WÄRTSILÄ

SULZER **RLA/RLB76**

Maintenance Manual

"Marine"

Vessel:

Type:

Engine No.:

Book No.:

Wärtsilä Switzerland Ltd
PO Box 414
CH-8401 Winterthur
Switzerland

24hrs Support: +41 52 262 80 10
technicalsupport.chts@wartsila.com

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Before the operator intends to use the engine or before maintenance work is undertaken, the Operating Instructions or the Maintenance Manual respectively is to be read carefully.

To ensure the best efficiency, reliability and lifetime of the engine and its components, only original spare parts should be used.
It is to be ensured as well that all equipment and tools for maintenance are in good condition.

The extent of any supplies and services is determined exclusively by the relevant supply contract.

The data, instructions and graphical illustrations etc. in this manual are based on drawings made by **Wärtsilä Switzerland Ltd** and correspond to the actual standard at the time of printing (year of printing is indicated on title page).
Those specifications and recommendations of the classification societies which are essential for the design have been considered therein. It must be recognized that such data, instructions and graphical illustrations may be subject to changes due to further development, widened experience or any other reason.

This manual is primarily intended for use by the engine operating and maintenance personnel. It must be ensured that it will always be at the disposal of such personnel for the operation of the engines and/or for the required maintenance work.

This manual has been prepared on the assumption that operation and maintenance of the engines concerned will always be carried out by qualified personnel having the special knowledge, training and qualifications needed to handle in a workman-like manner diesel engines of the corresponding size, the associated auxiliary equipment, as well as fuel and other operating media.

Therefore, generally applicable rules, which may also concern such items as protection against danger, are specified in this manual in exceptional cases only.
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Wärtsilä Switzerland Ltd
Winterthur
Switzerland

Information

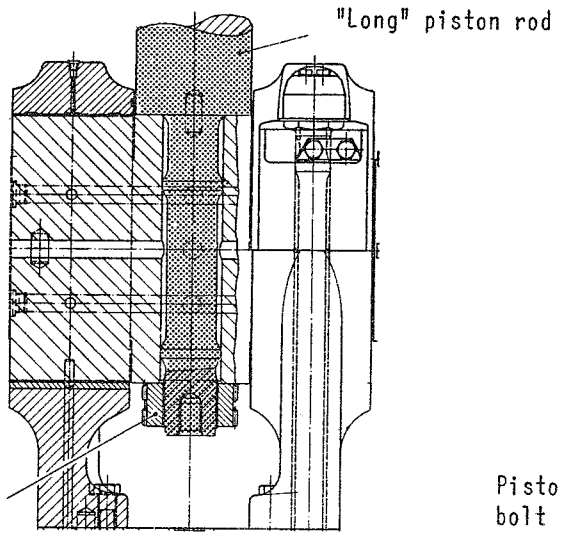
The engine can be equipped with "long" or "short" piston rods.

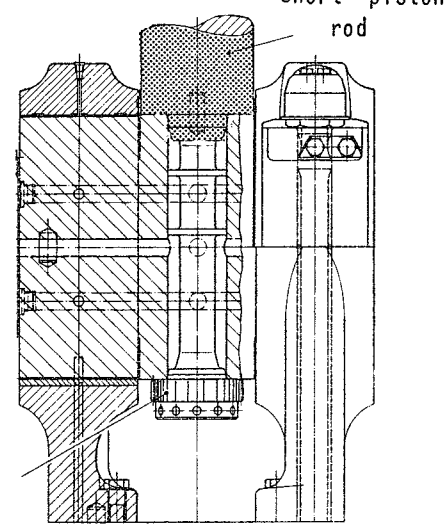
With the long version, the rod of the piston is led through the crosshead from above and secured at the bottom with a suitable nut.

In the case of short piston rods, connection is effected by means of a strong bolt, which is inserted at the bottom so that it passes through the crosshead and into the piston rod.

To rule of the possibility of mistakes, the data relevant to engines equipped with short piston rods are printed on green-coloured paper.

Customers are requested to remove the pages of the manual that do not apply to their particular engines.





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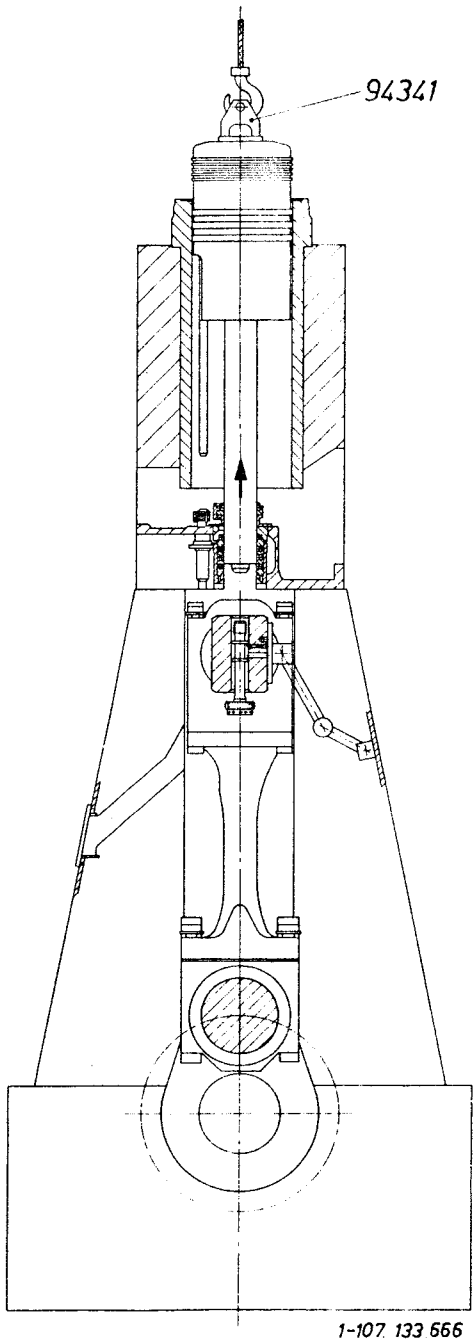
Working Piston

Removal of a Working Piston
(Valid for piston with "short" piston rod)

Tools:

1 Piston ring tensioning device	94338
1 Wooden bracket	94339
1 Suspension bracket	94341
1 Thread tap	94348
1 Device for loosening the piston rod bolt	94356
1 Extracting-screw for stand pipes	94381
2 Wooden bases	

Piston removal



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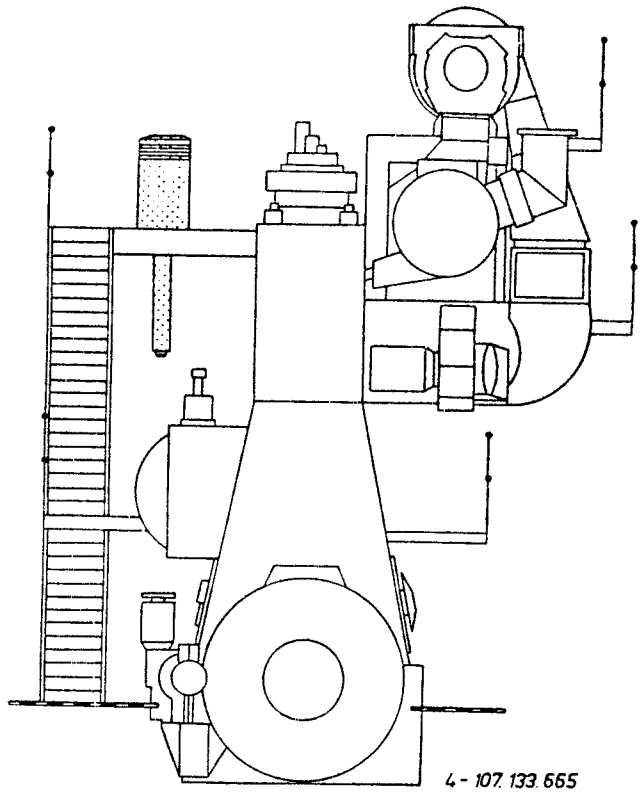
Piston Placing



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Before removing a piston, the following preparations have to be made:

- Drain the water from the cylinder jacket in question and remove the cylinder cover (see 271/1 and /2).
- Turn piston to B.D.C., loosen and piston rod bolt (see 340/3a)
- Grind away the wear ridge at the top of the cylinder liner running face (see 214/4).
- Turn piston to T.D.C. Remove combustion deposits from the threaded holes of the piston crown, using the thread tap 94348.
- Screw the suspension device 94341 into the piston crown and connect it to the crane. (Check once more whether the piston rod nut has in fact been removed!).

Procedure for Removal

- Using the crane, pull the piston out of the cylinder liner.
- In the event that the piston does not have to be dismantled but only cleaned, it can be placed on a wooden base on a support of the top platform.

(Depending on the number of cylinders, several platform supports have been so designed as to allow the piston to be landed after removal of the floor plate).

- Remove the piston rings by means of the tensioning device 94338 and clean the outside of the piston carefully (do not use any tools that might damage the surface!).
- Measure the piston ring groove depths and determine the axial clearance of the piston rings (see Table of Clearances 012/7). (If a piston has to be turned over, the piston cooling running pipes are to be fixed with the fixing device 94339 to protect them against bending).
- Remove the piston cooling stand pipes, using the tool 94381 (see sheet 361/2). The glands of the piston rod and the piston cooling pipes must also be removed later for cleaning and examination (see Group 231).

  Attention! A little water normally runs out during removal of the stand pipes. Care must be taken that this does not get into the oil.
- Maintenance work on the cylinder liner can now be carried out as well (measuring the bore, rounding off of scavenging and exhaust ports, according to the instructions given under Groups 214 and 215).
- Should it be necessary to dismantle the piston, follow the instructions on sheets 340/4 and 4a.

Working Piston

Fitting a Working Piston (Valid for piston with short Piston Rod)

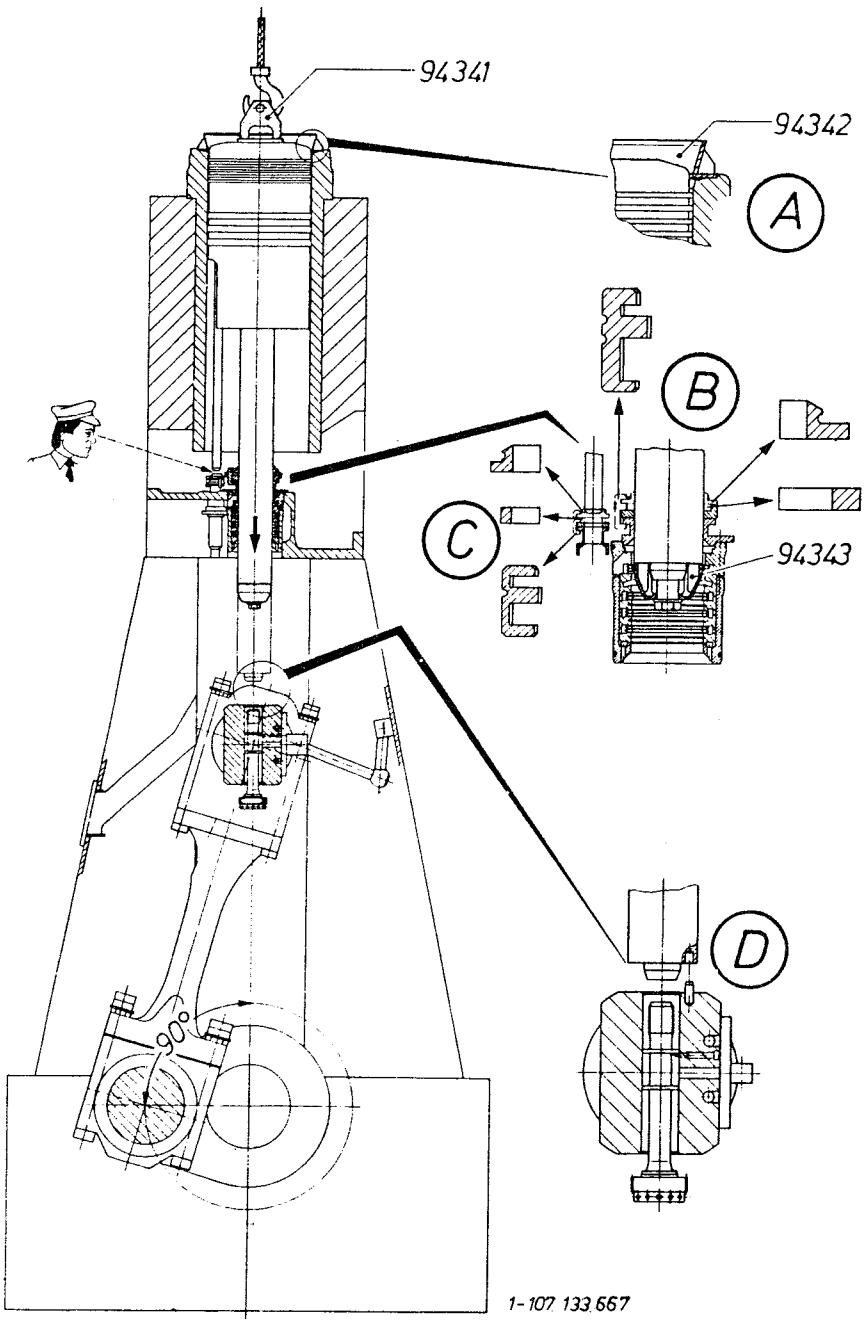
Tools:

1 Bar Ø 14,5	94115
1 Piston ring tensioner	94338
1 Suspension bracket	94341
1 Inserting cone	94342
1 Guide cone	94343
1 Device for lifting de piston rod screw	94344
1 Assorted spanners	

Preparations

- Fit the piston rings (see sheet 344/1).
- Liberally lubricate piston rings, piston skirt, piston rod and running face of cylinder liner.
- As a check, turn the crank of the cylinder lubricator until oil flows from all lubricating points in the cylinder liner.
- Swin open the cover for the gland space (on fuel pump side).

- The 3-piece scraper ring as well as the 3-piece sealing ring with locking piece and garter springs for the upper gland group of the piston rod (marked with arrows on Fig. 'B') must not yet be fitted. The same also applies to the gland groups of the piston cooling pipes (marked with arrows on Fig. 'C').



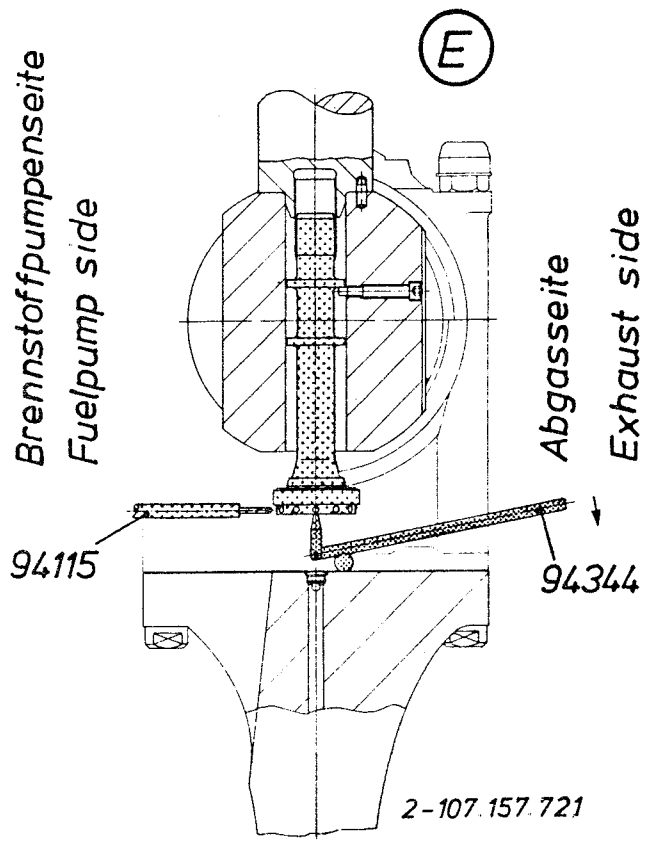
- Remove the stand pipes of the piston cooling chest, if this was not already done earlier (see sheet 361/1).
- Clamp the guide cone 94343 onto the projecting tip of the piston rod. (No axial clearance must exist between piston rod and cone!) Under no circumstances may there be any burrs or dents on the tapered surface of the cone, as such would damage the edges of the piston rod gland scraper rings!
- The centering projection on the lower end of the piston rod must be undamaged and well oiled.
- Check the mating faces of the piston rod and crosshead pin. They must be clean undamaged and free from burrs.
- Turn the crank of the cylinder in question to about 90° on the fuel pump side.
- Place the inserting cone 94342 on the cylinder liner (Fig. 'A'). Its bore must also be absolutely free from burrs or similar roughness, be absolutely clean and well oiled.
- The female thread in the lower end of the piston rod must be coated slightly with MOLYKOTE paste.

Fitting a Working Piston

After the preparations described on sheet 340/2 have been carried out, proceed with the fitting of the piston as follows:

- Guide the piston suspended on the crane, over the cylinder liner center and lower it slowly into it. Observe whether the guide cone 94343 easily slides into the piston rod gland.
- When the piston has been lowered to the point where the lowest piston ring is at the level of the inserting cone 94342, turn the piston rings so that with reference to the engine axis they are staggered at 180^0.
- Lower the piston slowly further until its running tubes are just above the piston cooling pipe glands. One person has to watch this fitting phase and direct another person on top of the engine, which way the piston must be turned so that the running tubes slide into the glands without touching.

  Attention! The turning of the piston must be done from above on the suspension device. Under no circumstances may the running pipes be used for this purpose.
- Now lower the piston further until the guide cone can be removed from the end of the piston rod.
- Finally lower the piston until the projecting tip enters and the piston rod rests on the crosshead pin, making sure that the centering pin on the crosshead pin correctly enters the bore in the piston rod end.
- Slightly ease the tension on the suspension rope!
- Coat the thread and shoulder of the piston rod screw slightly with MOLYKOTE paste. Place the lifting device 94344 beneath the piston rod screw and lift same up to such an extent that it can be screwed into the piston rod. Tighten the screw manually by means of the round bar 94115 (see Fig. "E").
- Crank the piston into T.D.C., remove suspension device and for the tightening of the piston rod screw crank the piston to B.D.C. (Follow instructions on sheet 340/4).
- Fit the stand pipes into the piston cooling chest and secure them (sheet 360/2).
- Complete assembly of glands to piston rods and piston cooling pipes.
- Remove all gear and tools from the engine and fit the cylinder cover.



Working Piston

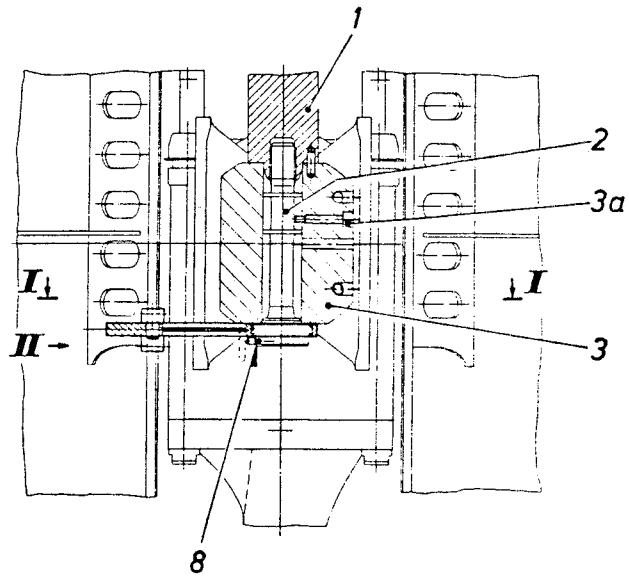
Loosening and Tightening of Piston Rod Screw (Valid for Piston with short Piston Rod)

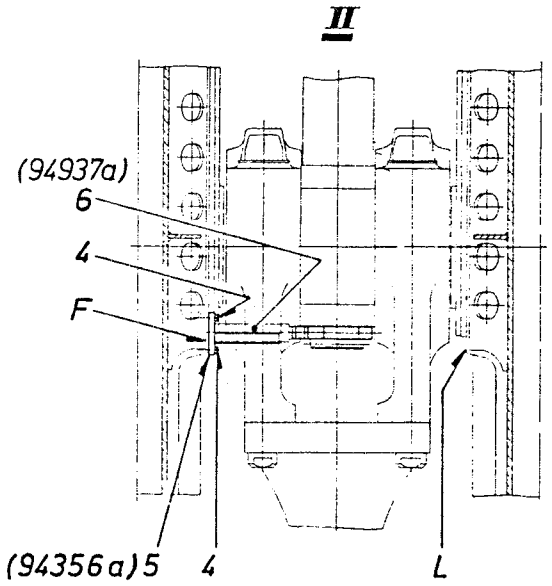
Tools:

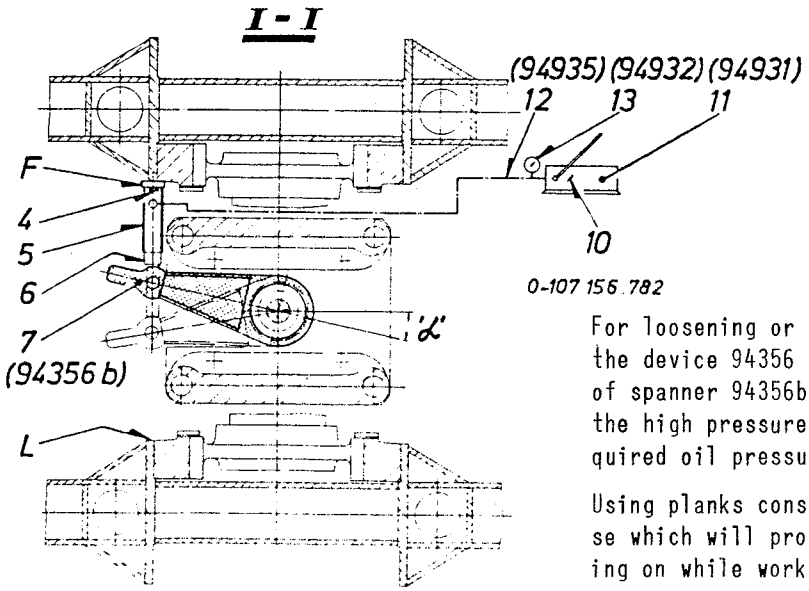
1	Tightening device (complete)	94356
1	High pressure oil pump	94931
1	Pressure gauge	94332
1	High pressure hose	94935
1	Hydraulic jack	94937a
1	Feeler gauge	94122

Key to Illustrations

1	Piston rod	10	Stop valve on pump
2	Piston rod screw	11	Hydr. HP. Oil Pump
3	Crosshead pin	12	High pressure hose
3a	Holding screw in crosshead pin	13	Pressure gauge
4	Screws 94356c	L	Position of holder 5 for loosening
5	Holder 94356a for jack	F	Position of holder 5 for tightening
6	Hydraulic jack		
7	Spec. spanner 94356b		
8	Holding pin		







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The illustrations show the tightening device when tightening the piston rod screw 2. For the loosening the jack holder 5 has to be fitted to the opposite side at 'L' and the jack has to press on the other side of the spanner 7.

For loosening or tightening of the piston rod screw 2 the device 94356 has to be used, which consists mainly of spanner 94356b, jack 94937a, Jack holder 94356c and the high pressure oil pump with hose providing the required oil pressure.

Using planks construct a platform inside the crank case which will provide the required firm base for standing on while working.

With the working piston at B.D.C. screw the jack holder 5 on the corresponding longitudinal frame center piece.

Procedure for Loosening

- Remove screws and locking segment for securing piston rod screw 2.
- Connect hydraulic jack 6 with high pressure hose to pump 11, place jack into holder 5 (jack piston to be pushed back into initial position).
- Fit spanner 7 onto screw 2 in such a way that it is closest possible to the piston of jack 6. Clamp the spanner in this position with the spanner holder 8.
- Operate the pump 11 and using the piston of jack 6 turn the spanner 7 with screw 2 until the same is loose. (It may be necessary in between to release the pressure, push back the jack piston and reset the spanner in order to loosen the screw 2 sufficiently until it can be unscrewed by hand).

  Never use the full stroke of the jack piston as this would shorten the life of the tool.

Procedure for Tightening

- Clean inside threads at the piston rod end as well as the contact surface of the screw and coat them with MOLYKOTE PASTE G.
- Fit screw 2 into the piston rod until metal-to-metal contact is established and tighten with spanner 7, giving it a strong jerk (check with the feeler gauge 94122 that the screw is actually seated.
- Mark the position of the toothed screw head relative to the crosshead with a felt tip pen or similar.
- Fit holder 5 on the left of screw 2 and place the jack 6 - which is connected by the HP hose to the HP-pump- into the holder.
- Fit the spanner 7 onto screw 2 in such a way that it is closest possible to the piston of jack 6, and screw spanner holder 8 onto the piston rod.
- Operate pump actuating the hydr. jack on the spanner until the piston rod screw 2 has turned by the following values:

  RL76: $5\frac{1}{2}$ Teeth (= angle α 29^0)

  RL90: 7 Teeth (= angle α 33^0)

  (Tightening value is engraved on the head of the piston rod screw)
- Remove tightening device and secure the screw 2 with the toothed locking segment and two screws. The screws themselves are to be locked with locking plates.
- Remove all gear and tools from the engine and store them. The screws 4 are to screwed into the threaded holes provided for this purpose in the base part of the jack holder 5. This is to prevent their getting lost.

Loosening and tightening with Spanner and Sledge Hammer

In the event that the hydraulic device is unavailable, the hydraulic jack can be substituted by a sledge hammer, with which the spanner 7 is struck.
The preparations concernin cleaning, application of MOLYKOTE paste G and the tightening angle 'α' remain exactly the same.

Working Piston

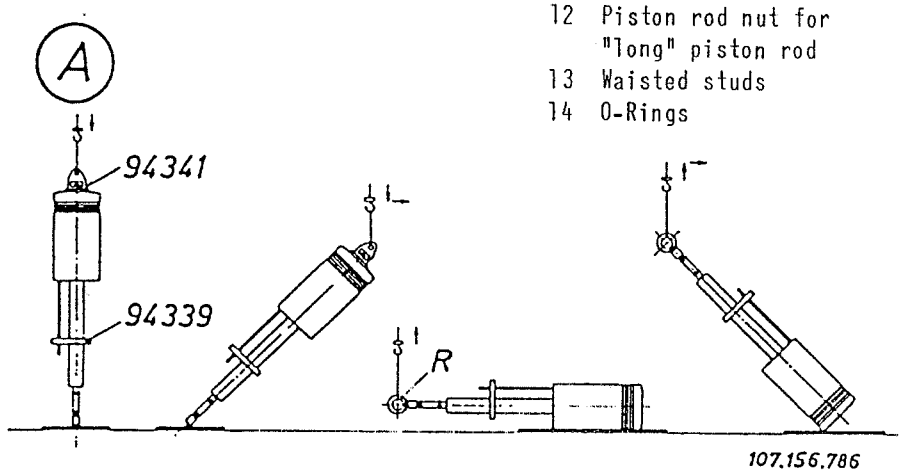
Dismantling and Assembling
(Valid for Piston with "short" Piston rod)

Tools:

1 Device with special spanner	94332
1 Fixing clamp for running pipes	94339
1 Suspension device	94341
1 Ring screw	94345
1 Device for resting the piston	94349
2 Jacking rods	94363
2 Jack screws	94364

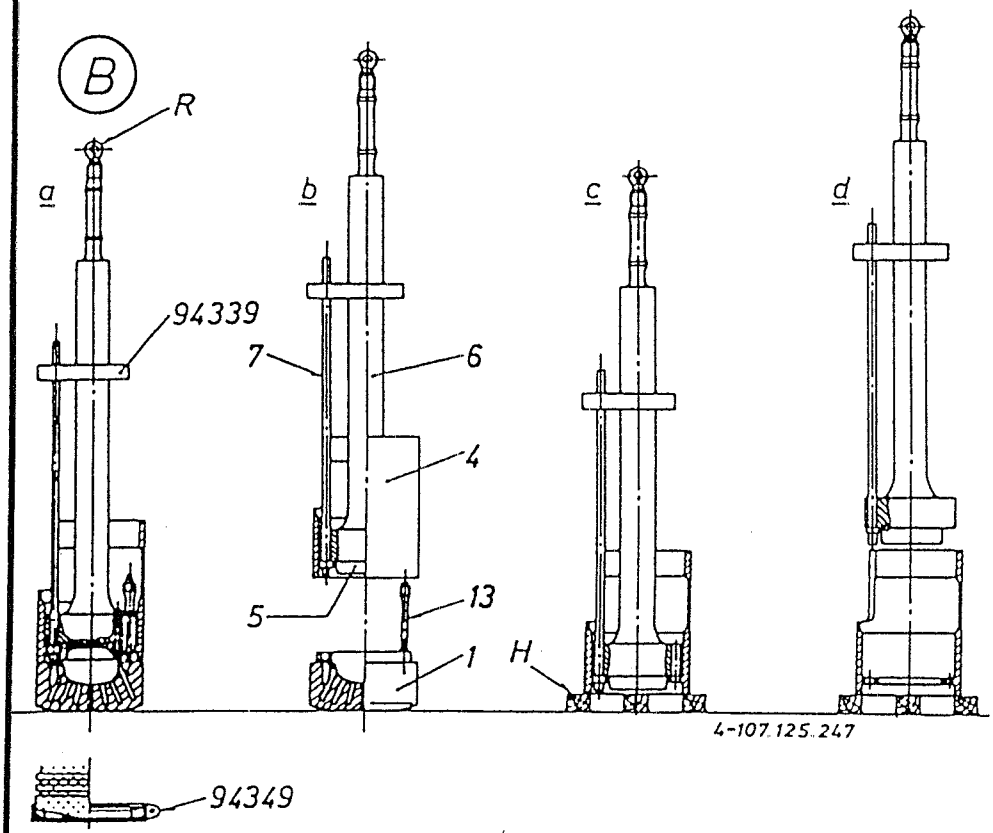
Key to Illustrations

1	Piston crown
2	Piston rings
3	Copper tyres
4	Piston skirt
5	Centering piece & coolg. space cover
6	Piston rod
7	Running pipe
8	Dowel pin for piston rod
9	Screw for item 5
10	O-Rings
11	Piston rod screw f. "short" piston rod
12	Piston rod nut for "long" piston rod
13	Waisted studs
14	O-Rings
15	Special O-Rings
16	Nut f. running pipe
17	Screw f. fixing piston skirt
18	Locking screw to 9
19	Locking screw to 13
20	Special nut to 13
21	Locking disc to 20
22	Screw for 21
23	Locking plate to 21/22
24	Locking plate to 25/26
25	Screw to 26
26	Locking disc to 16
27	Locking plate to 9
AL	Threaded holes for jack screws
R	Ring screws M90 (RL76) M110(RL90)
H	Wooden blocks
WE	Water inlet
WA	Water outlet
S	Gap



A) Inverting for Dismantling

If the dismantling of a piston becomes necessary (cleaning of the cooling space, re-machining of the piston ring grooves etc.) it must first be inverted and placed on a solid wooden base with the piston crown at the bottom. As protection against bending them, the running pipes must be secured with the fixing clamp 94339 (Fig. 'A').



Dismantling

a) Piston in dismantling position.

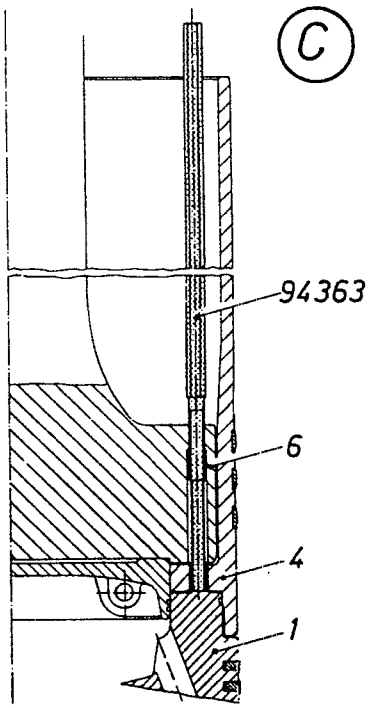
b) Lifting of piston rod with piston skirt from piston crown.

c) Piston skirt in position for separating from piston rod.

d) Removal of piston rod from piston skirt.

Procedure for Dismantling a Piston

Place the piston on an even surface as shown in fig. 'a' for fig. 'B', for the protection of the piston the base should be a clean board or alike. For safety reasons, piston rest device 94349 must be used for pistons with conical shape.



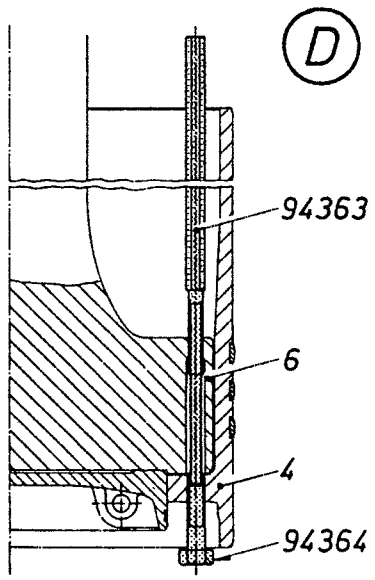
a) Separating Piston Crown from Piston Skirt

- Remove all locking devices 21, 22 and 23 from all nuts 20 (Fig. 'E').
- Clamp device 94332 onto piston skirt and loosen all the nuts 20 with the special box spanner (Fig. 'F'), remove all nuts 20.
- Lift piston rod with crane about 4 to 5 cm off the floor.
- Screw the two jacking rods (long) 94363 into the threaded holes AL (see Fig. 'E' section 11-11) until they touch the piston crown. Tighten both jacking rods simultaneously or alternately thus separating piston crown 1 from piston skirt 4 (Fig. 'C').
- Unscrew jacking rod partly until it no longer protrudes at the piston rod.

b) Separating Piston Rod from Piston Skirt

- Lift piston rod with piston skirt and insert the two screws 94364 into the threaded holes above which in the same axis the jacking rods 94363 are fitted (Fig. 'D').
- Loosen both screws 17 (Fig. 'E') with which piston rod 6 and piston skirt 4 are fastened together, with a spanner but.

do not yet remove them



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- Place piston rod with piston skirt on three wooden blocks 'H' (see Fig. 'B' in Fig. 'c').
- Remove the screws 17 which had previously been loosened, by hand and lift the piston rod with the piston skirt by about 3-4 cm oof the wooden blocks.
- Tighten both jacking rods 94363 simulteneously, whereby the piston skirt is separated with centering piece 5 still attached from the piston rod. The piston rod with centering piece 5 can now be lifted out and placed also on 3 wooden blocks.
- Remove jacking rods 94363 and screws 94364.
- If the running pipes must also be remove,d then the instructions from sheet 340/8 must be followed.

c) Removing Centering Piece 5 from Piston Rod (Fig. 'E')

- Attention! First remove the locking screws 18!
- Mark the screws 9 so that they can later again be fitted at the same place.
- Only now unscrew screws 9 by about 15 mm and tap their heads lightly with a lead- or wooden hammer so that the centering piece 5 slips out of the piston rod.
- Unscrew screws 9 completely and remove centering piece.

d) Removing Piston Studs (Fig. 'E')

The waisted studs 13 can only be removed when piston crown and piston skirt are separated and the locking screws 19 removed.

Code No.	Description and Use	940-21a	Sketch
94325a	1 Device (used together with the piston rod screw) to suspend the crosshead with or without the connecting rod. Also used as filler or oil space seal on the crosshead when the engine is operated without the particular working piston.