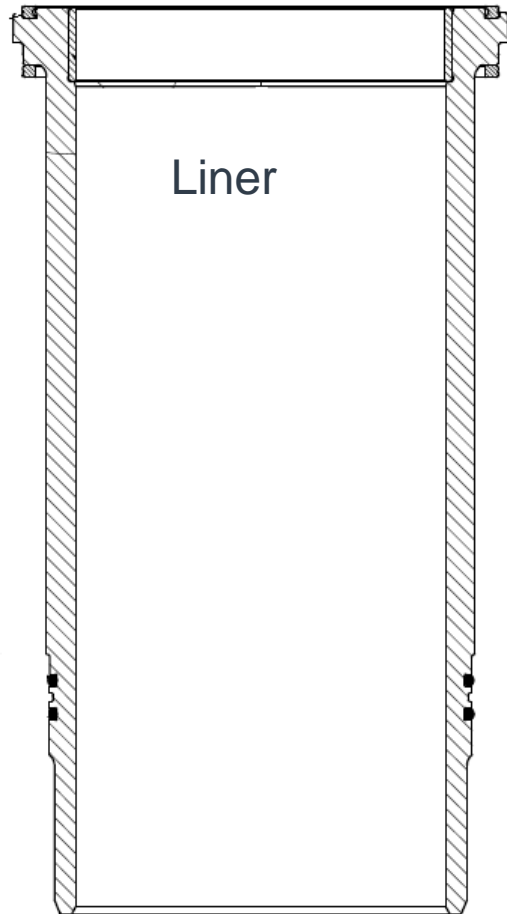
L28/32-L23/30H Liner with cooling water jacket



L28/32-L23/30H Liner with cooling water jacket

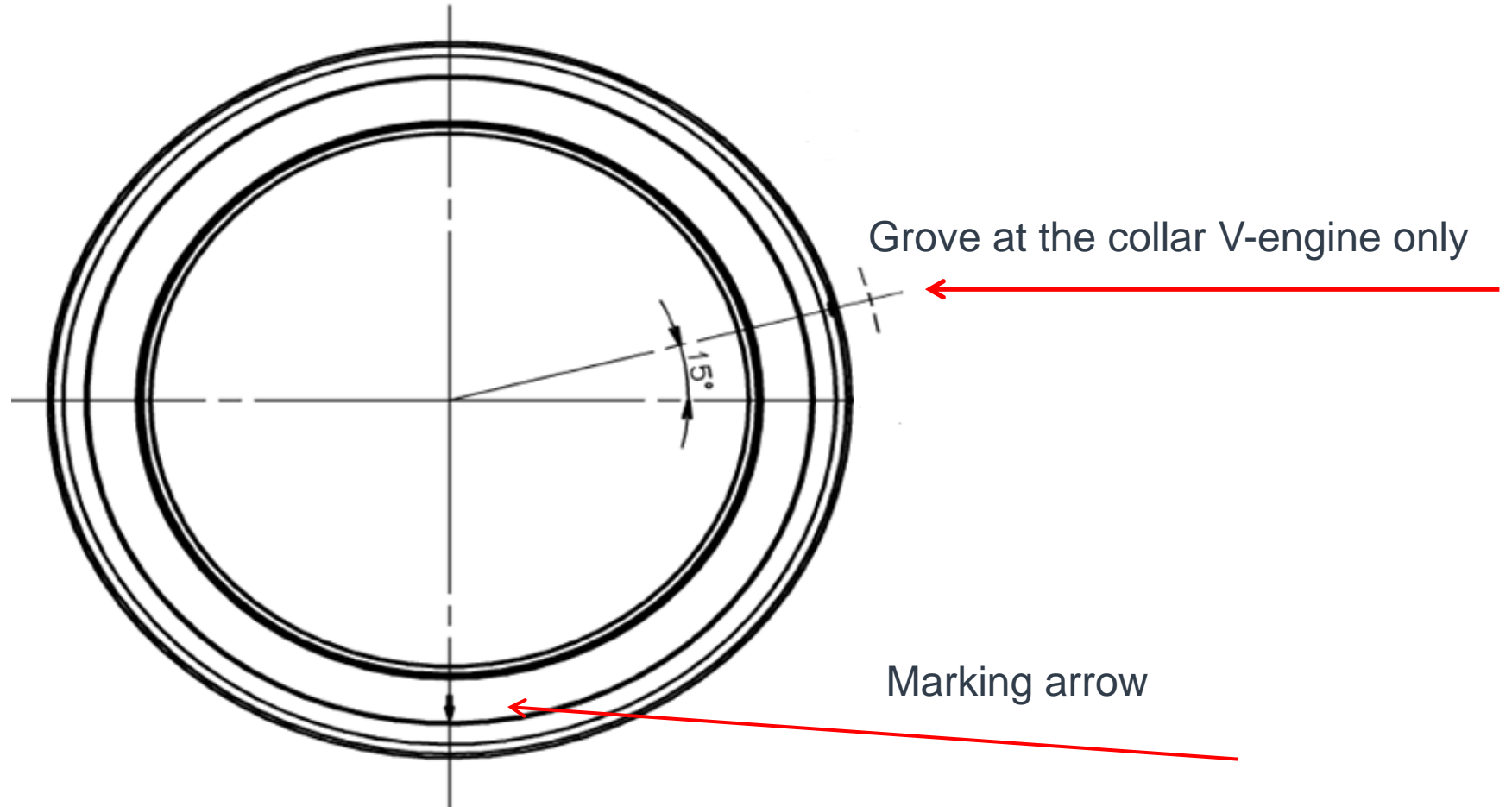


L28/32-L23/30H Liner, o-rings, sealing ring, flame ring



Flame ring

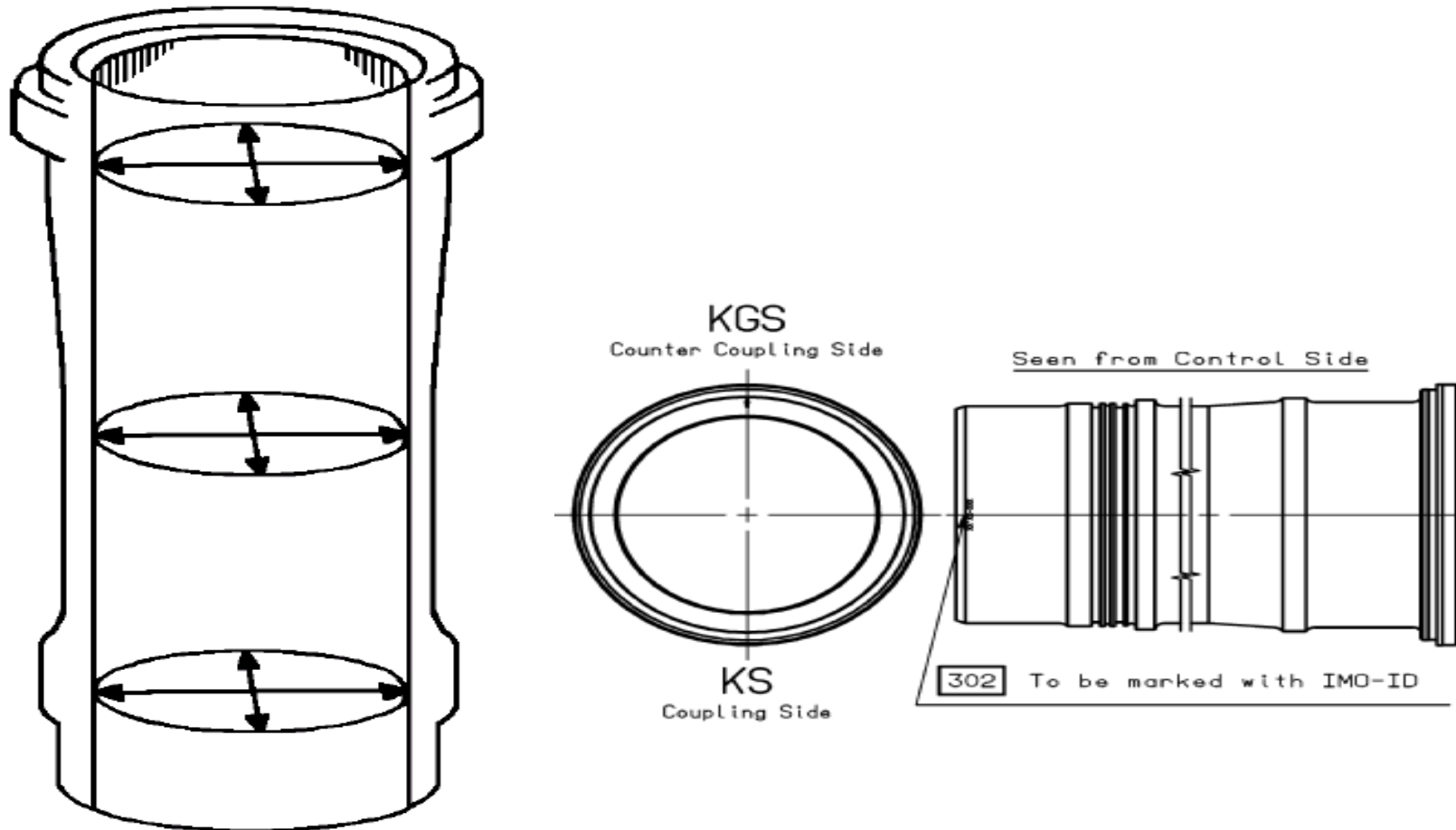
L28/32-L23/30H Liner Geometry



L28/32-L23/30H Liner Geometry



L28/32-L23/30H Liner Geometry



L28/32-L23/30H Liner Geometry

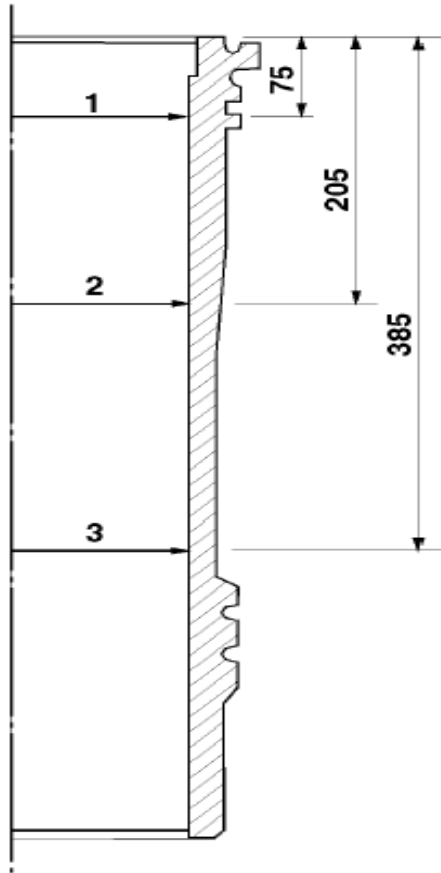


Measurements of Cylinder Liner L28/32H (with flame ring)

Plant/ship:		Engine Type:		Engine No.:			
Date:	Sign.:	Cyl. no.	Pos.	<input type="checkbox"/> A-side		<input type="checkbox"/> B-side	
				A	B	C	D
Running hours:		1	1				
Fuel: cSt			2				
Separator: Yes			3				
		2	1				
			2				
			3				
		3	1				
			2				
			3				
		4	1				
			2				
			3				
		5	1				
			2				
			3				
6	1						
	2						
	3						
7	1						
	2						
	3						
8	1						
	2						
	3						
Tem. of cyl. liner	25°C	9	1				
Nom. diameter	280H8		2				
Minimum	280.0		3				

10023-1EX/H5810/1997.07.01(5)

L28/32-L23/30H Liner Geometry

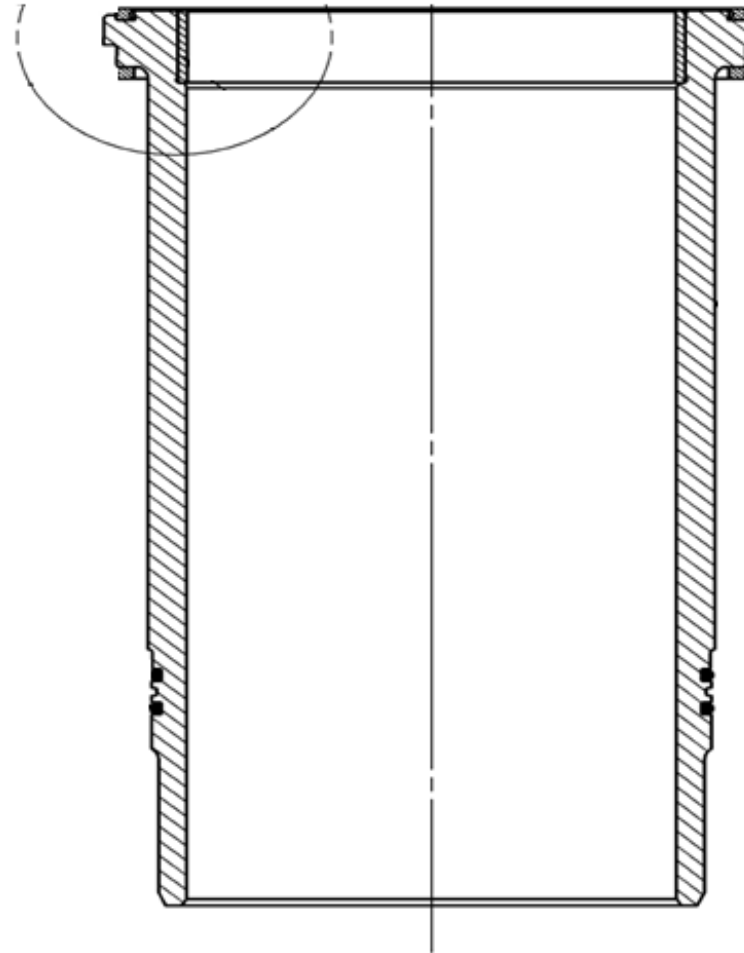
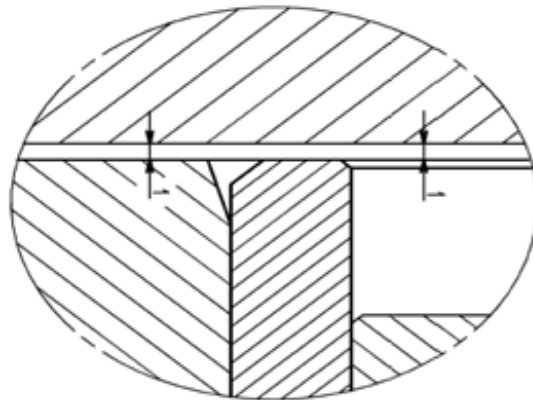
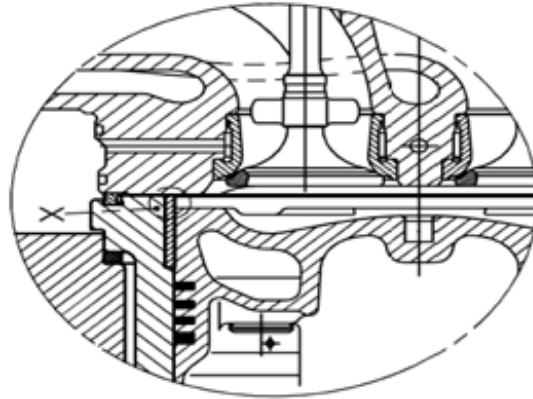


Uppermost deadpoint, compression ring no.: 1

Highest piston speed, compression ring no.: 1

Lowest deadpoint, compression ring no.: 1

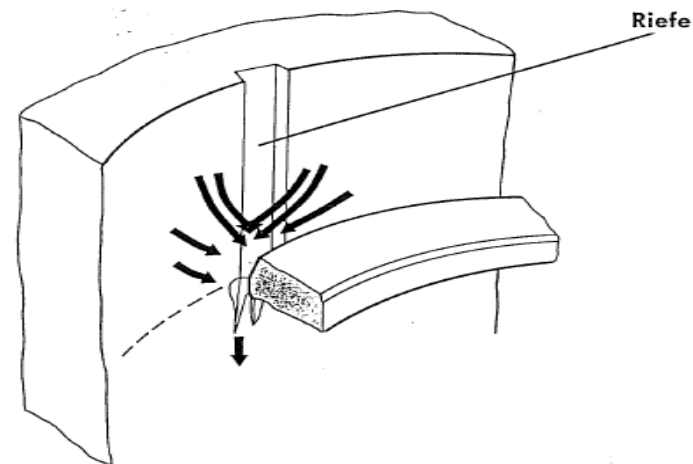
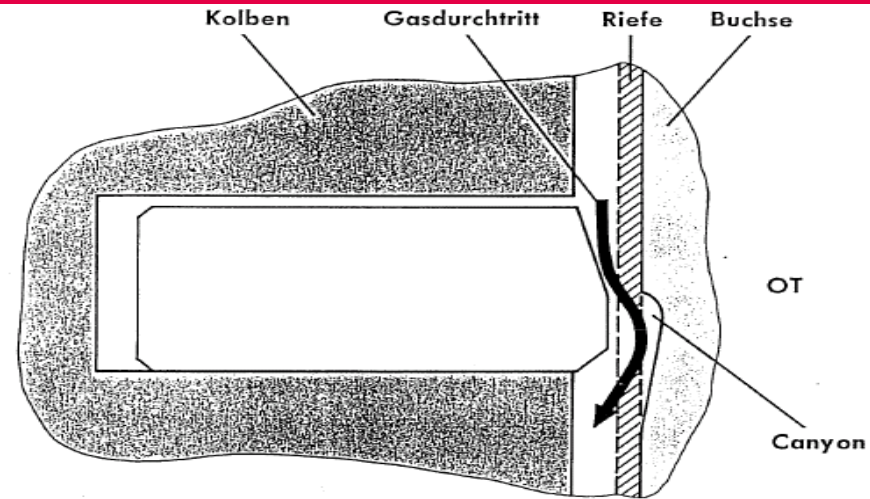
L28/32-L23/30H Liner Geometry



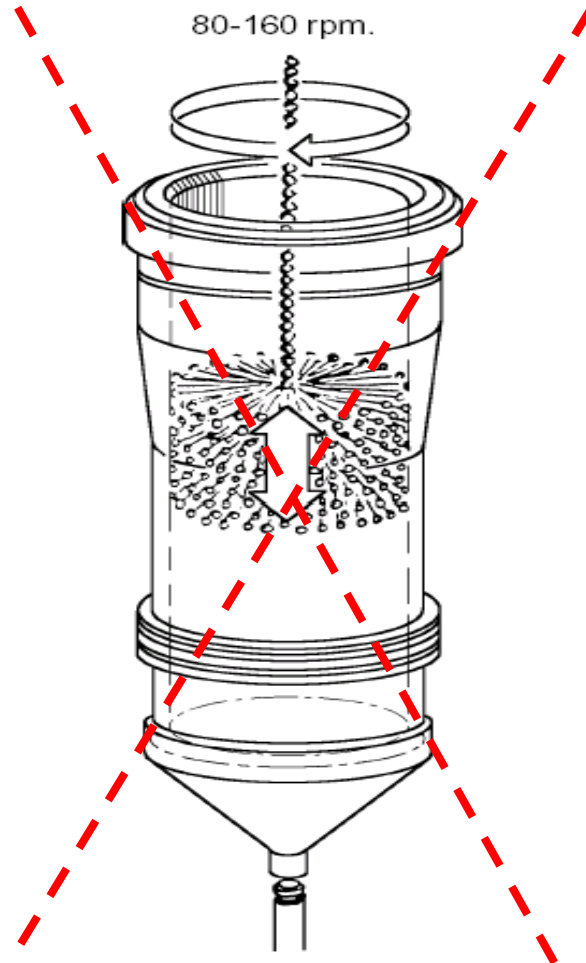
L28/32-L23/30H Liner Geometry



L28/32-L23/30H Liner Geometry



L28/32-L23/30H Liner Geometry



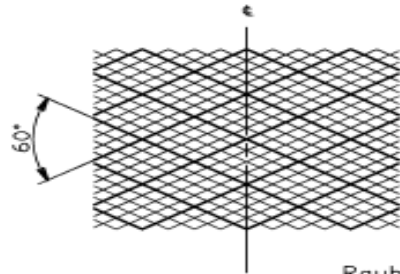
L28/32-L23/30H Liner Geometry



Honing brush for cleaning & rough up only
Pockets as in previous slide can not be restored by brush!



L28/32-L23/30H Liner Geometry



honng angle
Honwinkel: $60^\circ \pm 5^\circ$

Die Honriefen muessen in beiden Richtungen in gleicher Tiefe sein und annaehrend gleiche Abstaende haben. Die Oberflaeche muss frei von Blechmantel sein und darf keine Glattstellen aufweisen.

Honing scratches to be of equally depth in both directions and to have approximately equal distances. Surface must be free of smeared material and free of polished area.

Rauheit:	$R_{max} = 12-16 \mu m$	Messrichtung:	Measuring direction:
roughness	$R_z = 6-10 \mu m$	Tastweg 5mm	Measuring length 5mm
	($R_a = 1.3-1.6 \mu m$)	Wellenlaenge 0.8mm	cut of value 0.8mm

Plateau Flaechenanteil: 50-70% plateau area: 50-70%



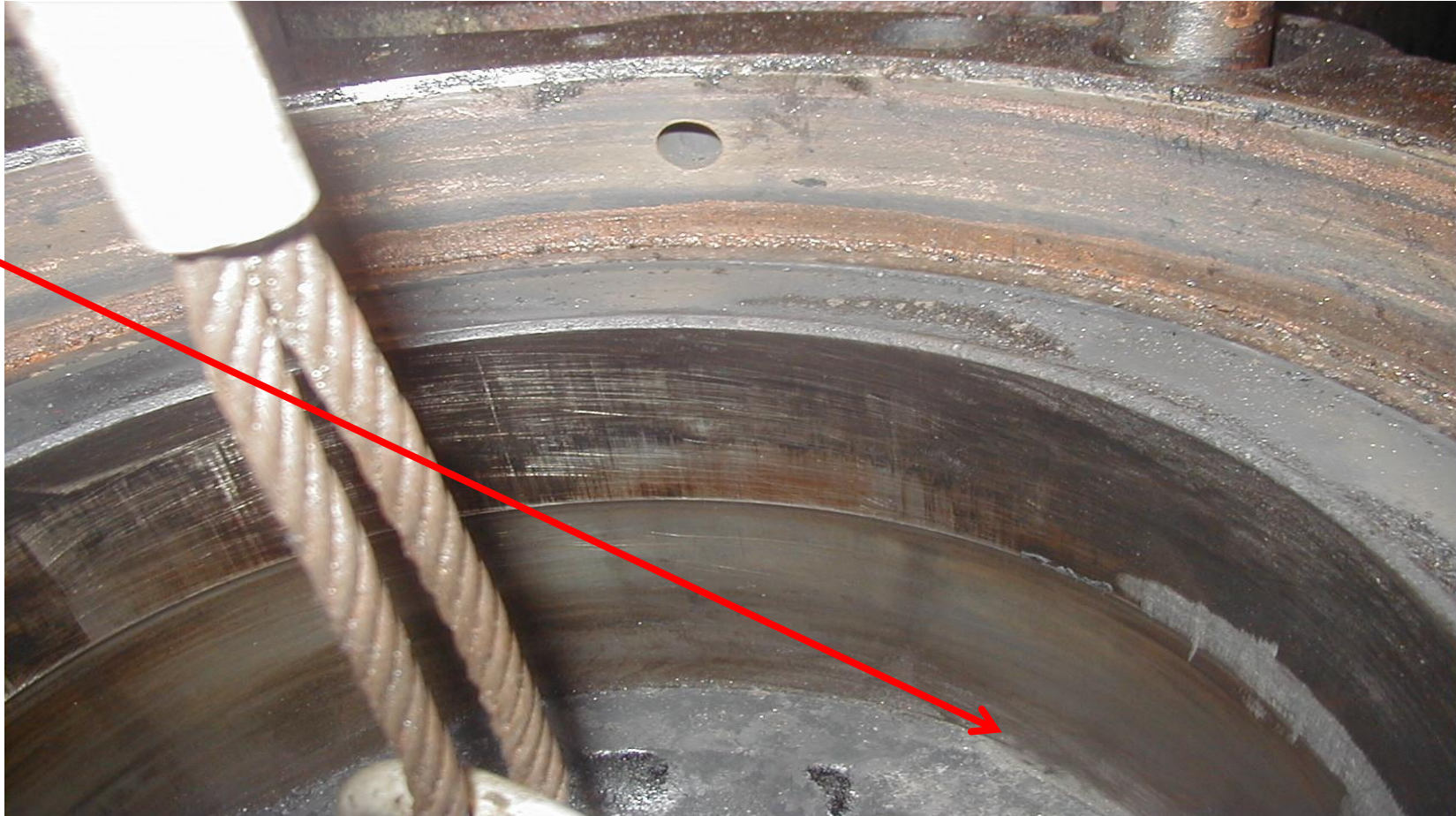
Die angegebenen Werte sind erreichbare Durchschnittszahlen.
The stated values are obtainable average figures.

Replacement for	Chk.	Date
	JFH	1999
Info No.	Description	
105950	Cylinc	

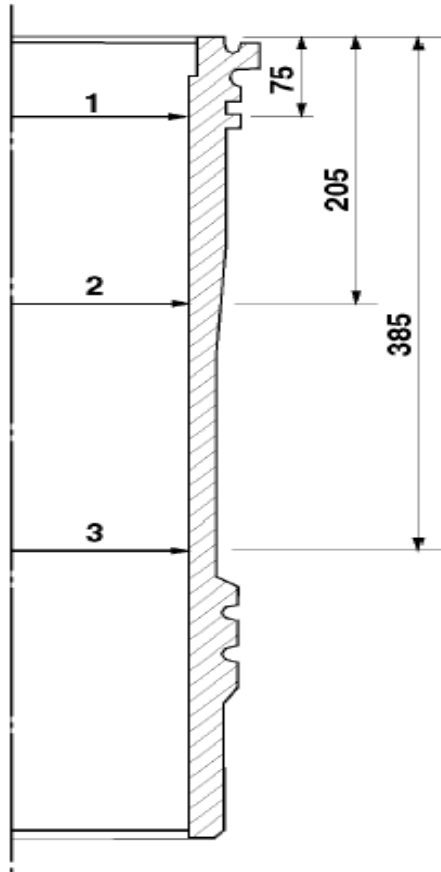
L28/32-L23/30H Liner Geometry



In order to lift
flame ring –
use old piston
ring on top of
piston



L28/32-L23/30H Liner Geometry

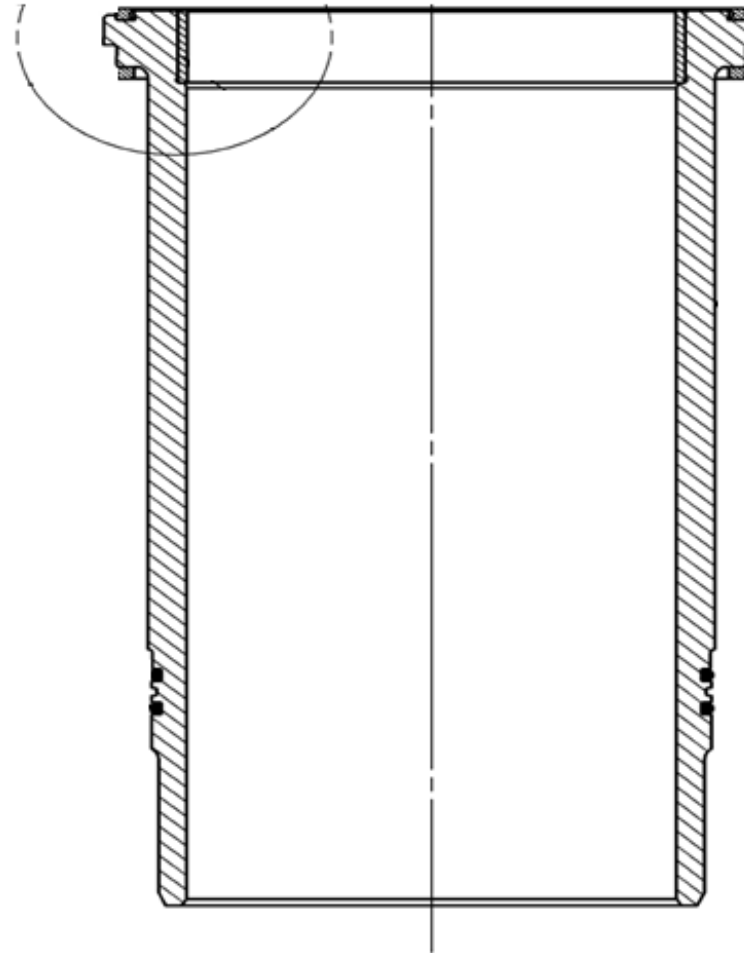
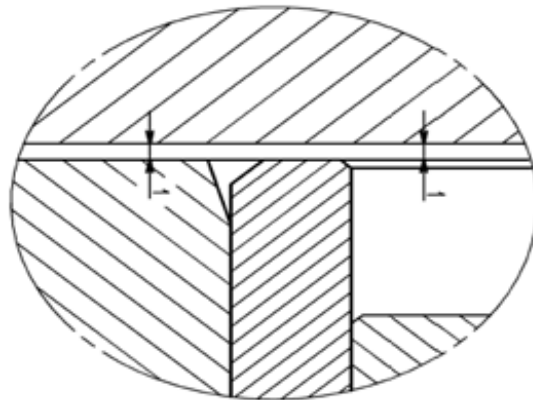
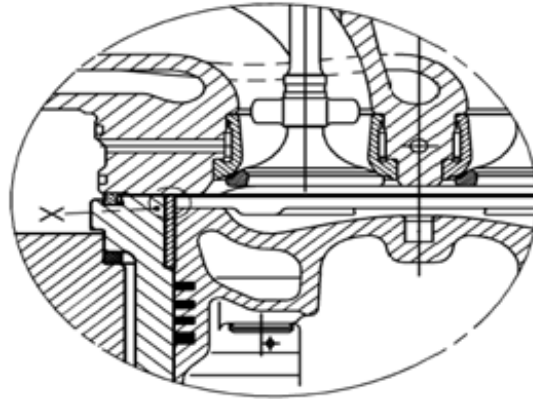


Uppermost deadpoint, compression ring no.: 1

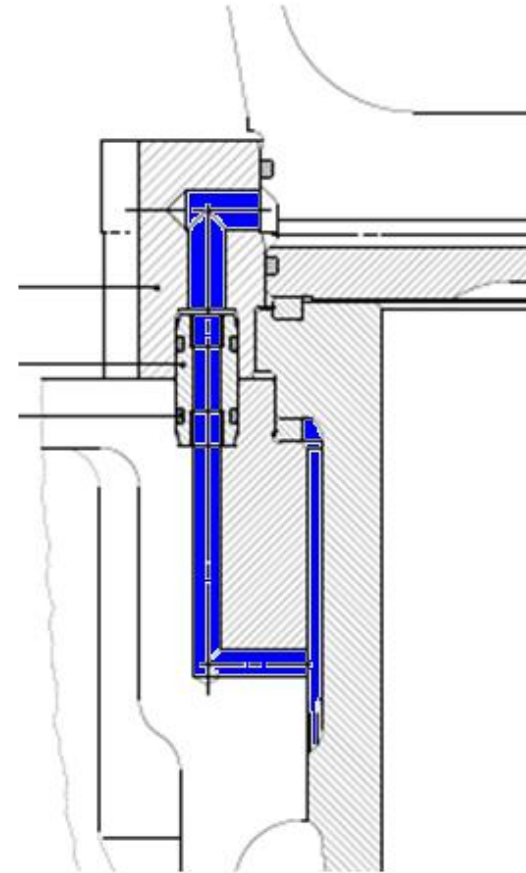
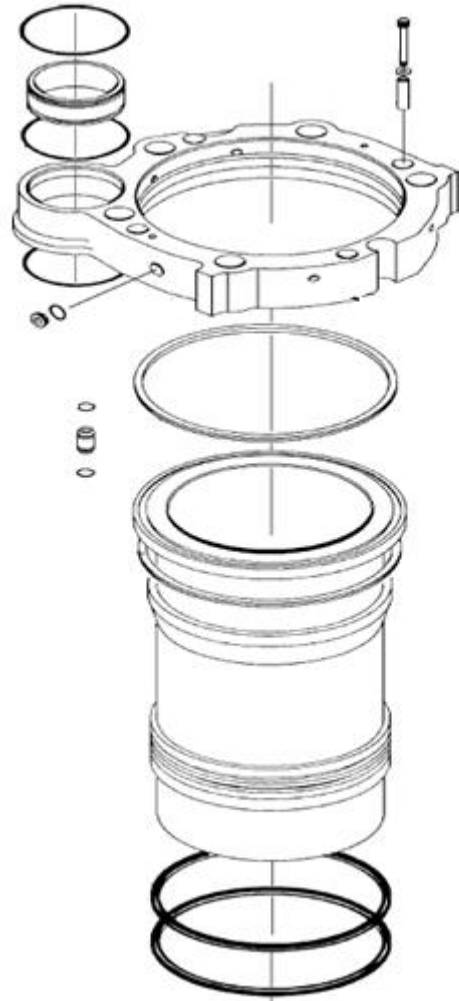
Highest piston speed, compression ring no.: 1

Lowest deadpoint, compression ring no.: 1

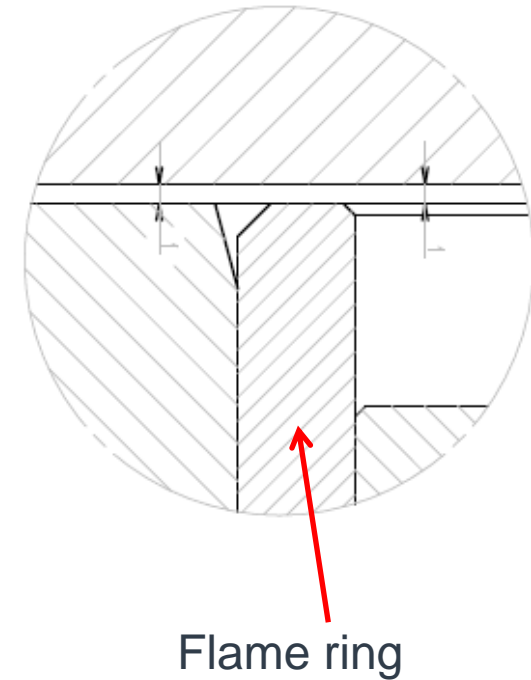
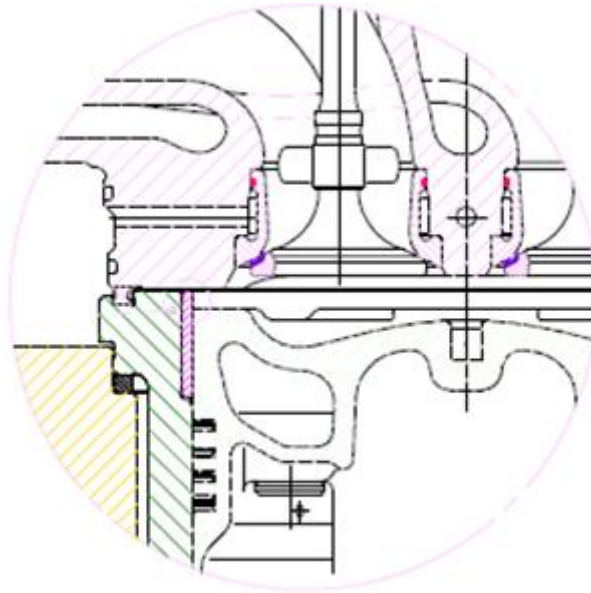
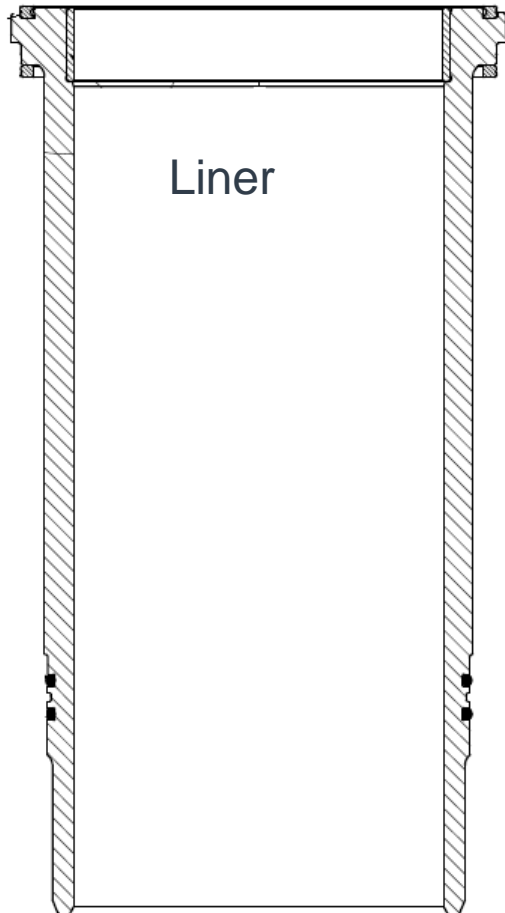
L28/32-L23/30H Liner Geometry



L28/32-L23/30H-V28/32S Cylinder Liner



L28/32-L23/30H Liner, o-rings, sealing ring, flame ring

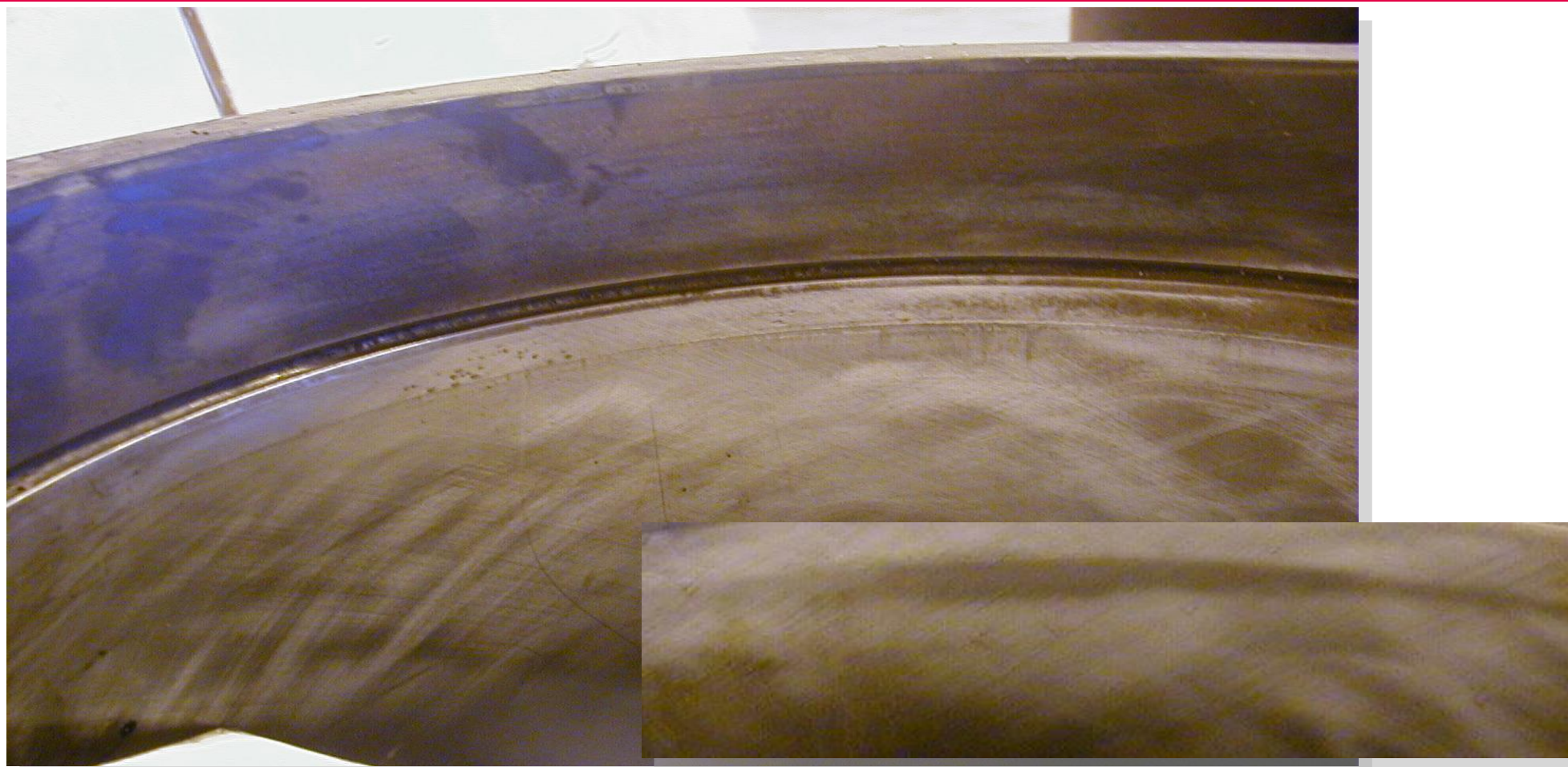


L28/32-L23/30H Cylinder Liner



Example of cavitations

L28/32-L23/30H Cylinder Liner



L28/32-L23/30H Cylinder Liner



L28/32H Cylinder Liner



If not detected and remedied in time liner tapering will result in premature wear of piston ring grooves and/or blow by.

Example; tapering with 0.4mm

Piston ring moves in and out groove 0.4mm at each revolution.

$720 \times 0.4 = 288\text{mm} / \text{Minute} = 17280\text{mm} / \text{Hour} = 415 \text{ meter per Day}$

Over 10000 running hours that is 173 KM!!

Disclaimer



All data provided in this document is non-binding.

This data serves informational purposes only and is especially not guaranteed in any way. Depending on the subsequent specific individual projects, the relevant data may be subject to changes and will be assessed and determined individually for each project. This will depend on the particular characteristics of each individual project, especially specific site and operational conditions.

Do you have any more questions?



Joe Bloggs

[Contact details]

Joe Bloggs

[Contact details]