VOID

Replaced by SL2023-747

Action code: AT FIRST OPPORTUNITY

Updated procedure due to potential crack in piston crown

Inner circular contact flange

SL2023-743/PRP
August 2023

Concerns

Owners and operators of MAN B&W two-stroke marine combustion engines.

Summary

To prevent personal injury and damage to the engine during piston overhaul, we have introduced an updated work procedure included in this Service Letter.

Enclosure

Work card 2265-0401-0044 - Piston

Dear Sir or Madam

We have recently received information about a potentially dangerous situation from the owner of an MAN B&W engine where the engine crew became aware of a crack in the piston crown at the bolted connection. It is important to note that the risk of experiencing such a crack in the piston crown is very low.

In a situation where the contact face on the piston crown towards the piston rod breaks off, the piston rod will either fall sideways or drop, depending on the circumstances. This poses a serious potential risk to people and property, and may even result in bodily injuries and/or fatal casualties.

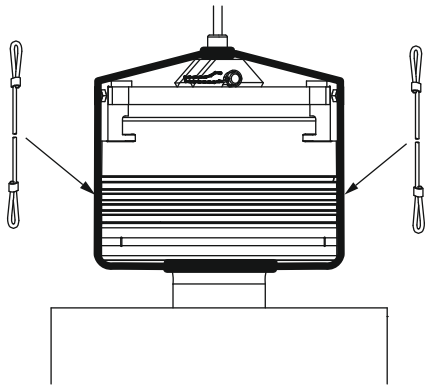
Additionally, in the event that such cracks develop, they can lead to an oil spill inside the engine. Such oil spills can be detected at the scavenge drain. If undetected for a long time, oil spills might, in rare cases, lead to substantial engine damage that potentially could result in a complete breakdown.

Questions regarding this Service Letter should be directed to our Operation department at: Operation2S@man-es.com

Yours faithfully

Susanne Kindt
Vice president, Two-stroke Engineering

Per Pallisgaard
Head of Product Safety DK



Head office (& po. address)
MAN Energy Solutions
Teglholmsgade 41
2450 Copenhagen SV
Denmark
Phone: +45 33 85 11 00
Fax: +45 33 85 10 30
info-cph@man-es.com
www.man-es.com

PrimeServ
Teglholmsgade 41
2450 Copenhagen SV
Denmark
Phone: +45 33 85 11 00
Fax: +45 33 85 10 49
PrimeServ-cph@man-es.com

Production
Teglholmsgade 35
2450 Copenhagen SV
Denmark
Phone: +45 33 85 11 00
Fax: +45 33 85 10 17
manufacturing-dk@man-es.com

Forwarding & Receiving
Teglholmsgade 35
2450 Copenhagen SV
Denmark
Phone: +45 33 85 11 00
Fax: +45 33 85 10 16
shipping-cph@man-es.com

MAN Energy Solutions
Branch of MAN Energy Solutions SE, Germany
CVR No.: 31611792
Head office: Teglholmsgade 41
2450 Copenhagen SV, Denmark
German Reg.No.: HRB 22056
Amtsgericht Augsburg

When dismantling the piston, we recommend checking for cracks in the bolted connection in the inner circular contact surface. If you find a crack, replace the piston crown.

Fig. 1: Dye check revealing cracks in piston crown (yellow arrows indicate the crack line)

MAN Energy Solutions has updated the work card for piston overhaul. The update introduces two textile rope slings to be used during lifting operations. In the unlikely event that a breakage should occur, the slings will prevent the piston rod from dropping in an uncontrolled manner.

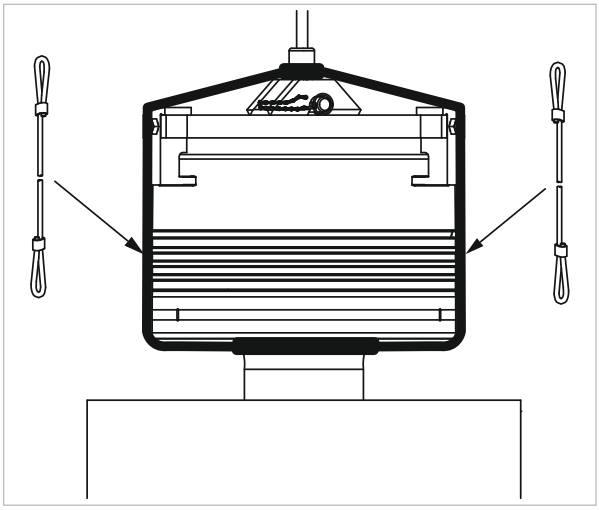


Fig. 2: Use textile rope slings for lifting operations

It is important that this information is communicated to the relevant technical personnel. You must make sure that any inspection, maintenance, and repair is carried out by trained staff, who are familiar with the related operating and maintenance instructions, and work cards.

Please insert this Service Letter and work card No. 2265-0401-0044 in the instruction book.

Checking

Warnings and key information

⚠ WARNING

Turning gear switch

ALWAYS bring the turning gear switch into the scavenge air receiver during inspection.

a. Block the starting air supply to the main starting valve.
b. Open the indicator valves.
c. The access cover to the scavenge air receiver must be locked and secured in **open position** during the inspection.
d. Bring in bottles with drinking water for consumption in the scavenge air receiver.
e. Take care when moving around in the receiver and bring proper lighting.
f. Pockets for thermometers are placed in head level. Hard hat is also recommended. Remember to take breaks to replenish fluid lost from sweating, especially in hot climates.

⚠ WARNING

Working inside crankcase

Risk of serious injury or death due to slips, falls and low overhead clearances.

- Observe safety precautions when working in the crankcase. *See description [0545-0100].*
- Use platform boards while working inside the crankcase. *See work card [7665-0601].*

NOTICE

Inspection of scavenge port.

For detailed information on scavenge port inspection, see *description [2245-0100]*.

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1. Scavenge port inspection

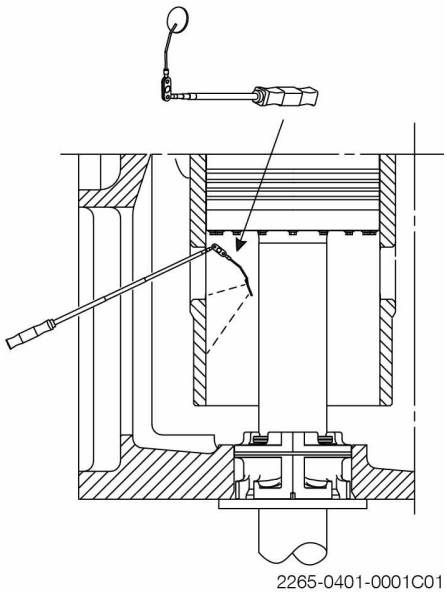
The scavenge port inspection is carried out from the scavenge air receiver.

Before entering the receiver, open the access cover and secure it in open position. An additional view of the rings is possible through the cleaning cover on the manouvering side.

NOTICE To detect possible leakages from the piston or cylinder cover, keep the cooling water and cooling oil circulating during the scavenge port inspection.

Turn the engine at least ½ a revolution, and begin with a unit arriving downwards, just above the scavenge air ports. Inspect the piston rod and the lower part of the cylinder wall.

While the piston is passing downwards, inspect the piston skirt, all the piston rings, the ring lands, and the piston top.



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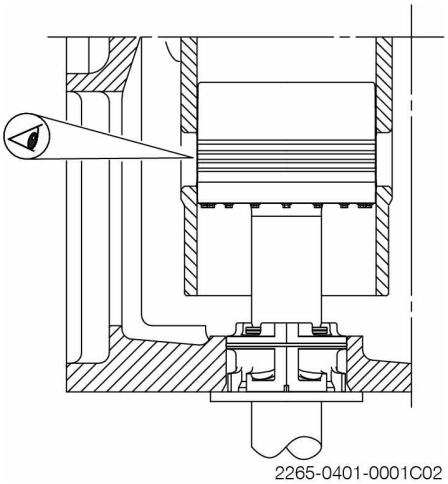
2. Ring inspection

Inspect the rings, one at a time, and note down the results for later references.

The piston may have a ring pack consisting of:

- All Cermet-coated rings.
- All non-Cermet-coated rings.
- A mix of Cermet-coated and non-Cermet-coated rings.

In addition to the above, please note that most new piston rings (both Cermet-coated and non-Cermet-coated) will be Alu-coated (golden finish) for running-in purposes. Average Alu-coat lifetime is 1000–1500 running hours.



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3. Piston ring wear criteria

For non-Cermet-coated rings the wear criteria is the width of POP-opening on the underside of the piston ring, or the depth of the CL-groove.

For Cermet-coated piston ring the wear criteria is the thickness of the Cermet coating layer.

See *description [2245-0100]*.

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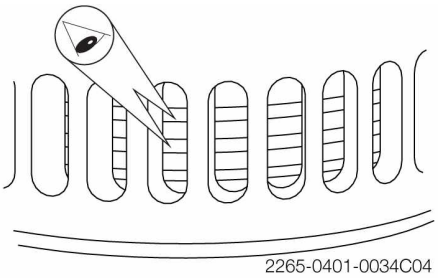
4. Ring running surface

Inspect the running surface of the piston rings for discoloration, deposits, or seizure marks.

Be aware of broken or collapsed rings. For details see *description [2245-0100]*.



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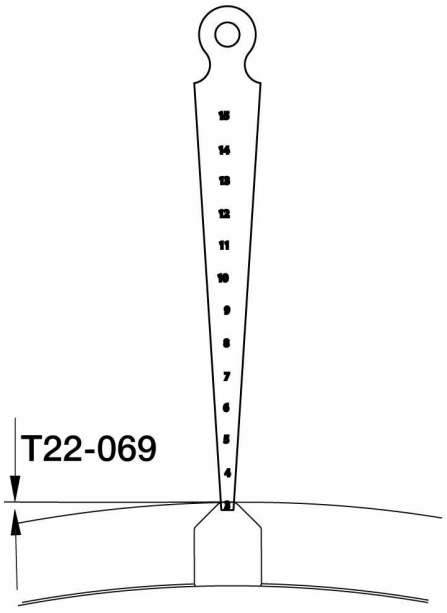
5. CPR-POP ring (Port-On-Plane)

To measure the wear of the ring, the width of the leakage passage can be measured using a feeler-gauge-type measuring tool.

The opening is 3 mm from the beginning, and the milled passage is designed in such a way that for every 1 mm the ring is worn radially, the gap opens 2 mm.

For maximum allowable width of the leakage gap, see *data*.

INFO **For engines supplied with Cermet-coated rings the leakage gap is not a wear criteria. Thus, the feeler-gauge-type measuring tool may not be available.**



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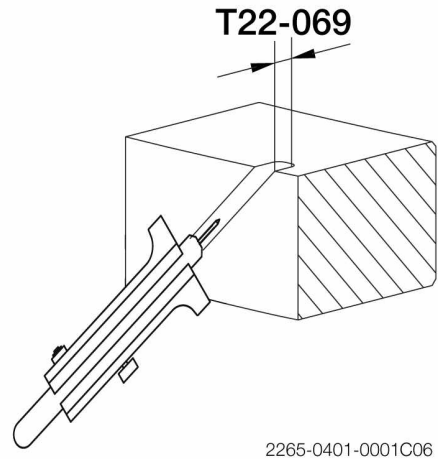
6. CPR-CL ring

If possible, measure the depth of the pressure relief grooves with a calliper.

The piston rings must be replaced if the radial depth of the grooves has worn down to less than the value, stated in *data*.

INFO **For engines supplied with Cermet-coated rings, depth of the relief grooves is not a wear criteria. Thus, the caliper may not be available.**



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7. Cermet-coated ring

Use the thickness gauge to check the thickness of the Cermet coating on the piston ring running surface.

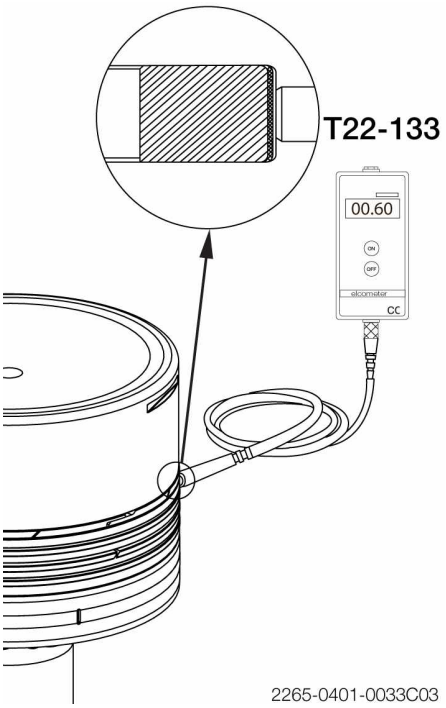
Press the measuring probe against the center of the piston ring running surface.

When doing a scavenge port inspection, insert the measuring probe through the most easily accessible scavenge port.

If possible take measurements on the upper half of the piston ring as wear here will often (especially for the uppermost piston ring) be higher than at the lower half of the ring.

For details on how to use the thickness gauge see separate instructions from thickness gauge manufacturer.

It is recommended to take at least 3 measurements in each measuring position to reduce the risk of measuring errors. In the Cylinder Condition Report note down the thickness measured for each ring for calculation of Cermet coating wear rate.



8. Cermet wear criteria

If the Cermet coating thickness is above 0.10 mm, the ring is in "good condition with no remarks".

If the Cermet coating is worn down to 0.10 mm or less, measurements in more positions (as many as possible, minimum 3 positions through scavenge ports on the exhaust side and 3 positions through scavenge ports on the manouvering side) must be carried out for a full evaluation of the piston ring condition.

If the Cermet coating thickness in any location on the piston ring is worn down to 0.05 mm or less, replacement of the piston ring should be done at the first convenient opportunity, taking into consideration previous Cermet coating wear rate calculations.

⚠ WARNING The piston ring must always be replaced before the Cermet coating is fully worn away in any location.

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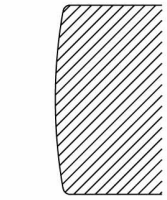
9. Piston Skirt

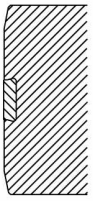
The Piston skirt may be either *Molybdenum* coated and barrel shaped, or non-coated with 1 or 2 bronze bands.

See the sketch showing the running surface of the skirts (details exaggerated for visibility).

For both types of piston skirts, the skirt must always be replaced if damaged by for example, Mo-coating peeling off or by active seizures.



Molybdenum coated with barrel shape and roundings



Non-coated with chamfers and bronze band(s)

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10. Molybdenum coated barrel shape skirt

At both the top and bottom of the skirt running surface a 2–3 mm rounding will be present. Between the roundings, a barrel shape (with cylinder diameter dependent radius) will be present. The roundings and barrel shape surface are covered by a wear layer of molybdenum.

NOTICE **If the Mo-coating is worn through to the base material, the cast iron will become visible by a locally more shiny appearance and the coating thickness measurement will thus locally result in “0” µm of remaining Mo coating.**

The level of wear on the barrel shape geometry can be seen by the height of the skirt center contact zone. If the contact has increased to the full height of the skirt, the barrel shape is worn out.

Light barrel shape skirt wear

Moderate barrel shape skirt wear

2265-0401-0034C09

11. Piston skirt replacement criteria

If either the skirt barrel shape is worn away **or** the Mo-coating is worn through to the cast iron base material in any position, the skirt should be replaced when convenient.

If both the barrel shape is worn away **and** the Mo-coating is worn through in any position, the skirt must be replaced as soon as possible.

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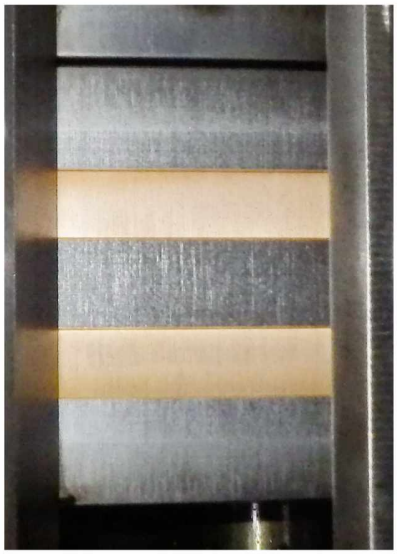
12. Non-coated bronze band skirt

In the middle of the skirt running surface 1 or 2 bronze bands are mounted. At the top and bottom of the skirt running surface a chamfer of 7-25 mm height is cut (depending on engine bore size).

The following criteria apply regarding replacement of the skirt:

- Wear of the bronze band(s) is natural and does not require replacement.
- When the chamfer is worn flush with the skirt running surface in any position, that is the chamfer has locally disappeared, the skirt is worn out and must be replaced as soon as possible.

As new, perfect condition



Bronze bands worn flush, but chamfers in fine condition.

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13. Piston support

Remove the piston from the cylinder and place it on the piston support, see *dismantling procedure*.

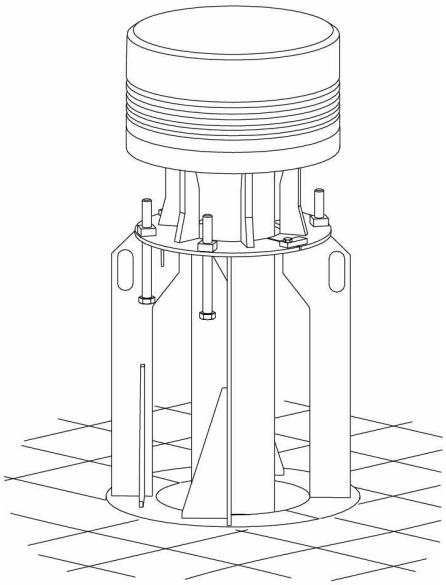
For overhauling of piston, see *description [2245-0100]*.

NOTICE It is recommended to replace all the piston rings whenever a piston is removed from the engine.

If however, the piston has been in service only for a short period of time (<200 hours) the piston rings may be re-used.

Before the removal of ring(s) from the piston, check the minimum free spread of the piston ring(s).

If it is below the mentioned limit, then the piston ring(s) must be replaced. See data.



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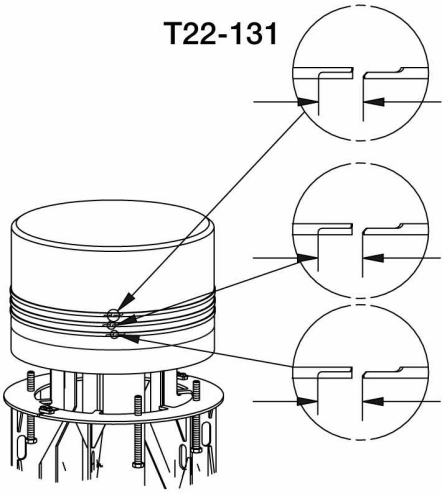
14. Free spread

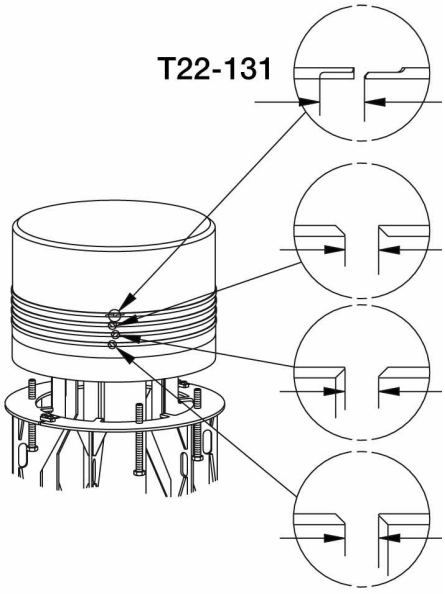
Before dismantling the piston rings, measure the free spread value of the piston rings, see *data*. Measured values should be noted in cylinder condition report.

For dismantling the piston rings, see *overhaul procedure*.

NOTICE Some pistons are equipped with four piston ring groves, but only three piston rings are provided.

In these cases only the three uppermost grooves are to be used.





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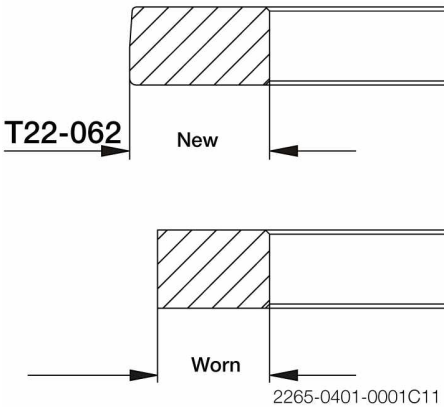
15. Radial ring width

Measure the radial width of the rings. Maximum permissible radial wear is 0.5% of nominal engine bore.

Note down the results in cylinder condition report for later references. See *description [2245-0100]*.

NOTICE This wear criteria ONLY applies to piston rings WITHOUT gas tight locks, POP-openings, CL-grooves or Cermet coating.



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16. Ring grooves

Clean the ring grooves and check them for burn marks or other deformation.

Measure the ring grooves with a caliper gauge, see *data*.

Clearance in piston ring grooves:

- The maximum vertical height in a worn ring groove must **not** exceed the value stated in *data*. The groove is also worn out if there is no chromium layer.

- If the ring grooves are worn out, the piston crown must be reconditioned, contact MAN Energy Solutions for advice.

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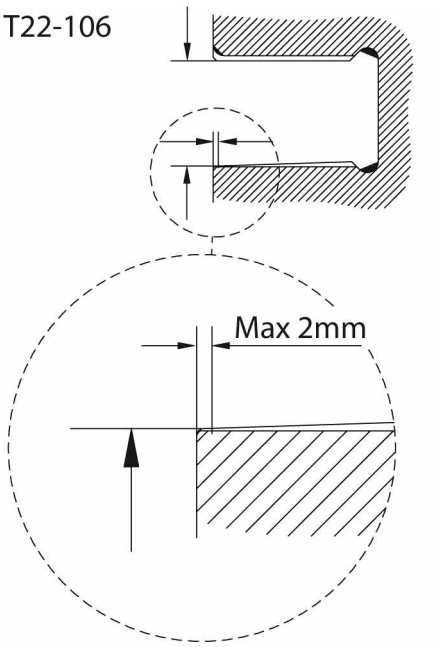

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17. Piston crown top

Clean the piston crown and check the burn-away by means of the template.

For maximum permissible burn-away value, see *data*.

Check the burn-away on the whole circumference of the piston crown top.

If the burn-away exceeds the values given in *data*, contact MAN Energy Solutions for advice.

Note down the results for later reference.

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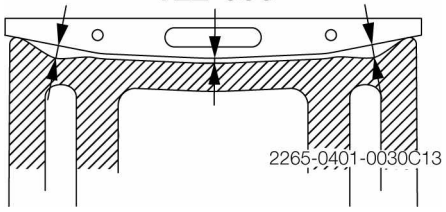

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Dismantling

Warnings and key information

⚠ DANGER

Risk of high velocity ejection of tool parts

Serious injuries or death due to misuse of/use of defective hydraulic tools

- Before using hydraulic tools, ensure that they are in good condition and properly maintained.
- Ensure proper understanding on the use of hydraulic tools before work is started.

⇨ See *work card [7665-0101]* for further information.

⚠ WARNING

Working inside crankcase

Risk of serious injury or death due to slips, falls and low overhead clearances.

- Observe safety precautions when working in the crankcase. *See description [0545-0100].*
- Use platform boards while working inside the crankcase. *See work card [7665-0601].*

⚠ WARNING

Heavy load

Risk of injuries or death due to falling object

- Safe working load (SWL): Always use lifting gear with sufficient SWL.
- Only use maintained and undamaged lifting gear.
- Stay clear of loads during lifting.

⚠ WARNING

Crushing hazard

Risk of serious injury or death.

- Keep clear of the piston during dismantling and mounting.
- Keep clear of the piston during the lifting procedure, use rope to guide the piston rod if needed.

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⚠ CAUTION

Crushing of Hands

Risk of serious injury

- Keep hands clear of support tool during lowering of the piston.
- Keep clear of the areas around and below the through hole of the gallery while the piston is being lowered onto the support tool.

⚠ CAUTION

Hot surfaces

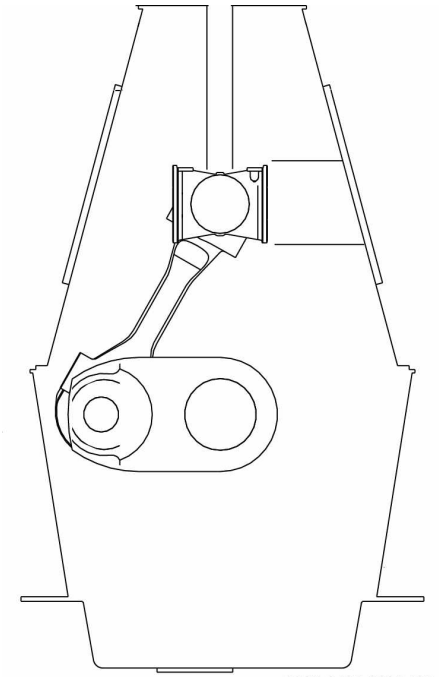
Risk of burns due to hot surfaces

- Wear proper protective gear during the procedure.

1. Access

Open the crankcase door to the cylinder concerned.

Turn the crosshead down far enough to give access to the piston rod stuffing box and the piston rod/crosshead connection.



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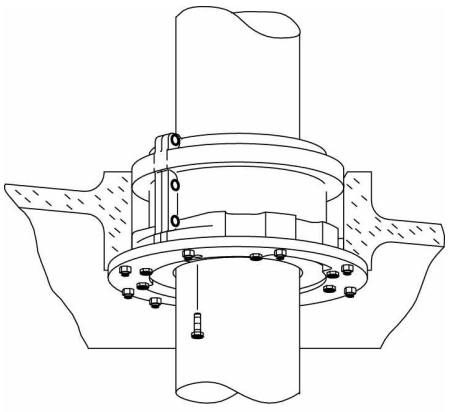
2. Stuffing box

NOTICE **Do not remove the outermost screws from the flange.**

Release the stuffing box by removing the innermost screws from the stuffing box flange.

On engine models where the drain pipe is connected directly to the stuffing box, disconnect the stuffing box drain pipe.



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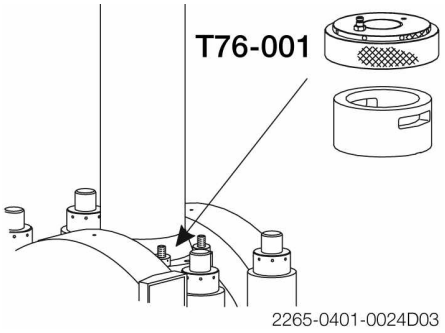
3. Loosen the piston rod-crosshead connection

DANGER Ensure proper use of hydraulic tools, for correct use, *see work card [7665-0101]*.

Loosen and remove the hydraulic nuts, see *data*.



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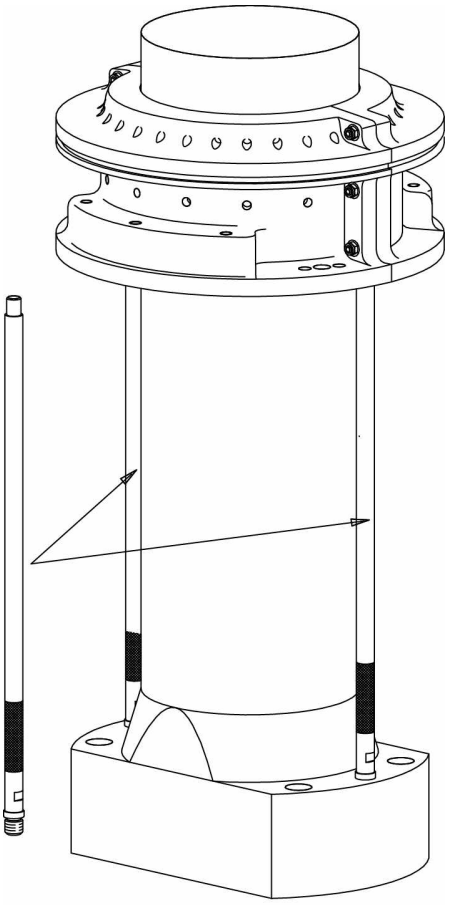
4. Stuffing box distance pieces

Mount the two distance pieces on the piston rod foot to protect the lower scraper ring and to guide the stuffing box.

INFO Design and length of distance pieces may vary.



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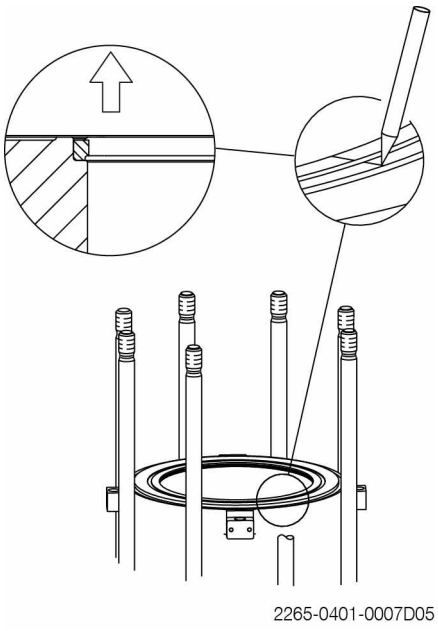
5. Cylinder cover

Remove the cylinder cover, see *work card [2265-0301]*.

Make a scratch mark in liner and piston cleaning ring to ensure correct remounting. Remove the piston cleaning ring.

Carefully remove any wear ridges at the top of the cylinder liner, see *work card [2265-0601]*.

If necessary, remove the aftmost access platform for the unit concerned. On some engine installations, this will be necessary to give room for the piston rod foot.



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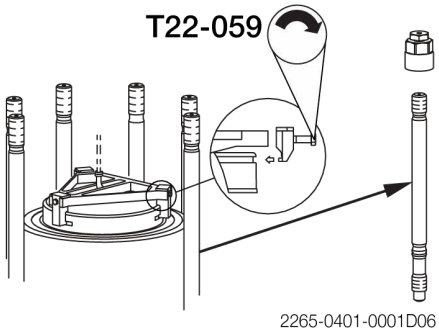
6. Piston lifting tool

Turn the piston to TDC. The top of the piston is now free of the cylinder liner.

NOTICE **Make sure to mount the lifting tool correctly, so that the claws of the lifting tool enter the lifting grooves of the piston crown. Also mount the engine room crane hook correctly onto the lifting tool dowel pin.**



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Clean the lifting groove of the piston crown and mount the lifting tool, see *data*.

If the engine isn't equipped with long distance pieces, remove one or two cylinder cover studs, using a stud setter.

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7. Piston lift

⚠ WARNING Always use lifting gear with sufficient safe working load (SWL), see data.

⚠ WARNING Keep clear of the piston during lift.

Lift the piston out of the cylinder liner and guide the piston rod foot through the stuffing box flange.

NOTICE The piston and the piston support, should not be placed on the gallery during engine operation.

If the engine is equipped with long distance pieces for the stuffing box, the piston rod foot can pass between two cylinder cover studs.

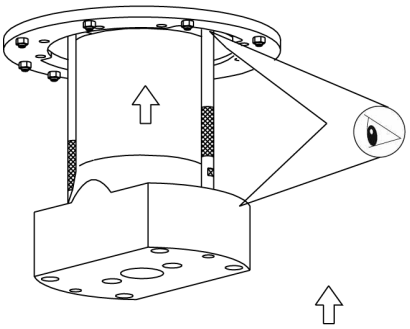
Place the two halves of the support around one of the openings in the platform.

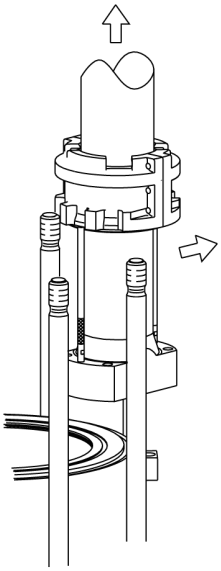
⚠ CAUTION Keep clear of the support tool and gallery openings during lowering of the piston.

Lower the piston rod foot and stuffing box through the opening in the platform.

Secure the two support halves with screws and lower the piston on the support.

Check that the piston is resting on the piston rod flange.





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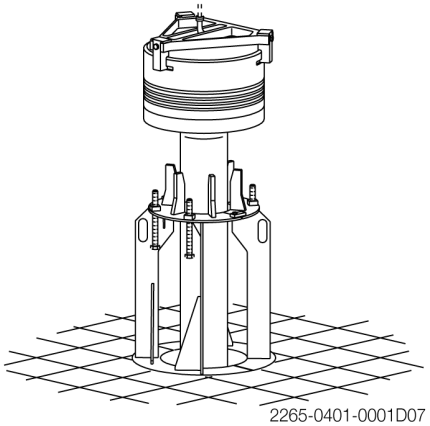

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8. Limited Lifting height

If the piston rod foot can not be lifted clear of the liner top with the standard lifting tool, contact MAN Energy Solutions for instructions for tilted lift.

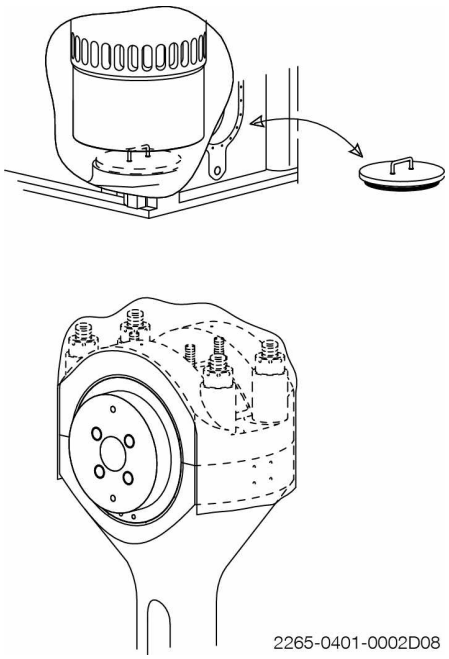
9. Protect the crosshead

Place a cover over the opening for the piston rod stuffing box in the bottom of the cylinder unit.

Turn the crosshead down far enough to permit mounting of the protective rubber cover on the crosshead bearing cap. The protective rubber cover is found on the 'Connecting rod and Crosshead' tool panel, see *plate [1470-0800]*.

The covers must remain in place to protect the crosshead bearing journal from impurities until the piston is remounted.

Clean, measure, and recondition the cylinder liner, see *work card [2265-0601]*.



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Overhaul

Warnings and key information

⚠ DANGER

Risk of high velocity ejection of tool parts

Serious injuries or death due to misuse of/use of defective hydraulic tools

- Before using hydraulic tools, ensure that they are in good condition and properly maintained.
- Ensure proper understanding on the use of hydraulic tools before work is started.

⇨ See *work card [7665-0101]* for further information.

⚠ WARNING

Heavy load

Risk of injuries or death due to falling object

- Safe working load (SWL): Always use lifting gear with sufficient SWL.
- Only use maintained and undamaged lifting gear.
- Stay clear of loads during lifting.

NOTICE

Risk for damage to pipes

Take care not to damage the pipes of the cooling insert when landing the piston crown on the piston rod.

1. Piston support

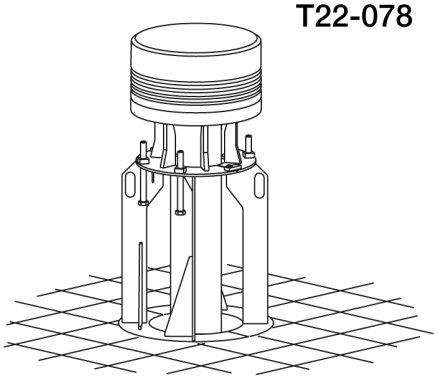
Place the piston in the support and remove the piston lifting tool, see *dismantling procedure*.

Clean the piston top and the piston rings.

Check the free ring gap and the burn-off on the piston top.

Remove the stuffing box, see *work card [2265-0501]*.

T22-078



2265-0401-0001O01

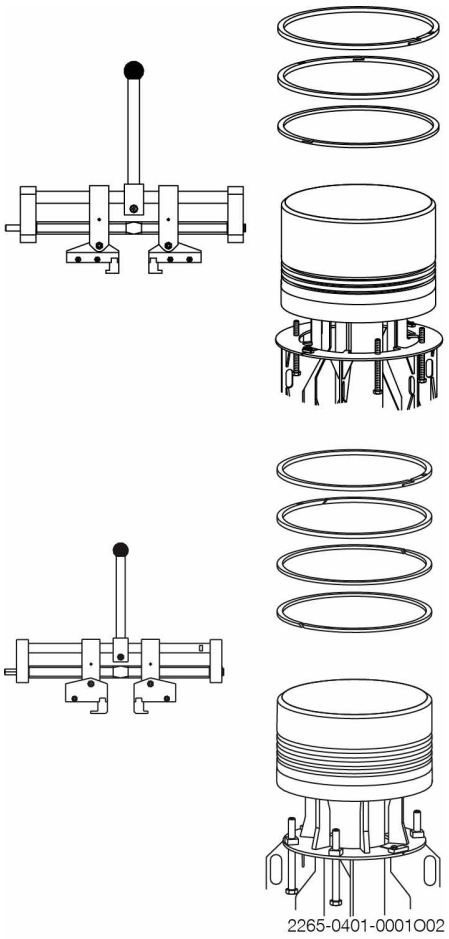
2. Piston ring dismantling

Remove the piston rings by means of the ring expanders. If the engine is equipped with two ring expanders, and four piston rings the short ring expander is for the uppermost (CPR) ring.

NOTICE Some pistons are equipped with four piston ring groves, but only three piston rings are provided. In these cases only the three uppermost grooves are to be used.

First remove the uppermost ring, then ring number two, three, and four if installed.

Clean and inspect the rings and the ring grooves, see *'Checking' procedure*.



3. Piston crown dismantling

⚠ WARNING Always use lifting gear with sufficient SWL, see data.

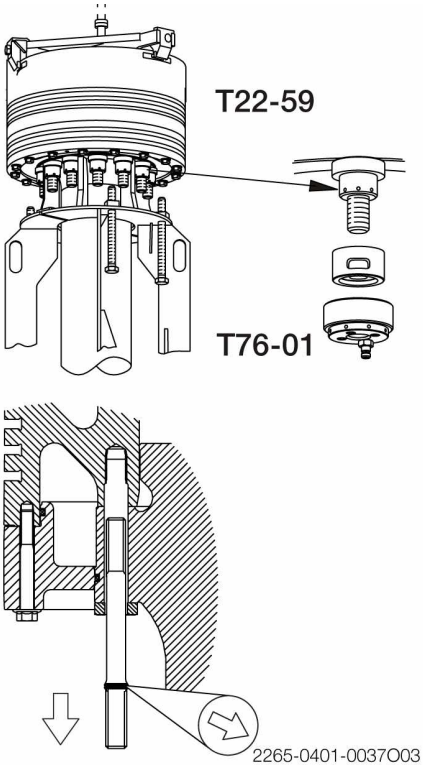
Mount the piston lifting tool on to the piston, see *data*.

⚠ DANGER Ensure proper use of hydraulic tools, for correct use, see work card [7665-0101].

Loosen and remove the hydraulic nuts between the rod and the piston crown, see *data*.

Lift the piston crown and skirt clear of the piston rod.

Dismount the piston crown studs & discard the O-rings.



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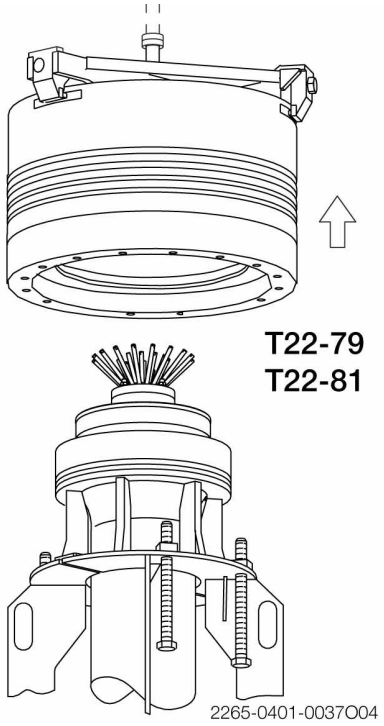
4. Lifting the piston crown

Lift the piston crown and skirt clear of the piston rod, see *data*.

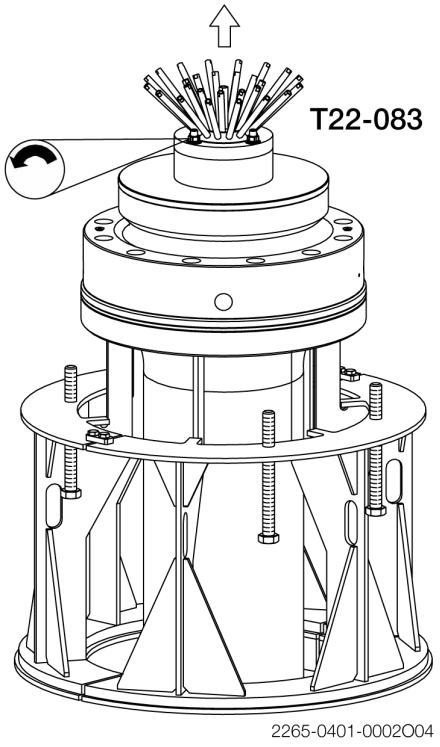


5. Cooling insert

Unscrew and remove the nuts for the cooling insert.

Mount eye-bolts on to the sides of the cooling insert and lift away, see *data*.

Clean and inspect the cooling insert.



6. Piston rod and cooling pipe

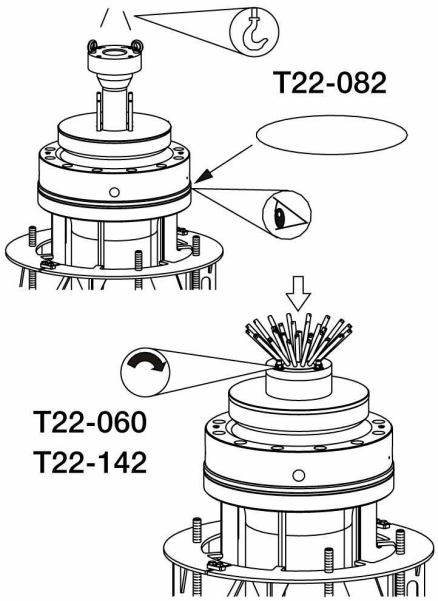
Screw on the eye bolts and lift out the cooling oil pipe.

Clean and inspect the cooling oil pipe and the piston rod, then reinsert the cooling oil pipe.

Remount the cooling insert and tighten the nuts as specified, see *data*.

Check that the surfaces of the O-ring groove are clean and smooth, see *data*.

Mount a new O-ring on the piston rod flange.



2265-0401-0002O05

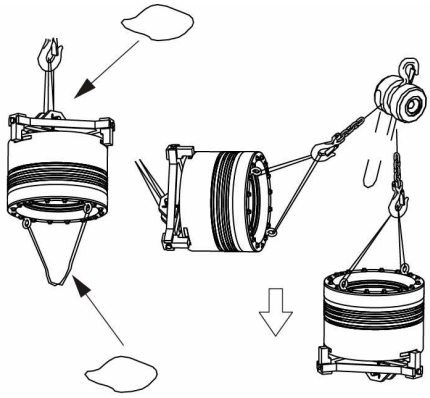
7. Piston crown turning

Unhook the crane from the piston lifting tool, and connect the lifting tool and the crane hook by means of a wire rope. Lift up the piston crown.

Mount two eye bolts in the piston skirt and a wire rope between the bolts as shown in the sketch.

Install a tackle in a suitable place with sufficient space below for the piston crown. Attach the tackle to the wire rope on the piston crown and carefully turn the piston crown upside down. Use both cranes if the engine room is equipped with two cranes.

Land the piston lifting tool and the piston crown on a sufficient support of wood pieces. Loosen the piston lifting tool and lift the piston crown clear of the tool.



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8. Piston crown cleaning

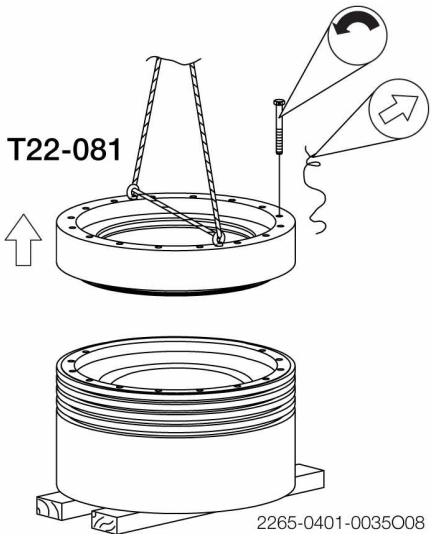
Place the piston crown with skirt on a wooden support as shown.

Remove the locking wire and the screws in the skirt. If necessary, use two dismantling screws to pull the skirt out of the piston crown. Mount two eye bolts in the skirt. Lift the skirt and land it on a couple of planks.

Discard the sealing ring on the piston skirt.

Thoroughly clean and inspect all parts of the crown and skirt. If coke deposits are found in the cooling spaces of the piston crown, they should be washed clean with Carbon Remover or a similar cleaning fluid. When all coke deposits have been dissolved, clean and inspect the piston crown again.

NOTICE **Coke deposits reduce heat transfer from the piston crown to the cooling oil. The deposits must be removed as a routine procedure when a piston is overhauled.**



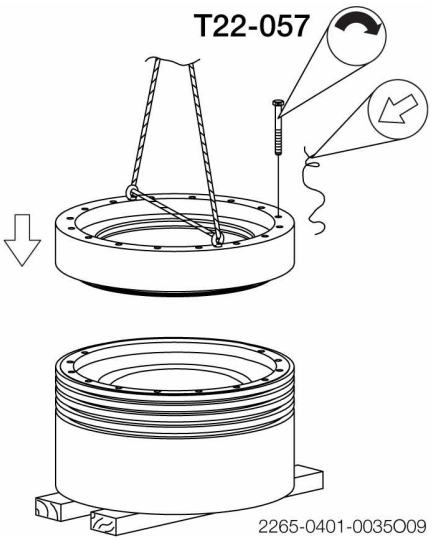
9. Piston crown assembly

Mount a new O-ring on the piston skirt. Check that the surfaces of the O-ring groove are clean and smooth. Coat the ring with lubricating oil before mounting.

Mount the piston skirt on the piston crown.

Tighten the screws to specified torque, see *data*.

Lock the screws with locking wire, see *work card [7665-0501]*.



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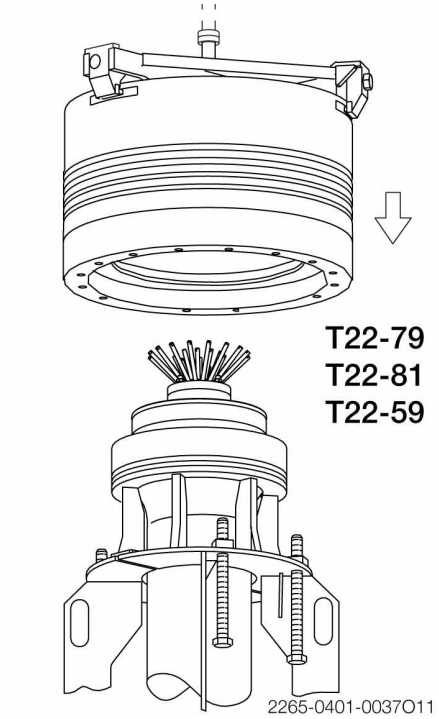
10. Landing of piston crown

Lubricate the O-ring on the piston rod flange with lubricating oil.

NOTICE Take care not to damage the pipes of the cooling insert when landing the piston crown on the piston rod.

Land the overhauled piston crown and skirt on the piston rod, see *data*.



11. Piston crown and skirt

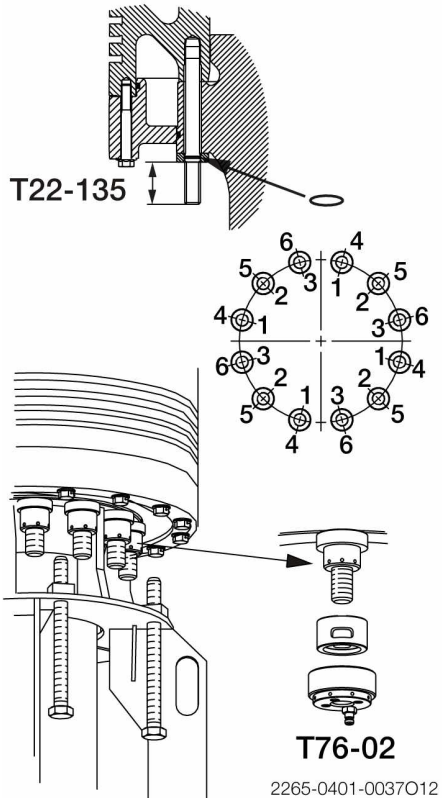
Screw the piston crown stud down to the contact, then unscrew the stud approx. 45°, and check the distance.

Check measurement before tightening of stud, see *data*.

⚠ DANGER Ensure proper use of hydraulic tools, for correct use, see work card [7665-0101].

Mount and tighten the hydraulic nuts on the piston crown studs.

When tightening the hydraulic nuts follow the tightening sequence. All the nuts must be tightened twice to full tightening pressure, see *data*.



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12. Sealing ring test

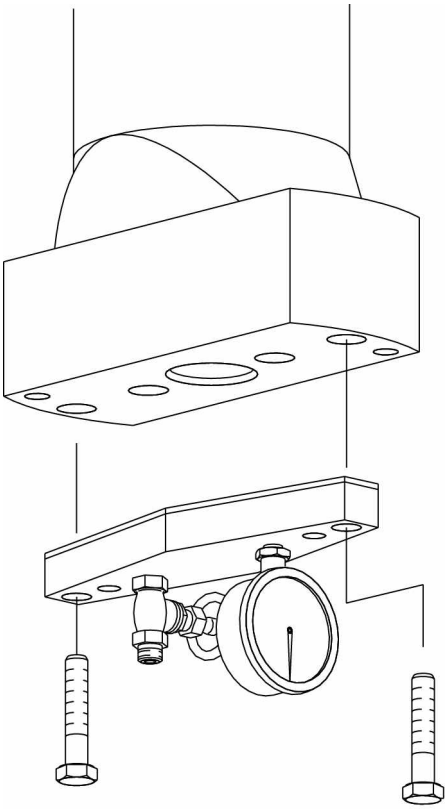
Mount the pressure-testing tool on the piston rod foot.

NOTICE If there is insufficient clearance or accessibility to mount the pressure testing tool, the piston should be turned before carrying out the sealing ring test. See "Piston turning" in work card [2265-0401].

Connect compressed air to the testing tool and fill the piston with compressed air to 4-5 bar.

Close the valve on the testing tool and remove the air connection.

The pressure must be maintained for a minimum of 30 minutes.



2265-0401-0001O09

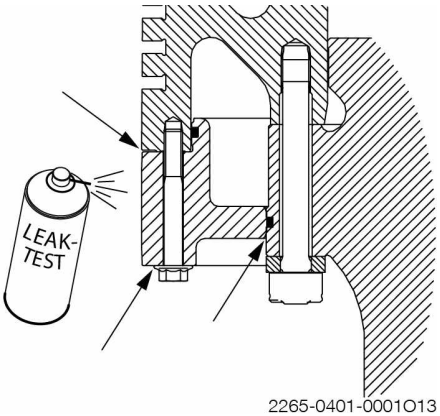
13. Leak test

Spray a little soap water on to the surface joints between piston rod/ crown/skirt and around the bolt heads to detect leaks.

Dry off all soap water.

⚠ CAUTION Large volume of compressed air - When releasing air pressure from the piston rod, open the valve on the testing tool carefully.

Release the pressure from the piston rod.



2265-0401-0001O13

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14. Piston completion

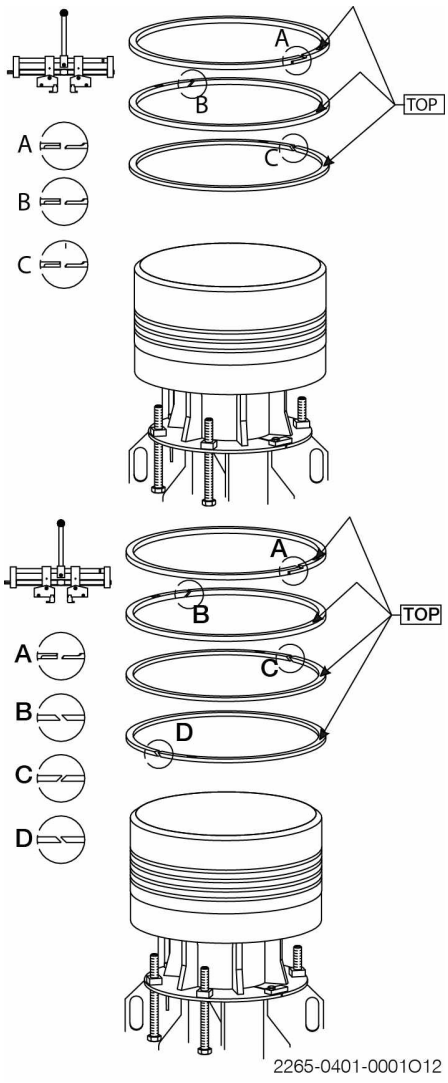
When mounting the piston rings, use the ring expanders to prevent unintended deformation of the rings.

NOTICE **Some pistons are equipped with four piston ring grooves, but only three piston rings are provided. In these cases only the three uppermost grooves are to be used.**

Mount the new piston rings. If equipped with CPR-CL alternately right-hand and left-hand cuts, but always with the ring gaps staggered 180° and with the TOP mark upwards.

Do not expand the rings more than necessary. The uppermost ring (CPR-POP) must be mounted with the short ring expander, if the engine is equipped with four piston rings.

Mount the piston rod stuffing box, see *work card [2265-0501]*.



2265-0401-0001O12

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Turning

If necessary to turn the piston and rod upside down for overhaul or transportation, do as follows:

1. Piston turning

Lift the piston with the normal lifting tool.

Lower the piston rod foot until it is close to the platform.

Land the foot on a wooden block.

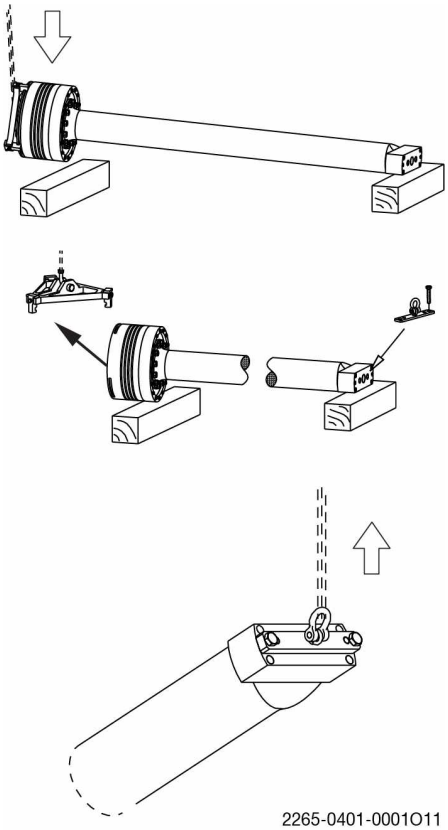
Lower the piston crown to the platform and land it on a wooden block in such a way that it is possible to remove the lifting tool.

Attach the lifting bracket to the bottom of the piston rod foot.

Hook the crane on to the lifting bracket.

Lift the piston rod foot clear of the wooden block.

Keep lifting until the piston rod is in a vertical position.



2265-0401-0001O11

NOTICE During the lift, follow with the crane to keep the crane positioned vertically above the lifting point. The stuffing box must be removed. See work card [2265-0501].

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Mounting

Warnings and key information

DANGER

Risk of high velocity ejection of tool parts

Serious injuries or death due to misuse of/use of defective hydraulic tools

- Before using hydraulic tools, ensure that they are in good condition and properly maintained.
- Ensure proper understanding on the use of hydraulic tools before work is started.

⇨ See *work card [7665-0101]* for further information.

WARNING

Working inside crankcase

Risk of serious injury or death due to slips, falls and low overhead clearances.

- Observe safety precautions when working in the crankcase. *See description [0545-0100].*
- Use platform boards while working inside the crankcase. *See work card [7665-0601].*

WARNING

Heavy load

Risk of injuries or death due to falling object

- Safe working load (SWL): Always use lifting gear with sufficient SWL.
- Only use maintained and undamaged lifting gear.
- Stay clear of loads during lifting.

WARNING

Crushing hazard

Risk of serious injury or death.

- Keep clear of the piston during dismantling and mounting.
- Keep clear of the piston during the lifting procedure, use rope to guide the piston rod if needed.

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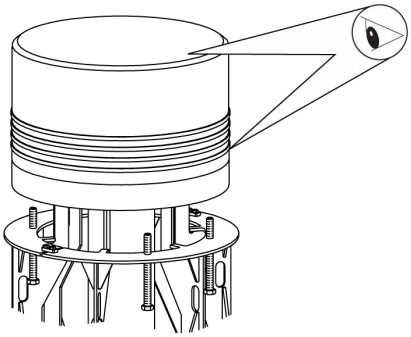
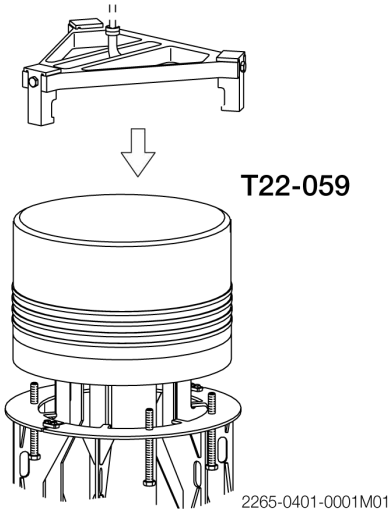
1. Preparation of piston

If not already done, check the piston rings and piston crown, see '*Checking' procedure*.

Mount the lifting tool on the piston crown, see *data*.

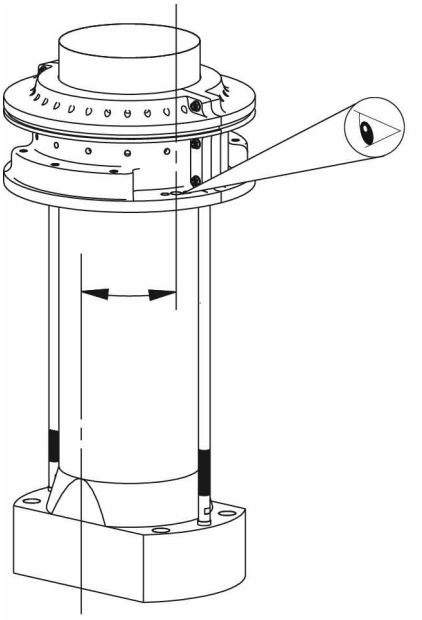




2265-0401-0001M01

2. Stuffing box position

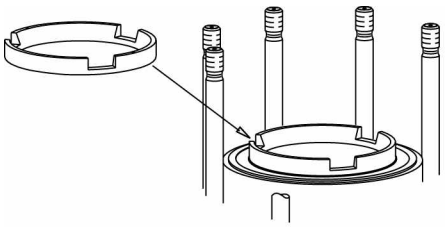
Ensure that the stuffing box is correctly positioned over the distance pieces mounted on the piston rod foot. Both the holes for the flange and the drain hole for the drain pipe must be positioned correctly.



2265-0401-0001M02

3. Mount the guide ring

Mount the guide ring in the top of the cylinder liner. The cut outs for the lifting tool must be turned to fit the piston lifting tool.

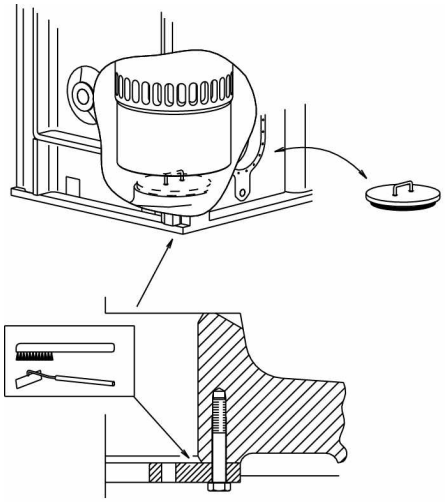


2265-0401-0001M03

4. Stuffing box cover

Remove the cover from the piston rod stuffing box opening in the bottom of the cylinder unit.

Clean the stuffing box flange.



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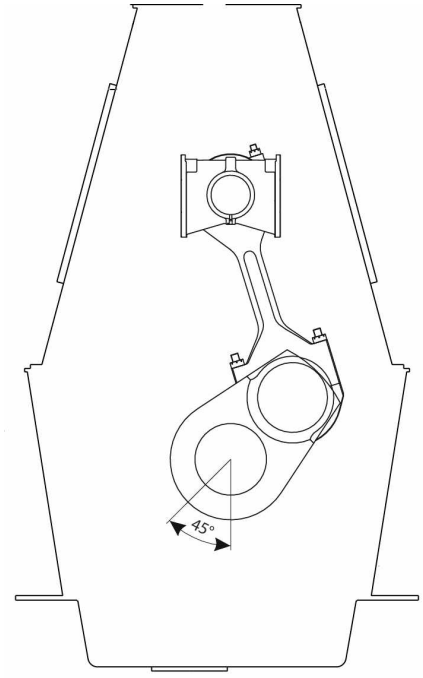
5. Crosshead position

Turn the crosshead to a position 45° from TDC (crank web pointing towards exhaust side).



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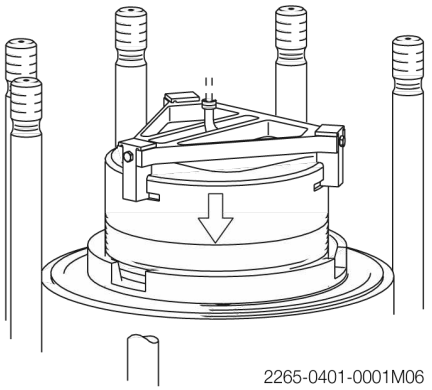
6. Mounting of piston

Coat the O-rings of the stuffing box and the piston rod with oil. Coat the piston rings and cylinder liner with cylinder lubricating oil.

Lower the piston into the cylinder liner, while guiding the piston rod foot through the cut-out in the stuffing box flange – until the piston rings are inside the liner.

T22-078



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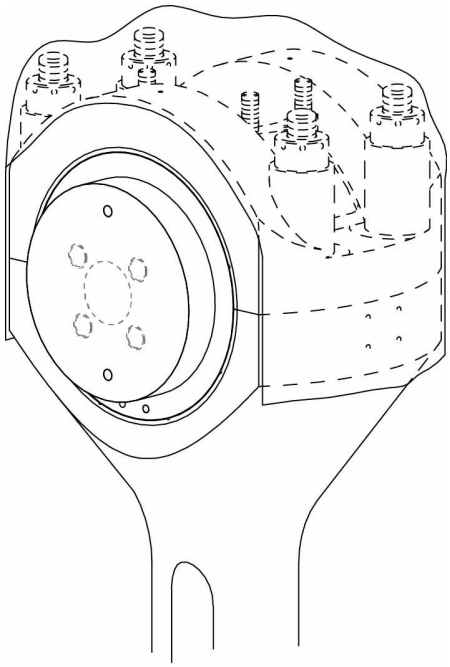
7. Remove the protective rubber cover

Remove the protective rubber cover from the crosshead.



2265-0401-0013M07

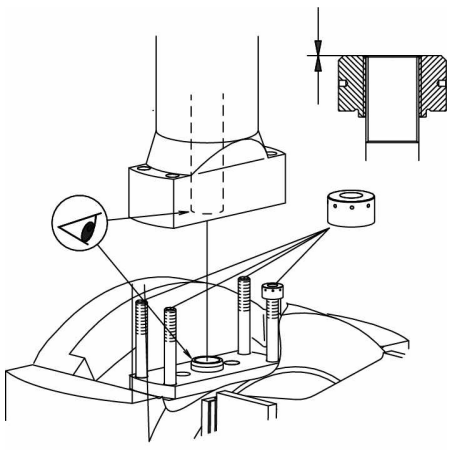
8. Crosshead alignment

Turn the crosshead almost to TDC.

If necessary, mount the hydraulic nuts on the studs and screw down until the nuts are flush with the top of the studs.

Turn the crosshead upwards until the piston rod foot lands on the nuts, thereby turning the crosshead until the face is parallel to the piston rod foot.

Lower the crosshead just enough to enable removal of the nuts. Turn the crosshead upwards until the piston rod lands on the crosshead. When



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mounting the piston on the crosshead, make sure that the piston rod foot does not damage the threads of the studs. Ensure that the guide ring in the crosshead fits correctly in the center hole of the piston rod.

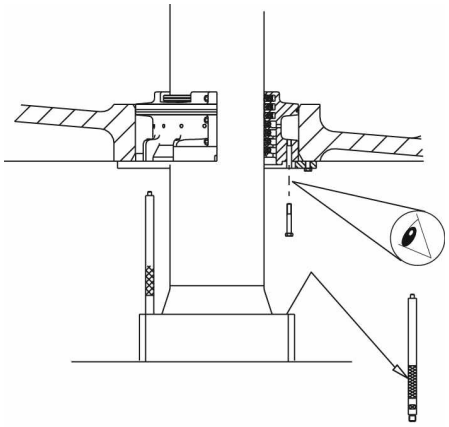
Unscrew the lifting tool and remove the lifting tool and the guide ring for piston rings.

9. Stuffing box

Turn down and land the stuffing box on the stuffing box flange. Check that the holes in the stuffing box and stuffing box flange are correctly centred.

Tighten the piston rod stuffing box by means of the screws through the inner holes in the stuffing box flange. For data and more information, see *work card [2265-0501]*.

On engine models where the drain pipe is connected directly to the stuffing box, mount the stuffing box drain pipe.



2265-0401-0001M09

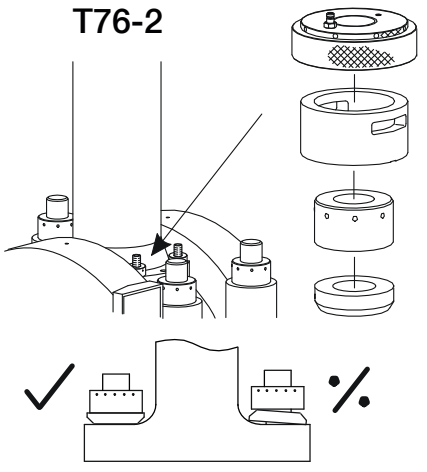
Remove the distance pieces from the piston rod foot.

10. Tightening of the piston rod-crosshead connection

⚠ DANGER Ensure proper use of hydraulic tools, for correct use, see work card [7665-0101].

⚠ CAUTION Risk of broken studs - Note that washers must be mounted between the nuts and the piston rod foot. The washers are designed with a chamfer on one side. Make sure to mount the washers with the chamfer on the lower side (facing towards the piston rod foot).

Mount and tighten the piston rod nuts with the hydraulic jacks, see *data*.



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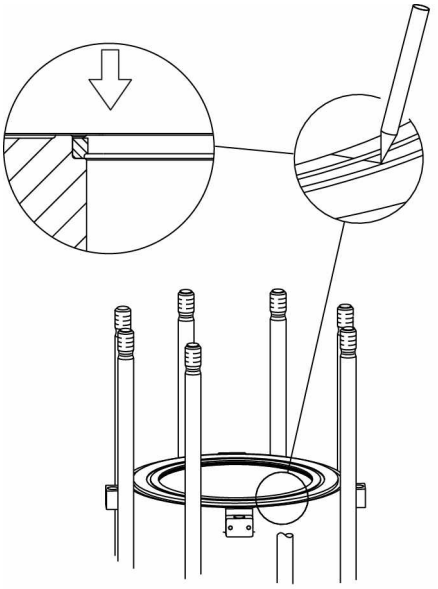
11. Piston cleaning ring

If the PC-ring is damaged (broken or cracked), it must be replaced by another ring, see *work card [2265-0601]*.

Mount the piston cleaning ring in accordance with the scratch mark.



2265-0401-0007M11

12. Mount cylinder cover

Mount the cylinder cover, see *work card [2265-0301]*.

13. Running-in

Smear the piston rod with molybdenum disulphide, and turn the crankshaft a couple of revolutions.

At the first opportunity, start the engine and keep it running for about 15 minutes at a speed corresponding to “Dead Slow” Ahead.

Then stop the engine and inspect the piston rod and stuffing box.

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