Piston variations

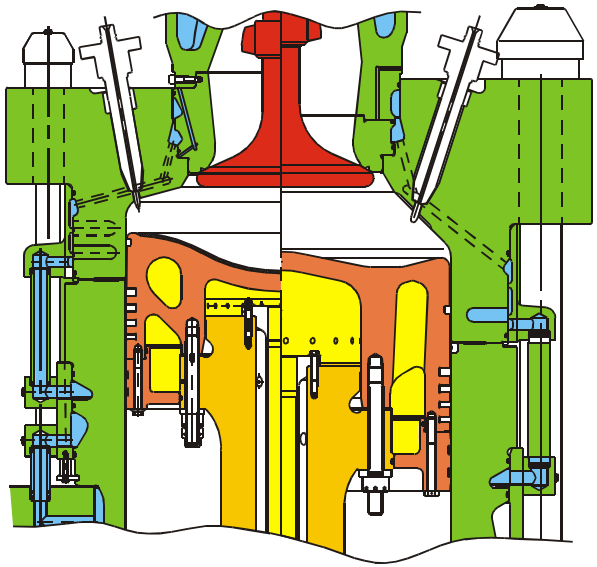
- Oros type
- Conventional type
- Bore cooled
- Standard cooled
- High topland
- Low topland
- Inconel on top
- Without Inconel on top
- Fully cast
- Cast/welded
- Forged/welded
- Configuration of ring grooves:
  - Four small
  - One big, three small
  - Two small, two big

Ordering non-genuine components increases the risk of receiving incorrect supplies

For genuine, fully guaranteed parts, contact :

Man Diesel PrimeServ Copenhagen
or
the engine builder

Previous **High topland**

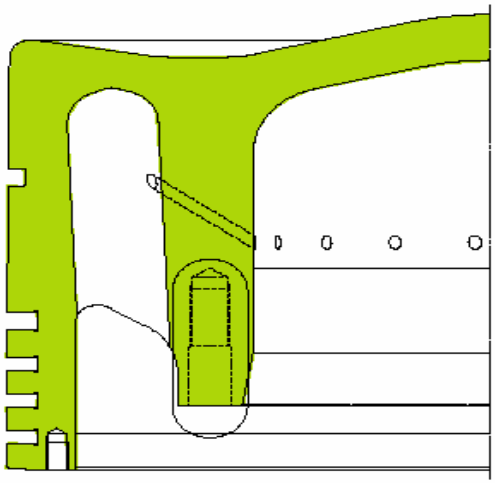


Piston ring groove development

Present standard:

1. Ring groove high.

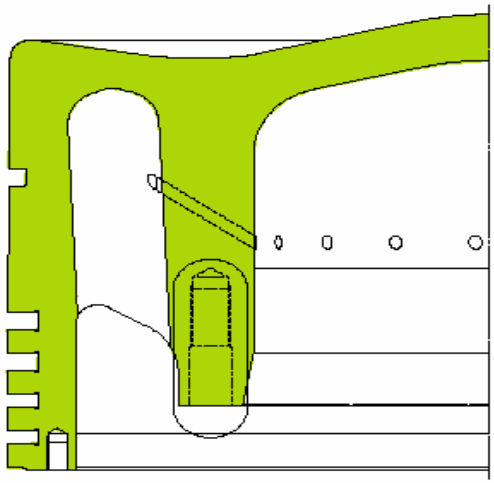
2.3.4 Ring grooves low.



Second standard:

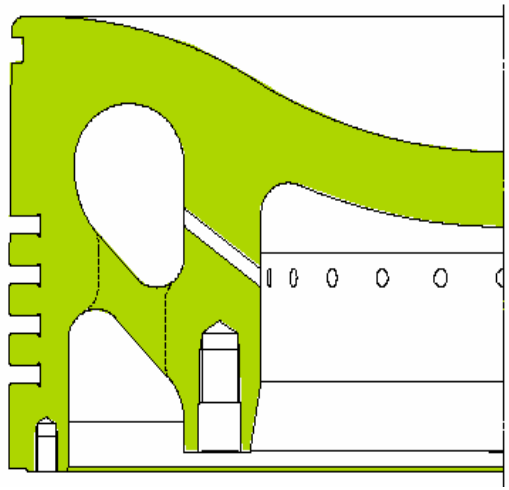
1.2. Ring grooves high.

3.4. Ring grooves low.



First standard:

1.2.3.4. Ring grooves low.



Piston Crown
98 MC/MC-C

Original design

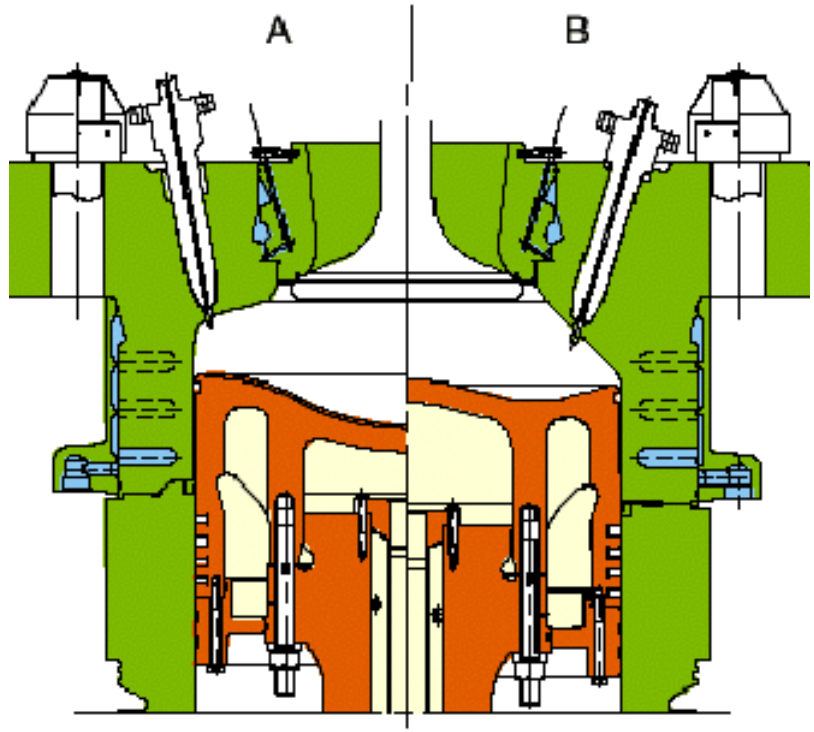
Expected lifetime: 80,000 hours

MD-C produced crown

Always made according to the latest design (Oros).

Oros type is a multi-bore cooled piston with high topland giving improved combustion and approx 100 degrees C lower temperature on the top.

Produced with increased chrome layer 0.5mm on bottom surface of ring grooves (SL 02-404).

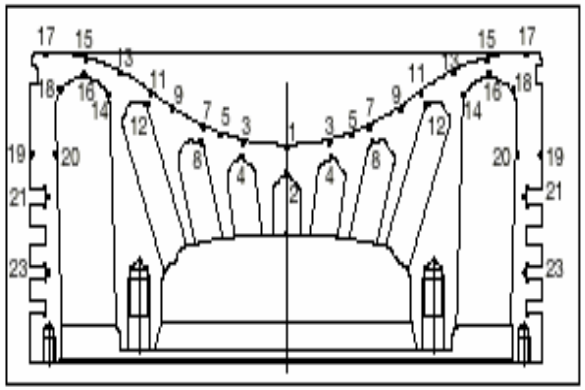


Piston Crown
98 MC/MC-C

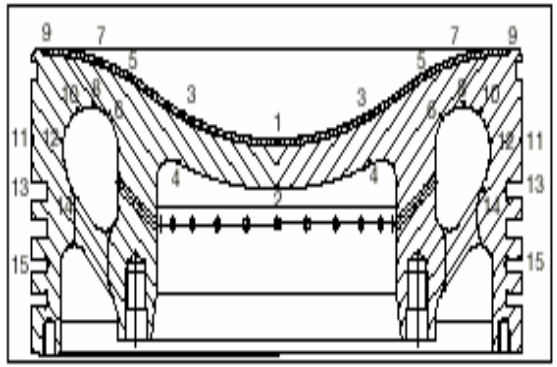
MD-C supply

- Ensures the correct topland.
- Ensures the correct ring configuration.
- Ensures the correct ring material for the original cylinder liner.

Multi Bore Cooled piston



Standard piston



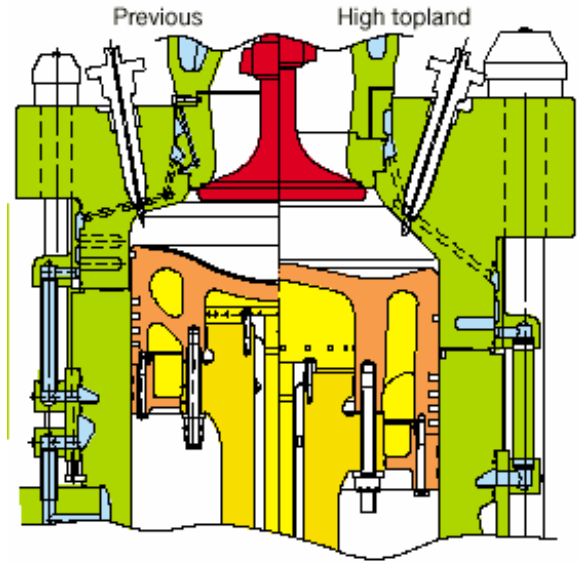
100% Load Piston crown temperature

Piston Crown
90MC/MC-C , 80MC/MC-C

Original design

Expected life time: 90MC/MC-C 80,000 hours

Expected life time: 80MC/MC-C 70,000 hours.



MD-C produced piston

Always produced according to latest design (Oros, Conventionel).

Oros type is multi-bored cooled piston with high topland given an improved combustion and approx 100 degrees C lower temperature on the top.

Piston Crown
90MC/MC-C, 80MC/MC-C

MD-C produced piston

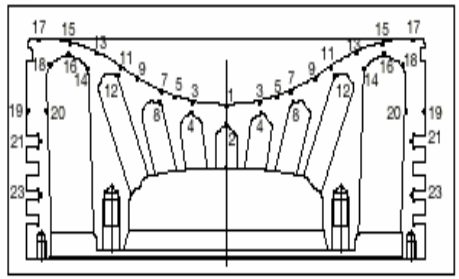
Conventional type with high and low topland

and 8 mm Inconel on the top, multi-bore or standard cooled.

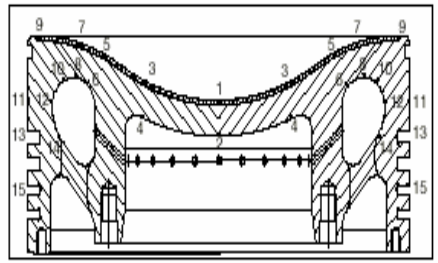
Produced with increased chrome layer 0,5 mm

on the bottom of the ring grooves (SL 02.404).

Multi Bore Cooled Piston



Standard piston



100 % Load Piston crown temperature

MD-C supply

- Ensure the correct topland.
- Ensure the correct ring configuration.
- Ensure the correct ring material for the original cylinder liner.

Piston Crown
70MC/MC-C

Original design

Expected lifetime 70,000 hours.

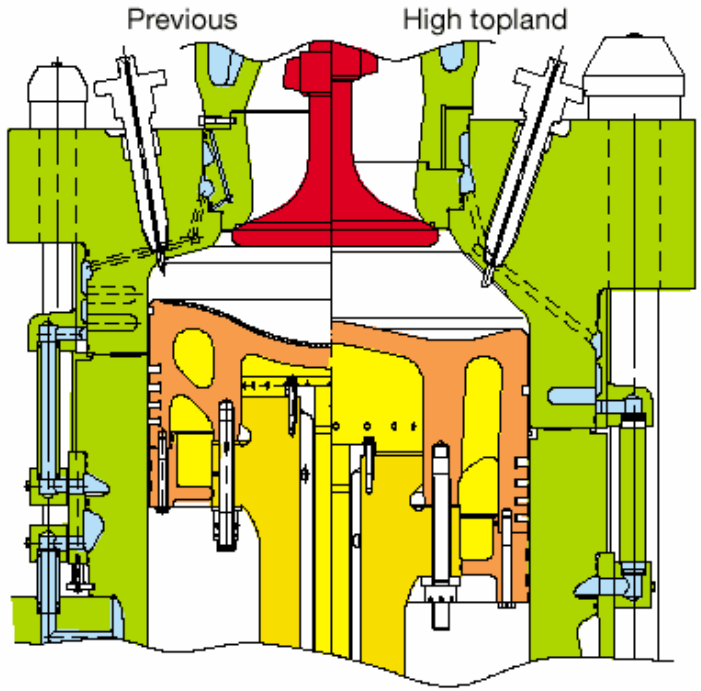
MD-C produced piston

Always made according to the latest design (Oros, conventional).

Oros type is a multi-bored cooled piston with high topland giving improved combustion and approx 100 degrees C lower temperature on the top.

Conventional type with high and low topland with and without 8 mm inconel on the top, depending on the type of engine and bore-cooled/standard cooled.

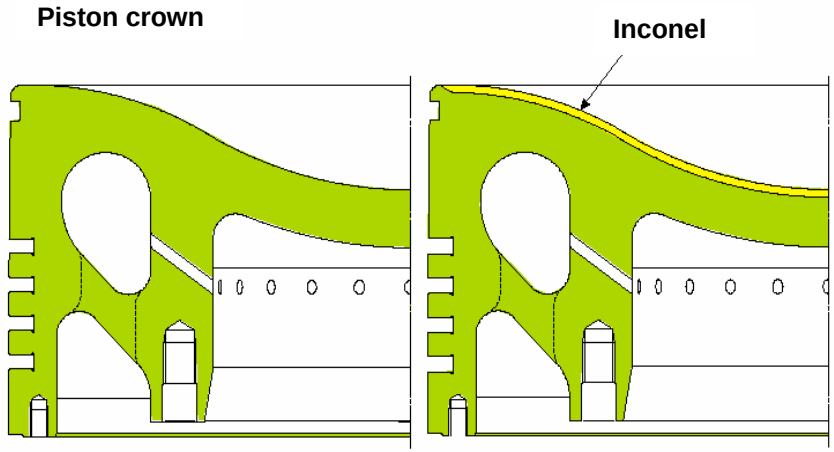
Produced with increased chrome layer 0.5mm on bottom surface of ring grooves (SL02-404).

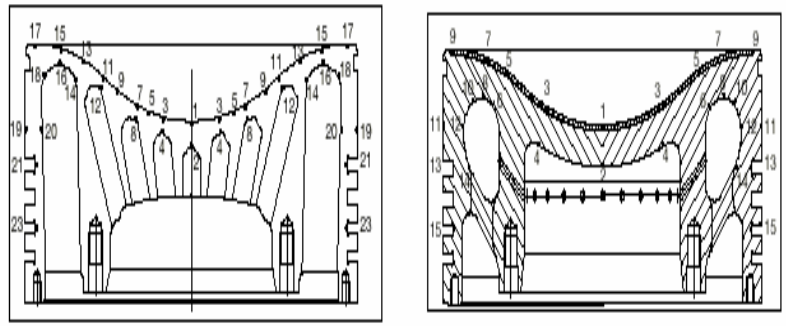


Piston Crown
70MC/MC-C

MD-C supply

- Ensures the correct topland.
- Ensures the correct top surface with or without Inconel layer.
- Ensures the correct ring configuration.
- Ensures the correct ring material for the original cylinder liner.





100% Load Piston crown temperature

Piston Crown
60 MC/MC-C, 50 MC/MC-C

Original design

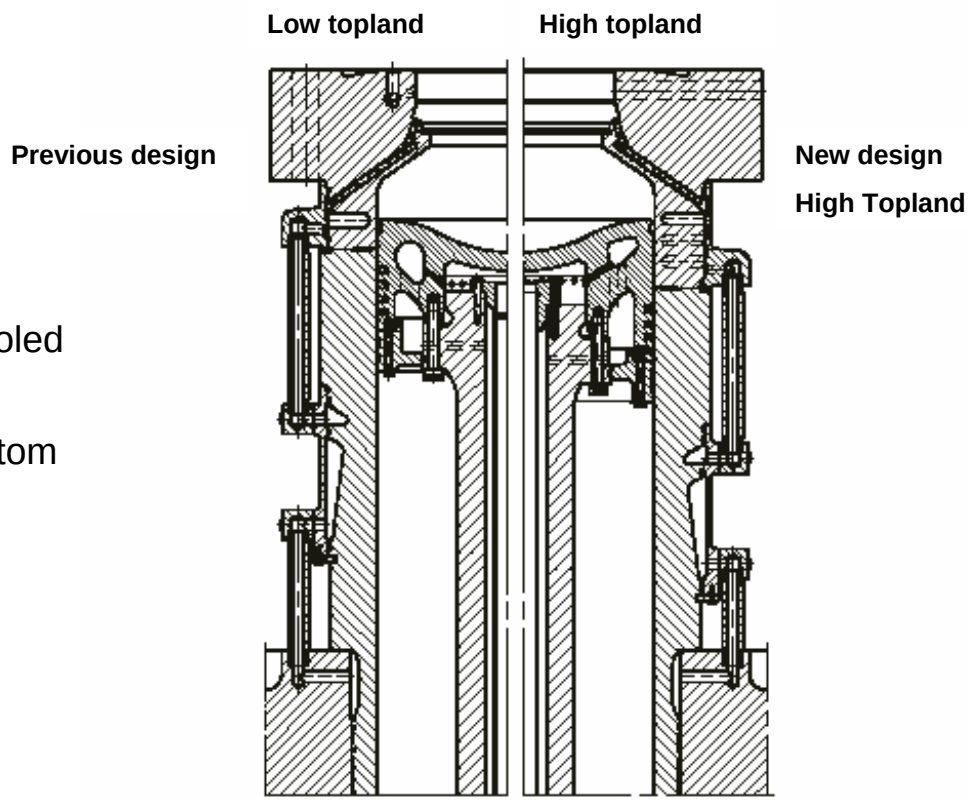
Expected lifetime 60,000 hours.

MD-C produced piston

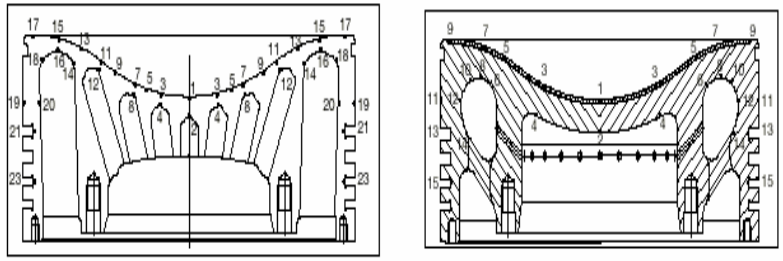
Always made according to latest design.

Produced with high and low topland; bore-cooled and standard cooled.

Produced with increased chrome layer at bottom of ring groove 0.5 mm (SL02-404).



Piston Crown
60 MC/MC-C, 50 MC/MC-C



100% Load Piston crown temperature

MD-C supply

- Ensures the correct topland.
- Ensures the correct ring configuration.
- Ensures the correct ring material for the correct cylinder liner.

Piston Crown
46MC/MC-C, 42MC, 35MC

Original design

Expected lifetime 50,000 hours

MD-C produced piston

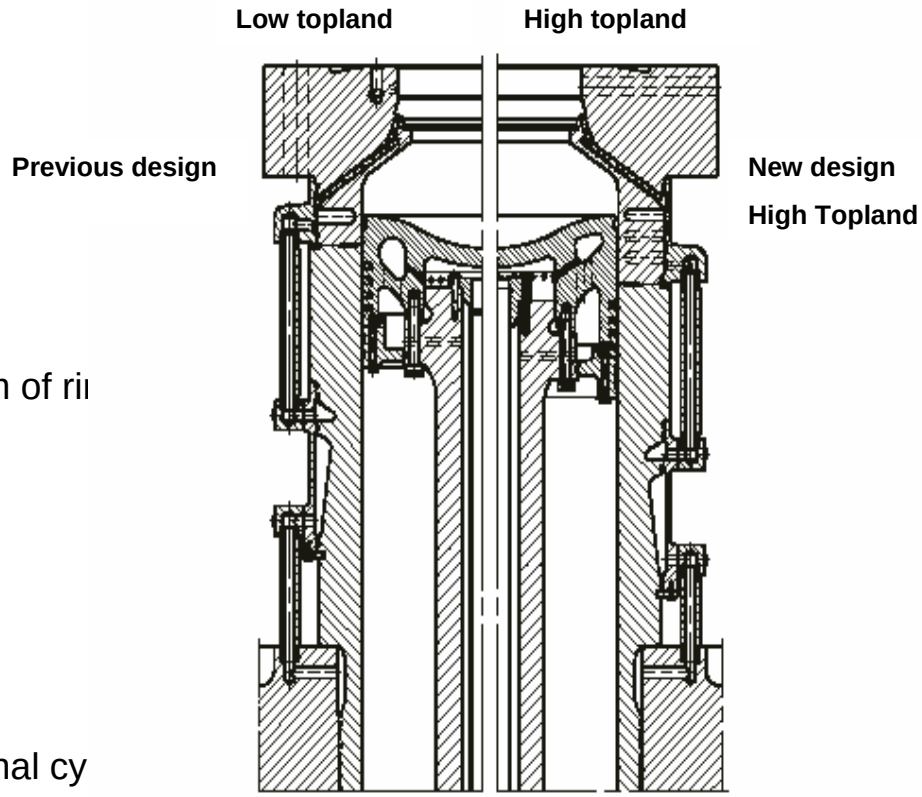
Always made according to latest design.

Produced with high and low topland.

Produced with increased chrome layer at bottom of ri
grooves 0.5mm (SL 02-404).

MD-C supply

- Ensures the correct topland.
- Ensures the correct ring configuration.
- Ensures the correct ring material for the original cy
  liner.



Piston Crown
26MC

Original design

Expected lifetime 40,000 hours

MD-C produced piston

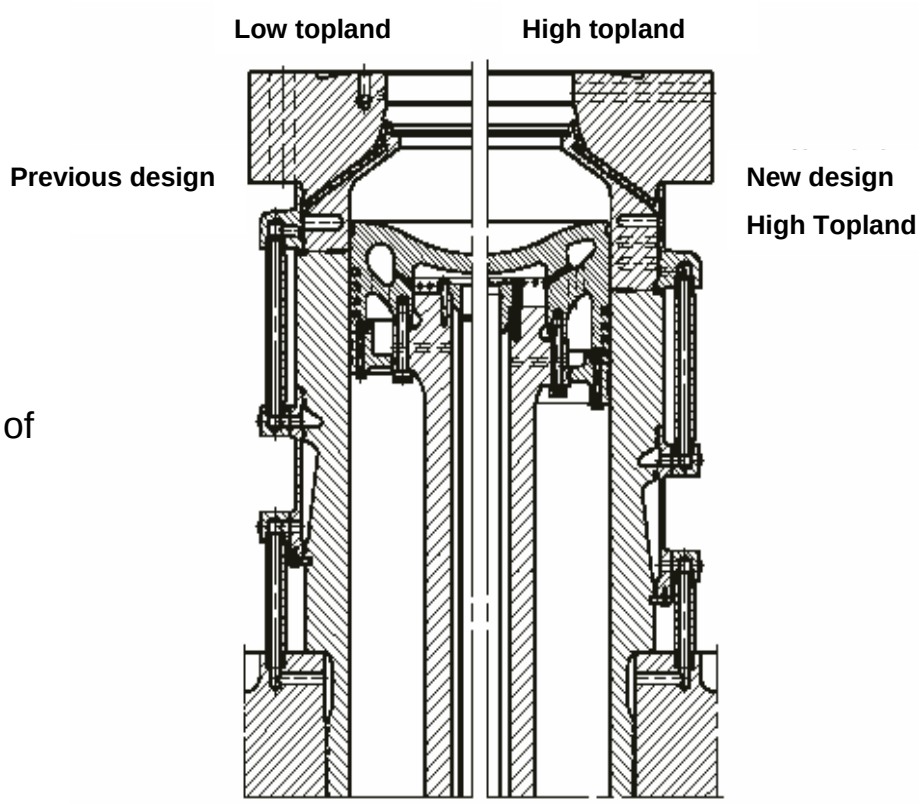
Always made according to latest design.

Produced with high and low topland.

Produced with increased chrome layer at bottom of ring grooves 0.5mm (SL 02-404).

MD-C supply

- Ensures the correct topland.
- Ensures the correct configuration.
- Ensures the correct material for the original cylinder liner.



MAN B&W Diesel A/S

Service Letter

SL02-404/JNM
June 2002

Increase of Chrome Layer Thickness
Action Code: WHEN CONVENIENT

Dear Sirs

This Service Letter is only valid for engines which have pistons on which the uppermost or the two uppermost ring grooves are higher than the rest.

Progress in chrome plating technology has made it possible to increase the plating thickness in the ring grooves of the pistons, without sacrificing the hardness or incurring too high extra costs.

The useful life of a piston crown depends, in many cases, on the wear in the ring grooves. Therefore, we have taken advantage of the improved plating technology to increase the plating thickness in the grooves of the piston crowns from 0.3 mm to 0.5 mm on engine types utilising “high” piston rings.

Since, the wear limit of the ring grooves corresponds to the plating thickness, the acceptable wear will be increased from 0.3 mm to 0.5 mm.

Our authorised repair shops have been instructed to increase the plating thickness to 0.5 mm in the grooves when reconditioning piston crowns of the types concerned.

We wish to draw your attention to the fact that piston crowns which were originally produced with a 0.3 mm plating will be returned from reconditioning with a 0.5 mm plating; thus the wear limit of the reconditioned units is increased to 0.5 mm. The clearance in the ring groove will remain unchanged.

HEAD OFFICE (& Postal address)
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DK-2450 Copenhagen SV
Telephone: +45 33 85 11 00
Telex: 16592 manbw dk
Telefax: +45 33 85 10 30
E-mail: manbw@manbw.dk
http://www.manbw.dk

DIESEL SERVICE
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Telex: 19042 manfw dk
Telefax: +45 33 85 10 16

MAN B&W Diesel A/S
Denmark
CVR.No.: 39 66 13 14

General comments on reconditioning

We find it is practical to divide the reconditioning of piston crowns into the following two types of jobs:

1. “Small jobs” affecting only the chrome plating in the ring grooves.

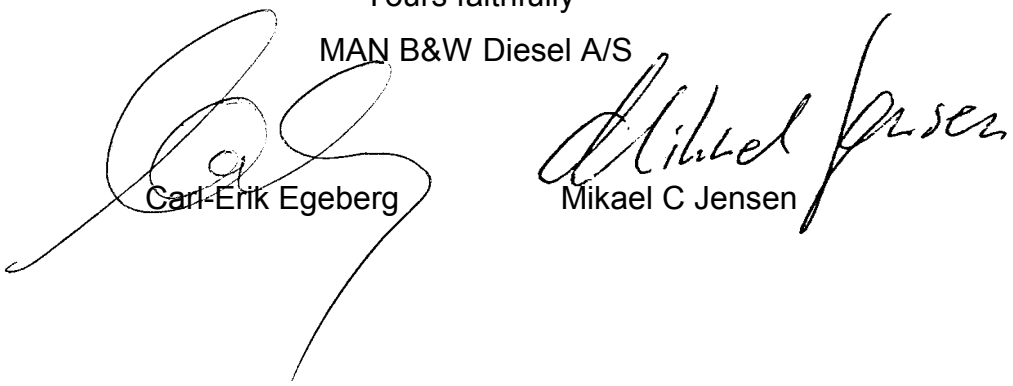
2. “Big jobs” where the base metal of the piston crown must be rebuilt by welding before chrome plating.

It goes without saying that the expenses for reconditioning a piston crown increase substantially if the ring groove is worn through the chrome plating. In that case the groove will most frequently have to be rebuilt by welding, making full reconditioning necessary.

Questions or comments regarding this SL should be directed to our Dept. 2300.

Yours faithfully

MAN B&W Diesel A/S



Carl-Erik Egeberg Mikael C Jensen

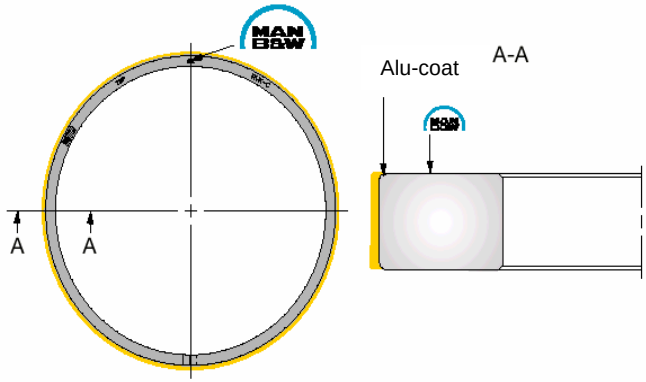
Piston ring, 98 MC/MC-C

Original design

Expected lifetime 12-16,000 hours

Genuine spare part

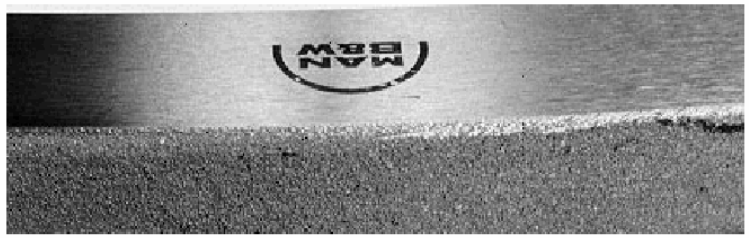
- **Alu-coated piston ring, developed at our Research Centre**
- **Reduced running-in time with more than 50%**
- **Saving cylinder oil**
- **Thickness about 0.3 mm**



Based on ring pack equipped with:

Upper ring designed with controlled pressure relief *(CPR) alu-coated chrome.

The remaining rings are alu-coated.



Piston ring, 98 MC/MC-C

MD-C supply

Always supplied according to latest design.

Upper ring : Height reduced by 0.1mm (reduced risk of sticking).

Position of relief grooves has been modified (grooves moved away from the stress area).

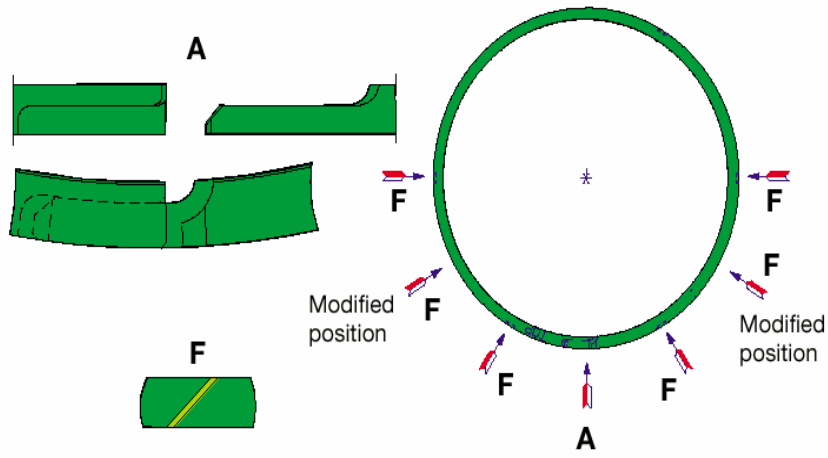
Ensures the correct ring configuration.

Ensures the correct ring material for the original cylinder liner.

*CPR ring ensures :

- Improved pressure drop across ring pack.
- Reduced heat load on second piston ring
- Longer lifetime of ring pack.

Controlled pressure relief piston ring (CPR)



Piston ring, 90 MC/C

Original design

Expected lifetime 12-16,000 hours

Cylinder liner equipped with PC ring

Based on ring pack equipped with :

Upper ring produced with controlled pressure relief *(CPR) alu-coated chrome/alu coated.

The rest of the rings are alu-coated.

Alternative :

The whole ring pack is taper faced with/without CPR and without alu-coating.

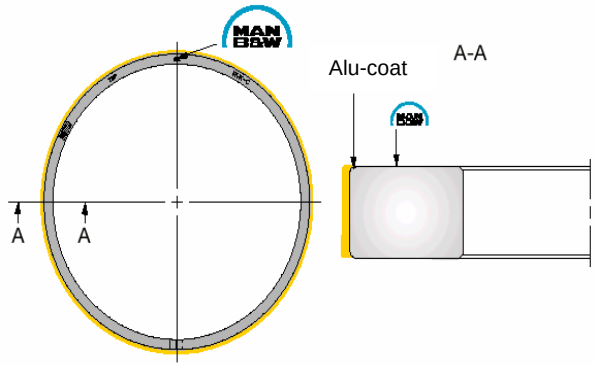
Price-wise cheaper but without the same expected lifetime.

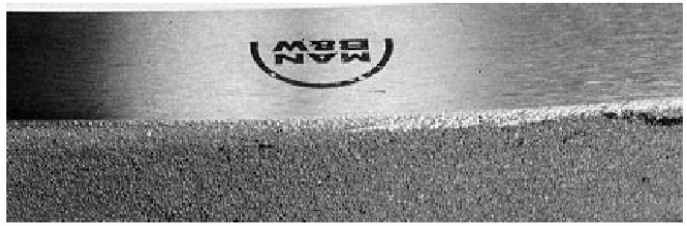
Genuine spare part

Alu-coated piston ring

Developed at our Research Centre

- **Reduced running in time more than 50%**
- **Saving cylinder oil**
- **Thickness about 0,3 mm**





Piston ring, 90 MC/MC-C

MD-C supply

Always supplied according to latest design.

Upper ring : Height reduced by 0.1mm
(Reduced risk of sticking).

Position of relief grooves has been modified.
(grooves moved away from stress area).

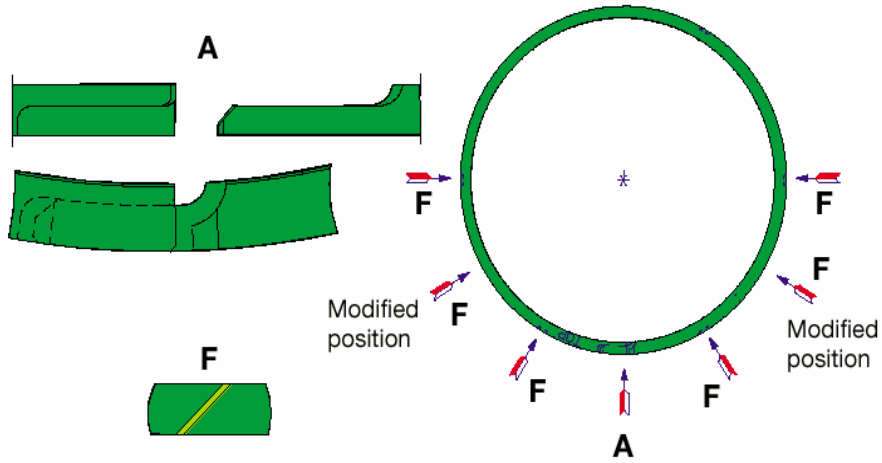
Ensures the correct ring configuration.

Ensures the correct ring material for the original cylinder liner.

*CPR ring ensures :

- Improved pressure drop across the ring pack.
- Reduced heat load on second piston ring.
- Longer lifetime of ring pack.

Controlled pressure relief piston ring (CPR)



Piston ring, 80 MC/MC-C – 26 MC

Original design

Expected lifetime 12-16,000 hours

Cylinder liner equipped with PC ring

Genuine spare part

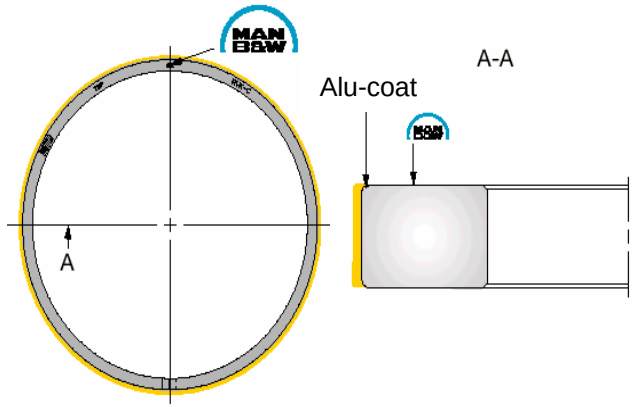
Alu-coated piston ring

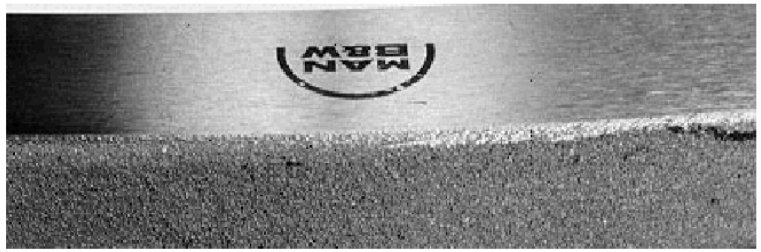
Developed at our Research Centre

•Reduced running in time more than 50%

•Saving cylinder oil

•Thickness about 0,3 mm





Based on ring pack is equipped with :

Upper ring produced with controlled pressure relief *(CPR) alu-coated.

The rest of the rings are alu-coated.

Alternative :

The whole ring pack is taper faced with/without CPR and without alu-coat.

Price-wise cheaper but without the same expected life-time.

Piston ring, 80 MC/MC-C – 26 MC

MD-C supply

Always supplied according to latest design.

Upper ring : Height reduced by 0.1mm. (Reduced risk of sticking).

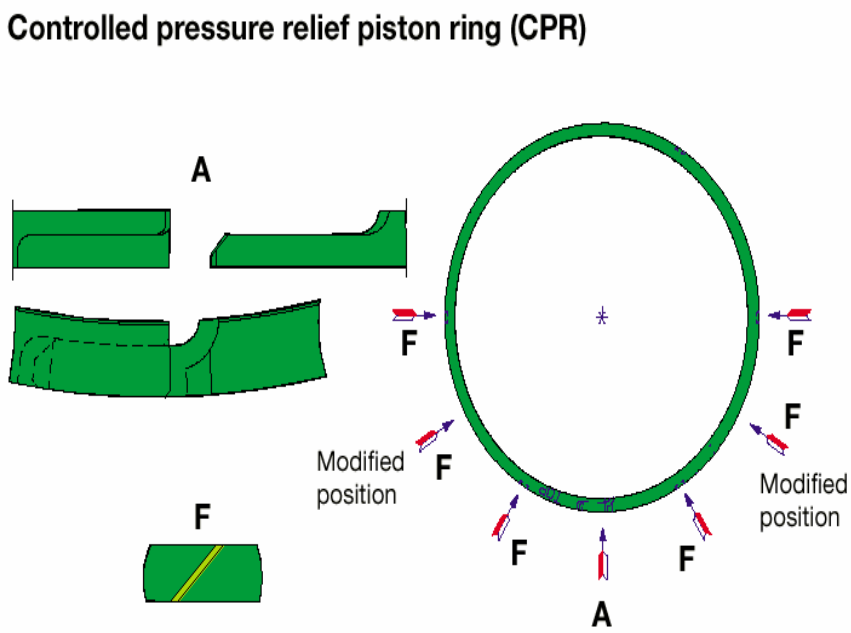
Position of relief grooves has been modified (grooves moved away from the stress area).

Ensures the correct ring configuration.

Ensures the correct ring material for the original cylinder liner.

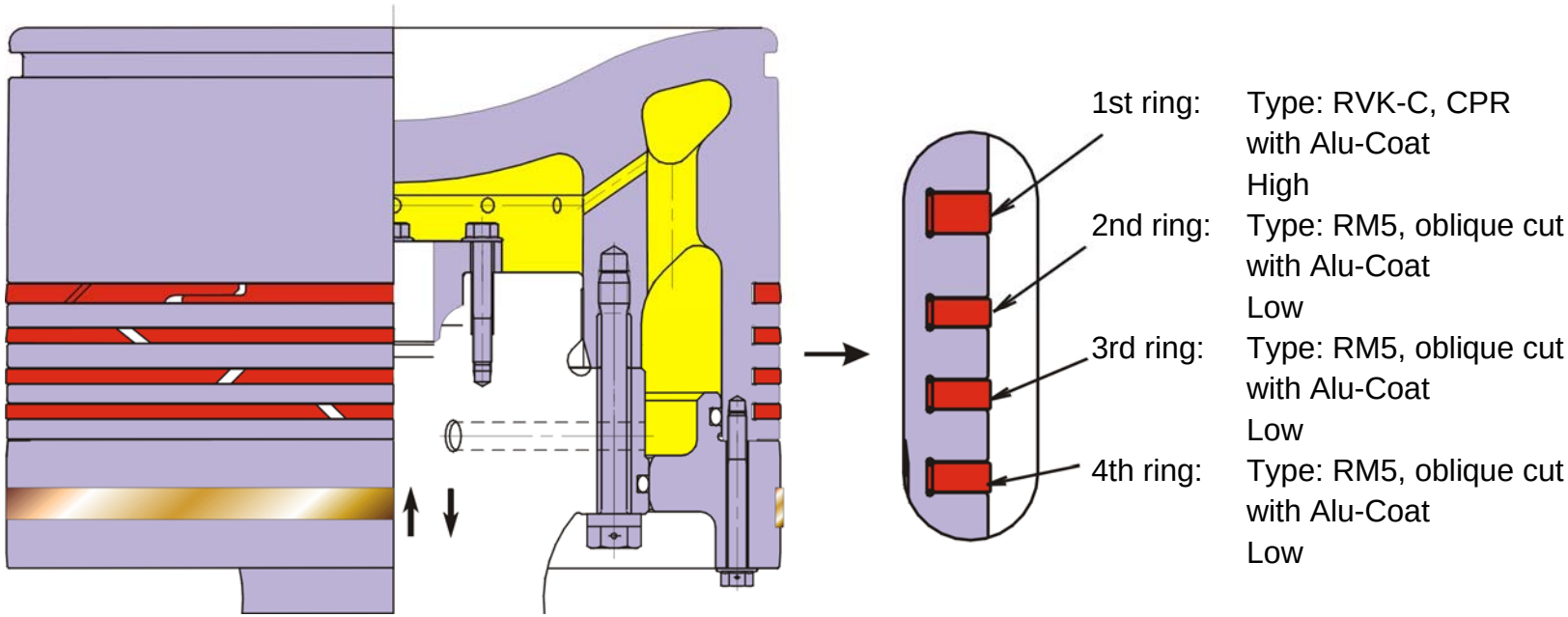
*CPR ring ensures :

- Improved pressure drop across the ring pack.
- Reduced heat load on second piston ring.
- Longer lifetime of ring pack.



Combustion Chamber Layout

Ring pack – When the liner is equipped with PC ring



1st ring:	Type: RVK-C, CPR with Alu-Coat High
2nd ring:	Type: RM5, oblique cut with Alu-Coat Low
3rd ring:	Type: RM5, oblique cut with Alu-Coat Low
4th ring:	Type: RM5, oblique cut with Alu-Coat Low

For L/K90MC, K80MC
See special plate

- High topland piston crown
- 1st piston ring with increased height
- Copper band on piston skirt

Ring pack for L/K90MC, K80MC

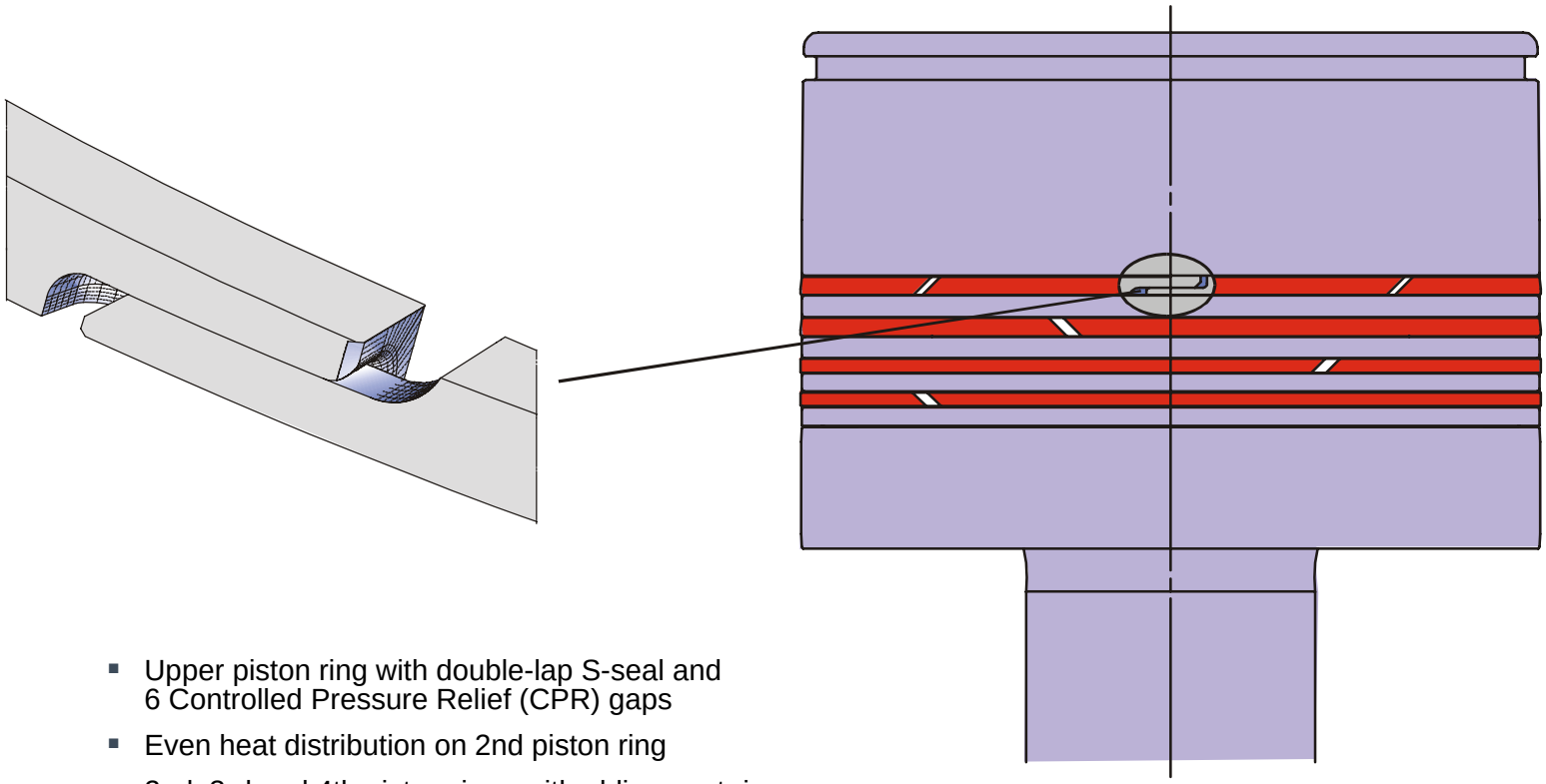
The stated type of engines are sensitive for coke formations and thereby for scuffing.

The guide line for the ring pack is following:

Ring pack with CPR ring and liner **with** PC ring.	Ring pack with CPR ring and liner **without** PC ring.
1st ring: CPR with alu-coat.	1st ring: CPR with PM14
2nd ring: RM5 with alu-coat	2nd ring: RM5 with alu-coat
3rd ring: RM5 with alu-coat	3rd ring: RM5 with alu-coat
4th ring: RM5 with alu-coat	4th ring: RM5 with alu-coat

UBP 03/05-05

Piston Rings for MC Engines



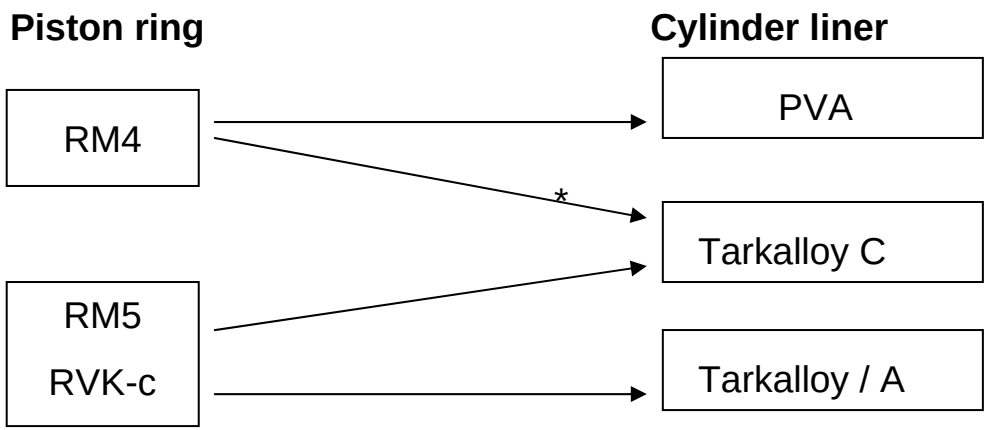
- Upper piston ring with double-lap S-seal and 6 Controlled Pressure Relief (CPR) gaps
- Even heat distribution on 2nd piston ring
- 2nd, 3rd and 4th piston rings with oblique cut ring gaps
- New piston ring material:
  RVK-C for 70-26 cm bores and RVK-C with Alu-coating on 98-80 cm bores

  When the liner is equipped with PC ring

Piston Ring and Cylinder Liner Wear
98 to 80 Bores

MAN Diesel standard piston rings and their compatibility with different kinds of cylinder liner materials

Ring No. 1	CPR, high	RVK-C with Alu-coating	Standard
Ring No. 2	Low, left cut	RM5 with Alu-coating	
Ring No. 3	Low, right cut	RM5 with Alu-coating	
Ring No. 4	Low, left cut	RM5 with Alu-coating	



*RM4 piston ring has in special cases been used succesfully in tarkalloy C-Va cylinder liner

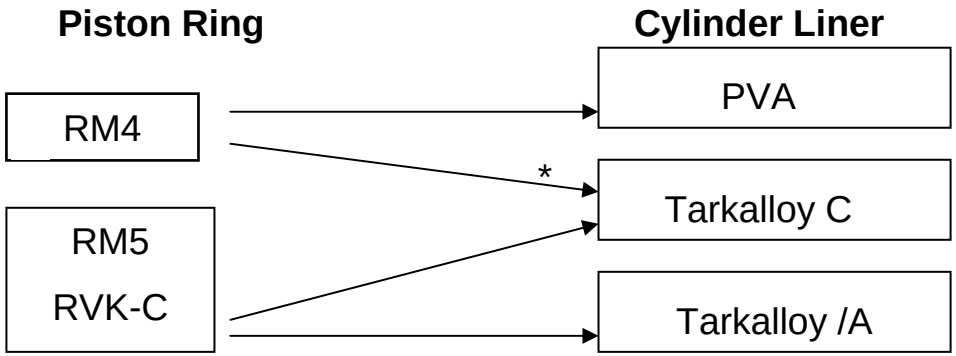
For the existing engines without a PC ring, the top ring of RVK-C with PM 14 (relatively hard material) coating is still necessary

Other combinations of piston ring/cylinder liner materials can lead to increased wear of either the piston rings or the cylinder liners

Piston Ring and Cylinder Liner Wear
70 to 26 Bores

Man Diesel standard piston rings and their compatibility with different kinds of cylinder liner materials.

		Standard	Optional
Ring No. 1	CPR, high	RVK-C	Alu-coating
Ring No. 2	Low, left cut	RM5	Alu-coating
Ring No. 3	Low, right cut	RM5	Alu-coating
Ring No. 4	Low, left cut	RM5	Alu-coating



***RM4** piston ring has in special cases been used succesfully in C-Va cylinder liner

Other combinations of piston ring/cylinder liner materials can lead to increased wear of either the piston rings or the cylinder liners

Piston Ring - Cylinder Liner compatibility

Cylinder liner and piston ring wear highly depends on the compatibility between the cylinder liner and the piston ring material.

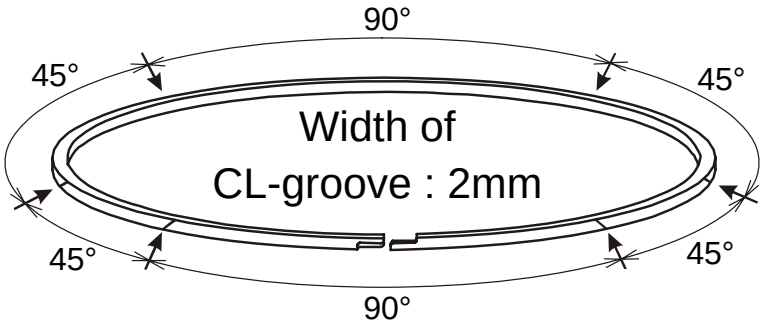
Daros	Nippon	Riken	Properties	Cylinder liner material
RM 5	Uballoy	Rik 45	Grey cast iron	Tarkalloy
RM 5	NPR Uballoy S	Rik 47	Copper-molybdenum alloyed,flake graphite	Tarkalloy Tarkalloy-C
RM 4			Vanadium and copper molybdenum alloyed, flake graphite	PVA *(Tarkalloy C)
RVK-C	Tarkalloy G	Rik 29	Alloyed high strength CV graphite iron	Tarkalloy C/A
RVK/pm 14			Base material RKV with ceramic coating on the running surface	All
RVK-C	Tarkalloy G	Rik 29V	Alloyed high strength CV graphite iron with wear reducing carbides	Tarkalloy C/A
RVK-C/Alu-bronze	Tarkalloy G/ Alu-bronze	Rik29V/ Alu-bronze	Alloyed high strength CV graphite iron,with wear reducing coating	All

CV : Compact vermicular iron

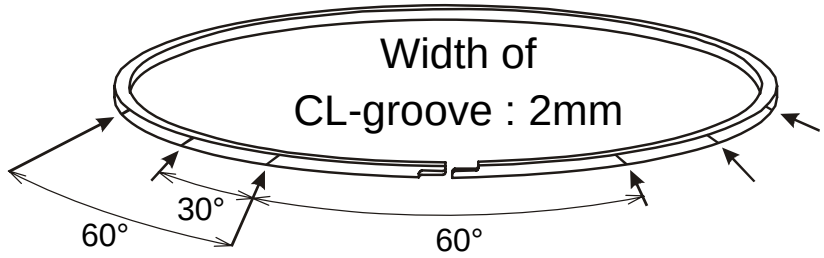
Please view page 2 for further remarks

CPR Piston Ring Development

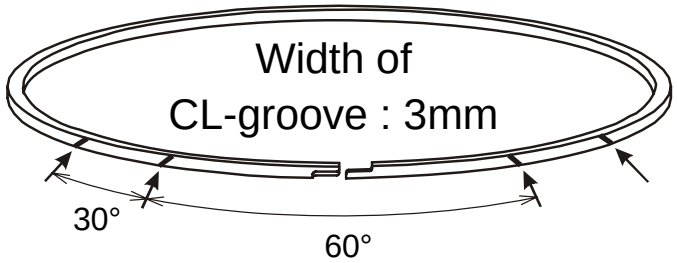
Original location of grooves
(6 CL-grooves)



6 relocated CL-grooves
(E-Type from Jan. 2002)



4 relocated CL-grooves
(E4-Type)



Essential Problems in the Last Decade and Their Solutions

Problems	Solutions
• Short time between overhauls and high wear rates for liners and piston rings	• Introduction of CPR top rings and high topland piston
• Excessive corrosion in the lower part of the liners	• Decreased cooling of cylinder liners and introduction of PC-ring
• Main bearing damage on thick shell bearings	• Modification of bearings design • Alignment instructions and offset bearings • Introduction of thin shell bearings • Flex Type introduced
• Too high rpm at slow steaming	• Cylinder cut-out

Essential Problems in the Last Decade and Their Solutions

Problems	Solutions
▪ Cracked cylinder liners with cast in cooling pipes	▪ Introduction of bore-cooled liners, low liners with optimized temperature level and higher cylinder cover
▪ Broken or collapsed piston rings	▪ One high upper ring, CPR top ring, high topland pistons ▪ Modification of ring design
▪ Scuffing between liner and piston rings	▪ PC-ring in top of liner and alu-coated piston rings ▪ Improved water mist catcher
▪ Insufficient combustion	▪ Modified fuel valves ▪ Cylinder cut out
▪ High wear for piston ring grooves Large bore engines	▪ Increased chrome thickness from 0.3 mm to 0.5 mm

Further improvements necessary

Cylinder Condition

Bad

7S80MC
Running hours: 5,098

Good

12K90MC-C
Running hours: 12,045

Design and Experience

7S80MC
M/T Vanadis

Cylinder unit No.4

Piston with CPR top ring
after 17,296 running hours
without overhaul

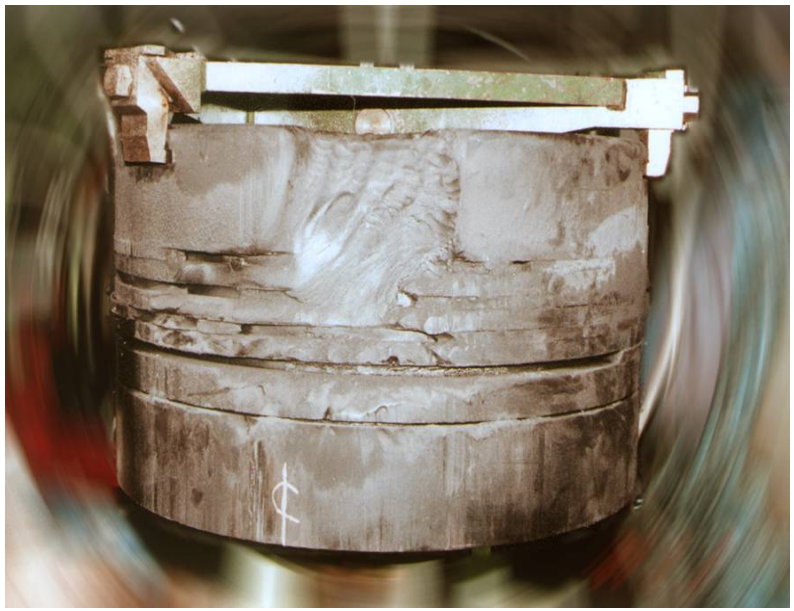
Exhaust side

CPR = Controlled Pressure Relief

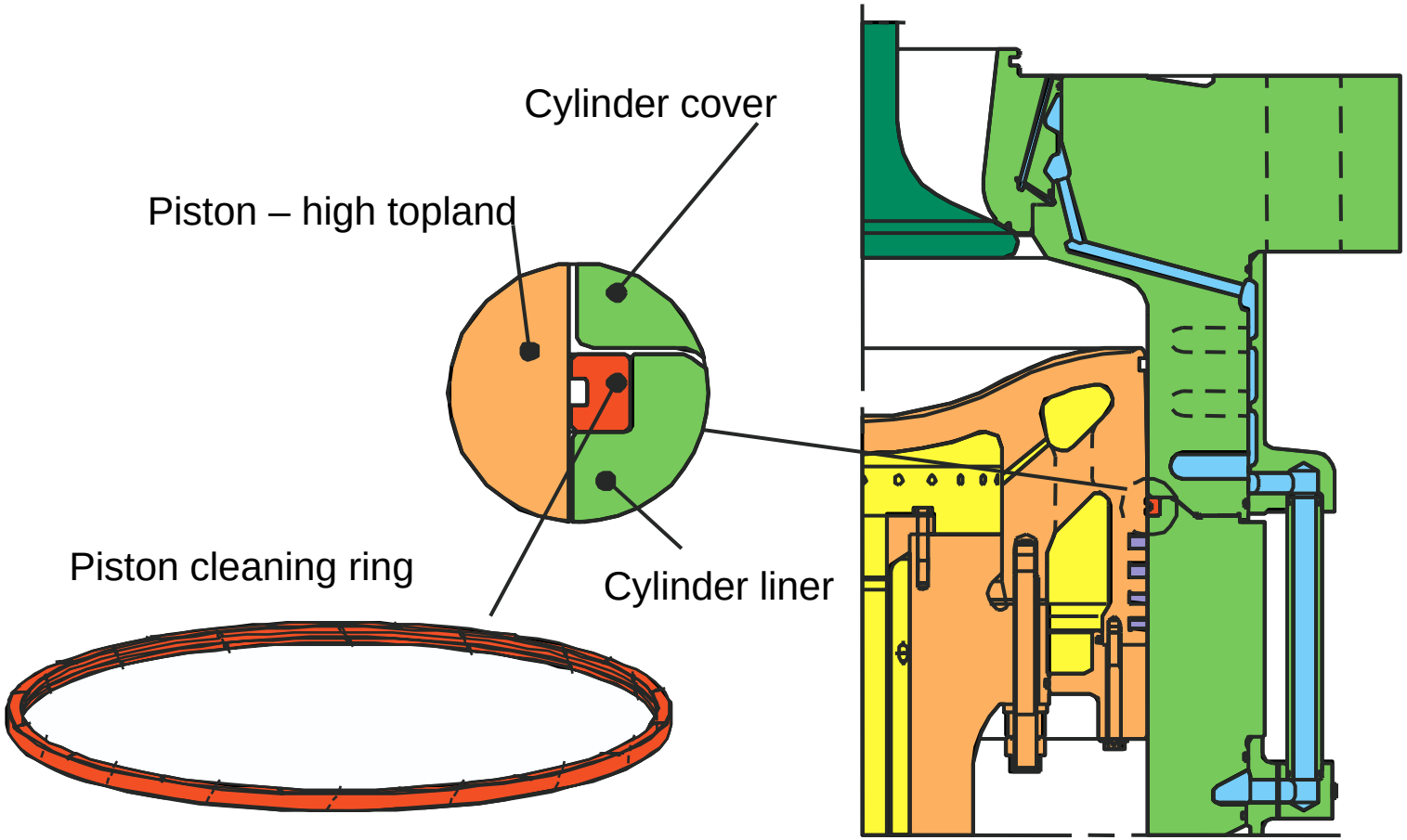
6L80MC

Damaged piston

Reason: fuel valves in bad condition



Cylinder Liner / Piston Cleaning Ring



Combustion Chamber
Large Bore Engines

Features:

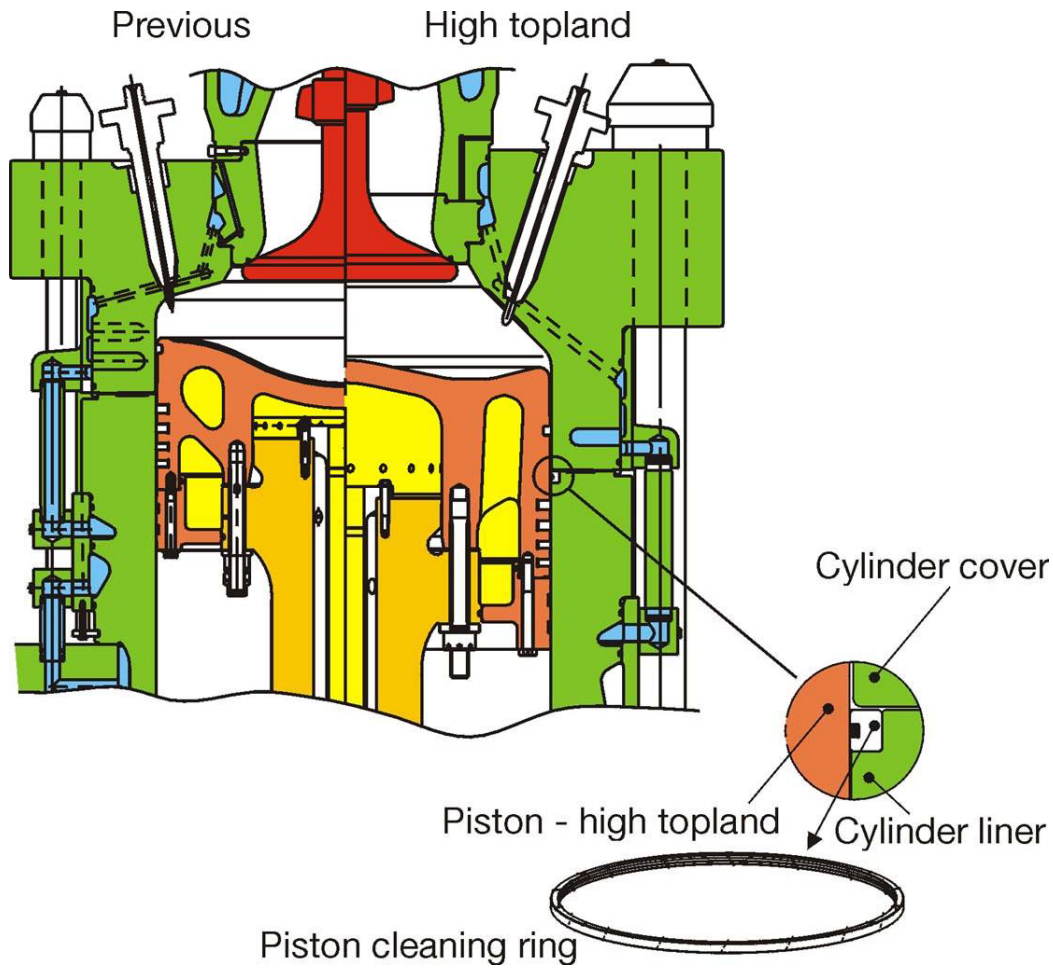
- High topland
- Oros shape piston top
- CPR top ring
- Alu-coated piston rings
- Bore cooled,
  heat resistant steel forged piston
- Piston cleaning ring

Improvements:

- Approx. 100 °C lower temperature on top compared with former type piston
- Increased chrome layer thickness in bottom of ring grooves

Verification:

- Extensive calculations
- Comprehensive tests on K90MC, K90MC-C and K98MC
- Service test on K90MC



New material specification for piston rings supplied from MD-C

1) **CV1** ”**C** for Cast iron – **V** for Vermicularjern – **1** for identification” ex. RVK-C
2) **CF4** ”**C** for Cast iron – **F** for Flagegrafitjern – **4** for Identification” ex. RM4
3) **CF5** ”**C** for Cast iron – **F** for Flagegrafitjern – **5** for Identification” ex. RM5

Juni 2004