

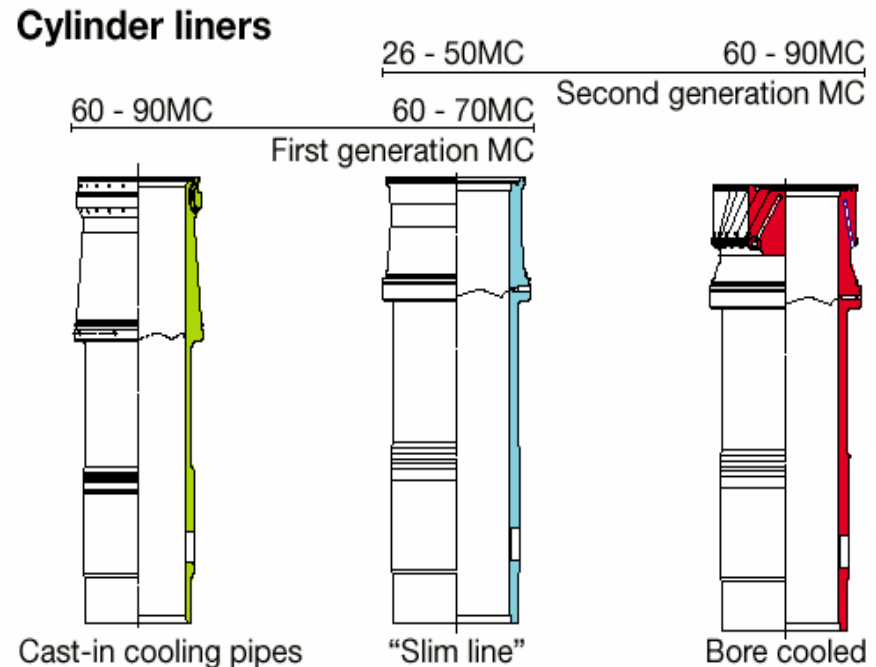
Cylinder liner variations



- Cast-in pipes with :
Shape Round cross-section and two bends
Shape Oval cross-section and one bend
- Bore cooled liner
- Slim liner
- Lubricating holes tangential
- Lubricating holes radial
- Short length for high topland
- Long length for low topland
- Differently situated O-rings
- Different numbers of lubricating holes
- Material tarkalloy - A
- Material tarkalloy - C
- Material cast Iron
- Scavenge ports different heights

A lot of possibilities to receive wrong deliveries from ungenue suppliers.

Genuine suppliers : MD-C and Engine builder.



Cylinder liner, 98MC/MC-C



Original design

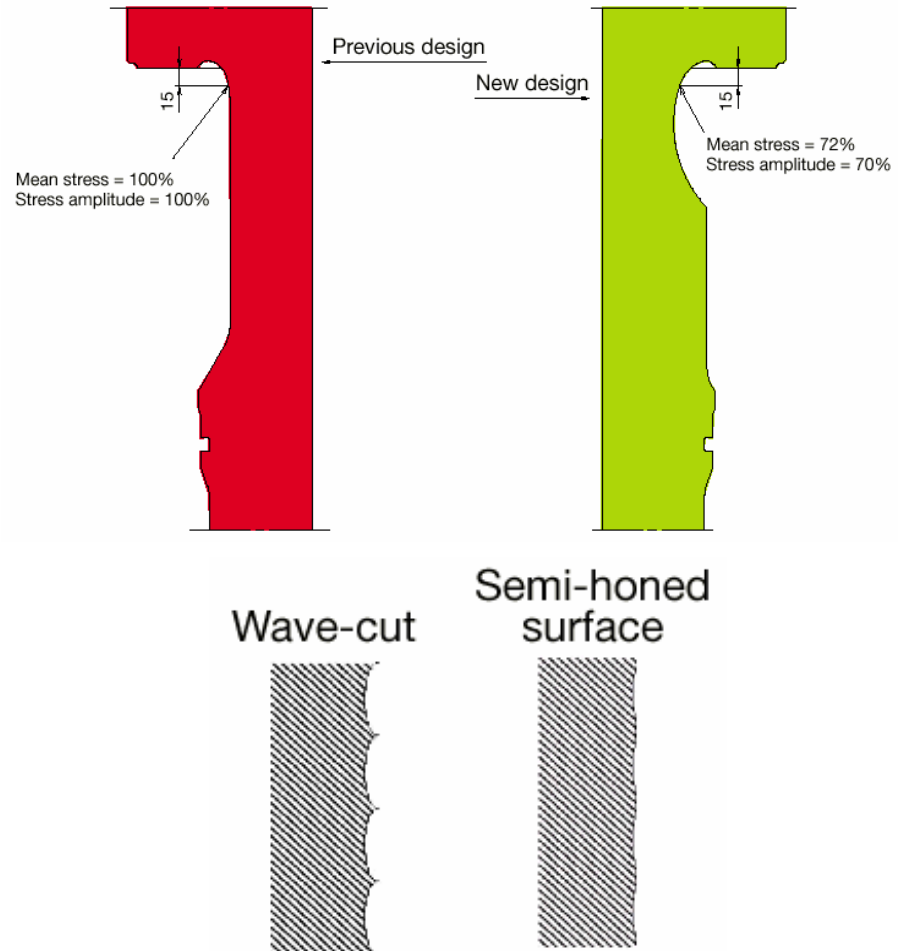
Expected lifetime 80,000 hours.

MD-C produced liner

- Always made according to latest design
- Lower part of liner has been modified to reduce mean stress and stress amplitude
- Wave-cut and semi-honed surfaces

MD-C supply

- Ensures correct liner material for the original piston ring pack
- Ensures correct port height
- Ensures correct angle and number of lubricating holes



Cylinder liner 90MC/MC-C, 80MC/MC-C



Original design

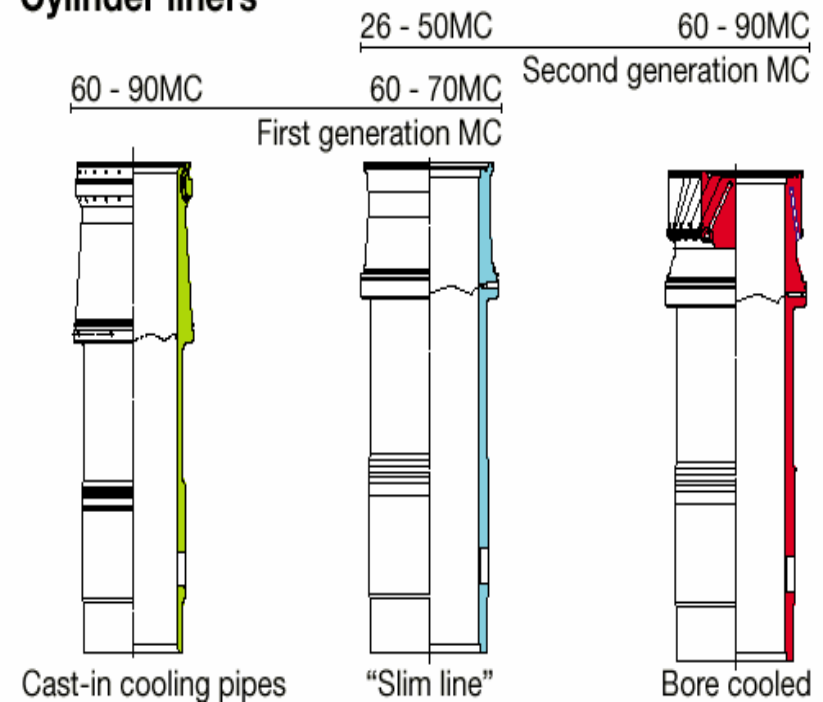
90MC/MC-C expected lifetime 80,000 hours.

80MC/MC-C expected lifetime 70,000 hours.

Liners produced by MD Copenhagen

Always made according to latest design.

Cylinder liners



Cylinder liners

90 MC/MC-C, 80 MC/MC-C



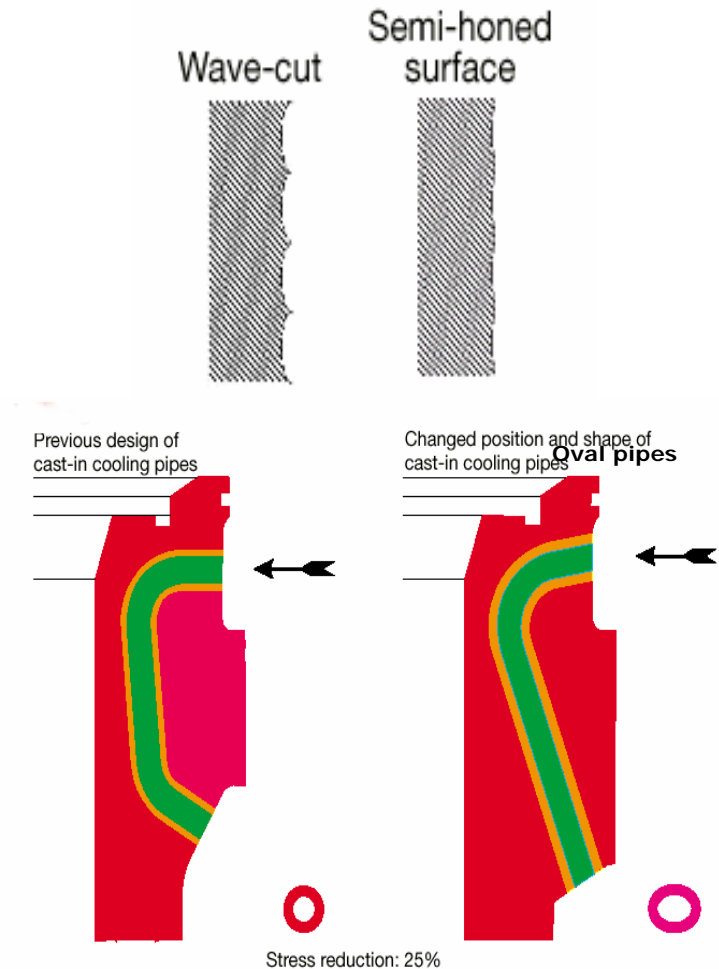
MD-C produced liners

All types with wave cut and semi-honed surfaces.

Cast-in in cooling pipes with oval cross-section and one bend.

MD-C supply

- Ensures correct liner material for the original piston ring pack.
- Ensures correct port height.
- Ensures correct angle and number of lubricating holes.



Cylinder liner, 70 MC/MC-C, 60 MC/MC-C



Original design

70 MC/MC-C expected lifetime 70,000 hours.

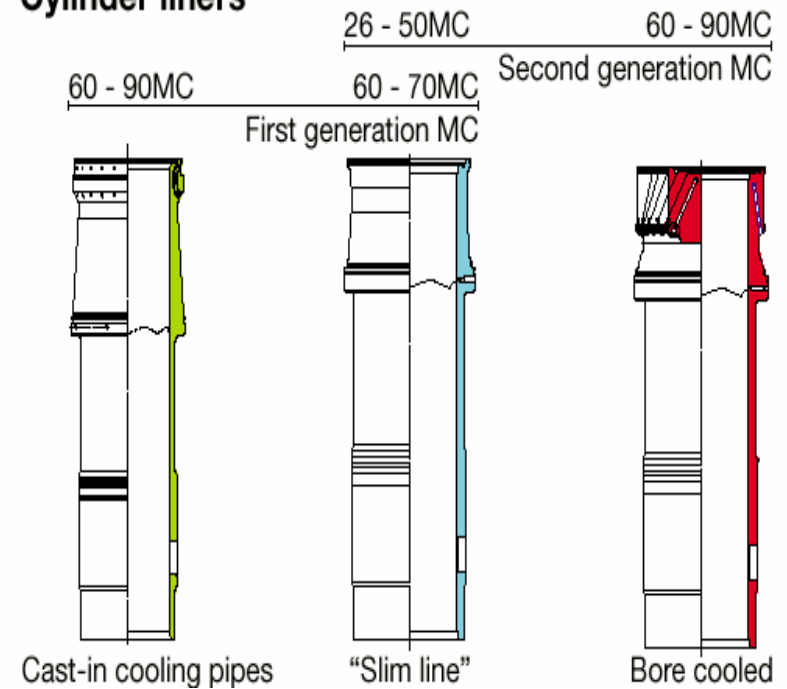
60 MC/MC-C expected lifetime 60,000 hours.

MD-C produced liners

Always made according to latest design.

Bore-cooled liner with correct number of cooling bores
(increased from 24 to 30 for S type).

Cylinder liners



Cylinder liner 70 MC/MC-C , 60 MC/MC-C



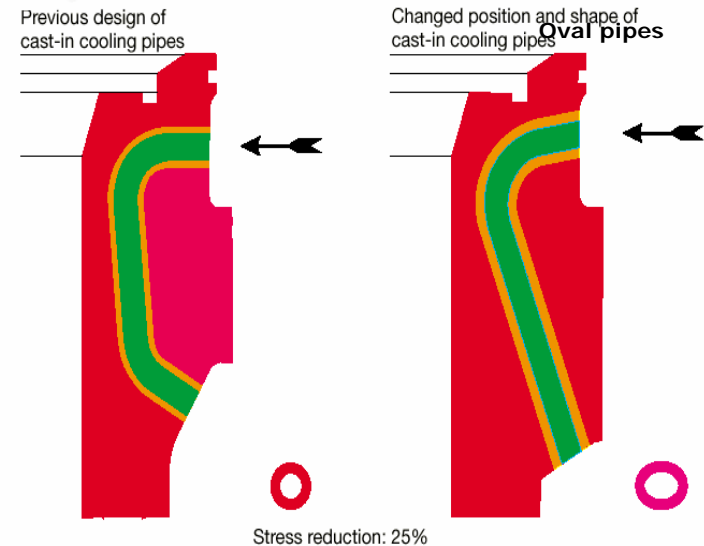
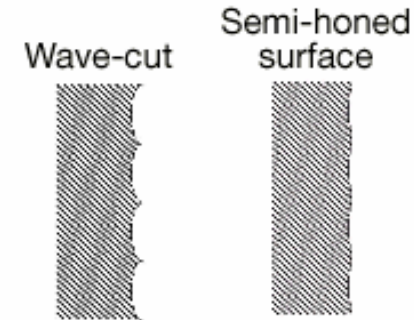
MD-C produced liners

All types with wave cuts and semi honed surfaces.

Cast-in cooling pipes liner with oval pipes and one bend.

MD-C supply

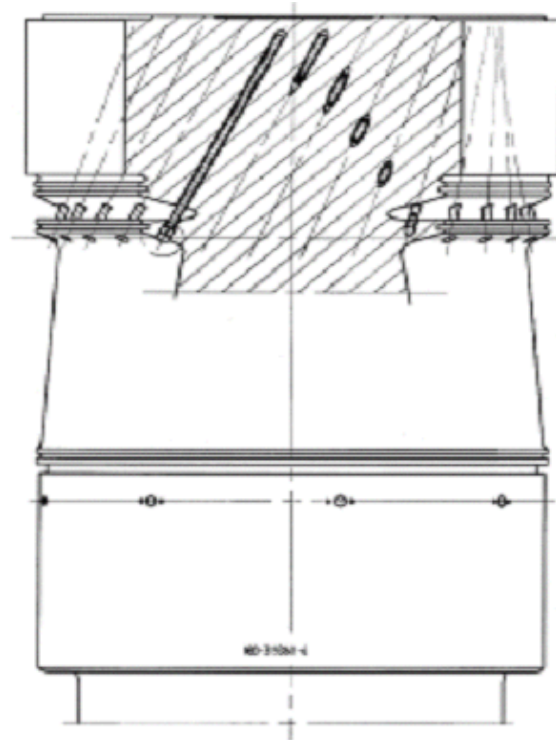
- Ensures correct liner material for the original piston ring pack.
- Ensures correct port height.
- Ensures correct angle and number of lubricating holes.
- Ensures correct design: Slim liner or liner with casting cooling pipes.



Cylinder liner 70 MC/MC-C, 60 MC/MC-C



Cylinder liner for S70MC-C



The number of cooling bores have been increased from 24 to 30

Cylinder liners, 50 MC/MC-C, 46 MC/MC-C, 42 MC, 35 MC, 26 MC



Original design

50MC/MC-C:

Expected lifetime 60,000 hours

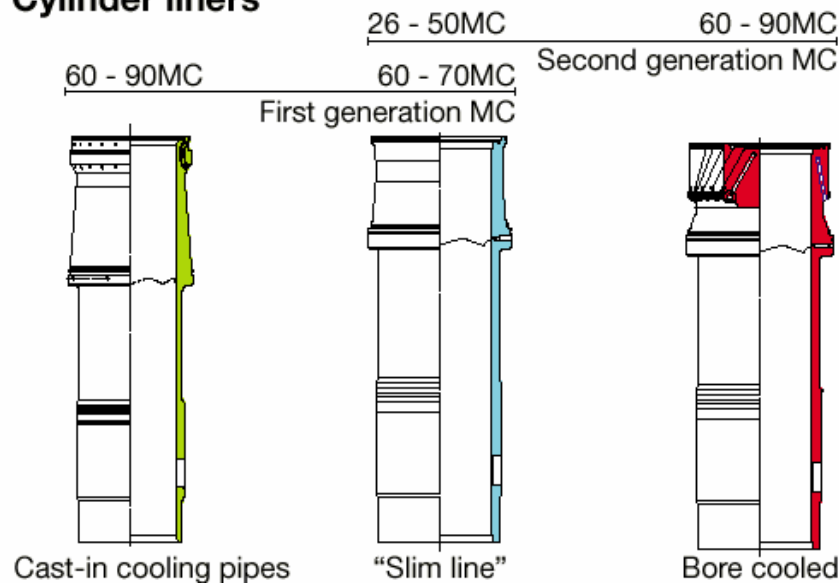
46MC/MC-C, 42MC, 35MC:

Expected lifetime 50,000 hours

26MC:

Expected lifetime 40,000 hours

Cylinder liners



Cylinder liners, 50 MC/MC-C, 46 MC/MC-C, 42 MC, 35 MC, 26 MC



MD-C produced liners

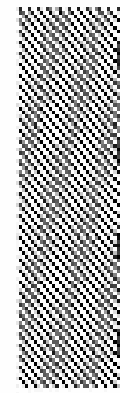
Always produced to the latest design.

Produced with wave-cut and semi-honed surfaces.

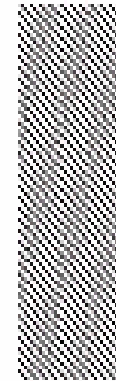
MD-C supply

- Ensures correct liner material for the original piston ring pack.
- Ensures correct port height.
- Ensures correct angles and number of lubricating holes.

Wave-cut



Semi-honed
surface



Cylinder Condition



Cylinder liner standard as per 981001

MC-engines

80/90/98

Bore cooled

Piston cleaning ring (PC-ring)

Tarkalloy-C

Dry cylinder frame

60/70

Bore cooled (except S60MC + S60MC-C)

Tarkalloy-C (S60MC-C – Tarkalloy-A)

Dry cylinder frame

26/35/42/46/50

Slim liner

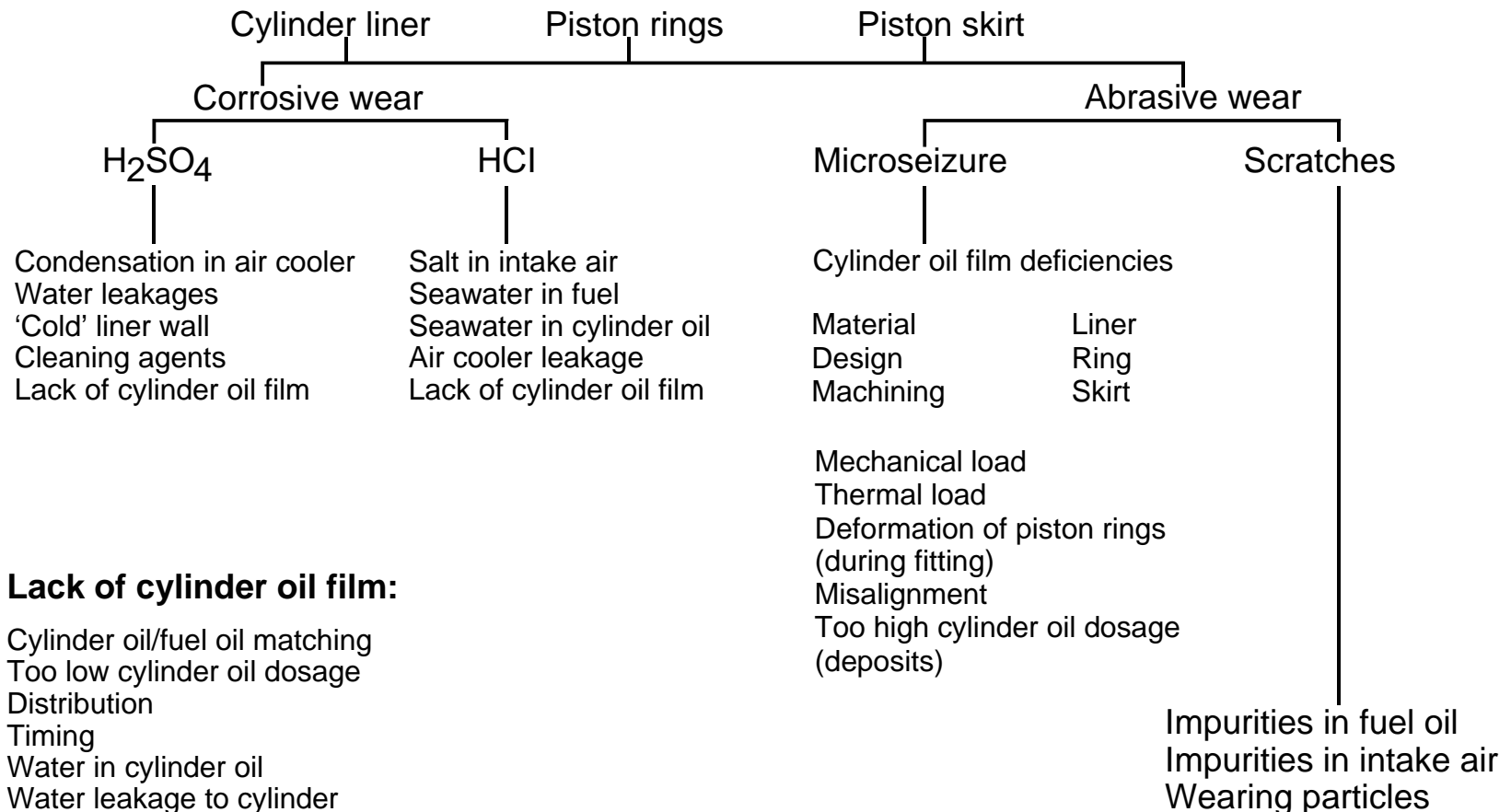
Tarkalloy-C

Dry cylinder frame (except L35/42)

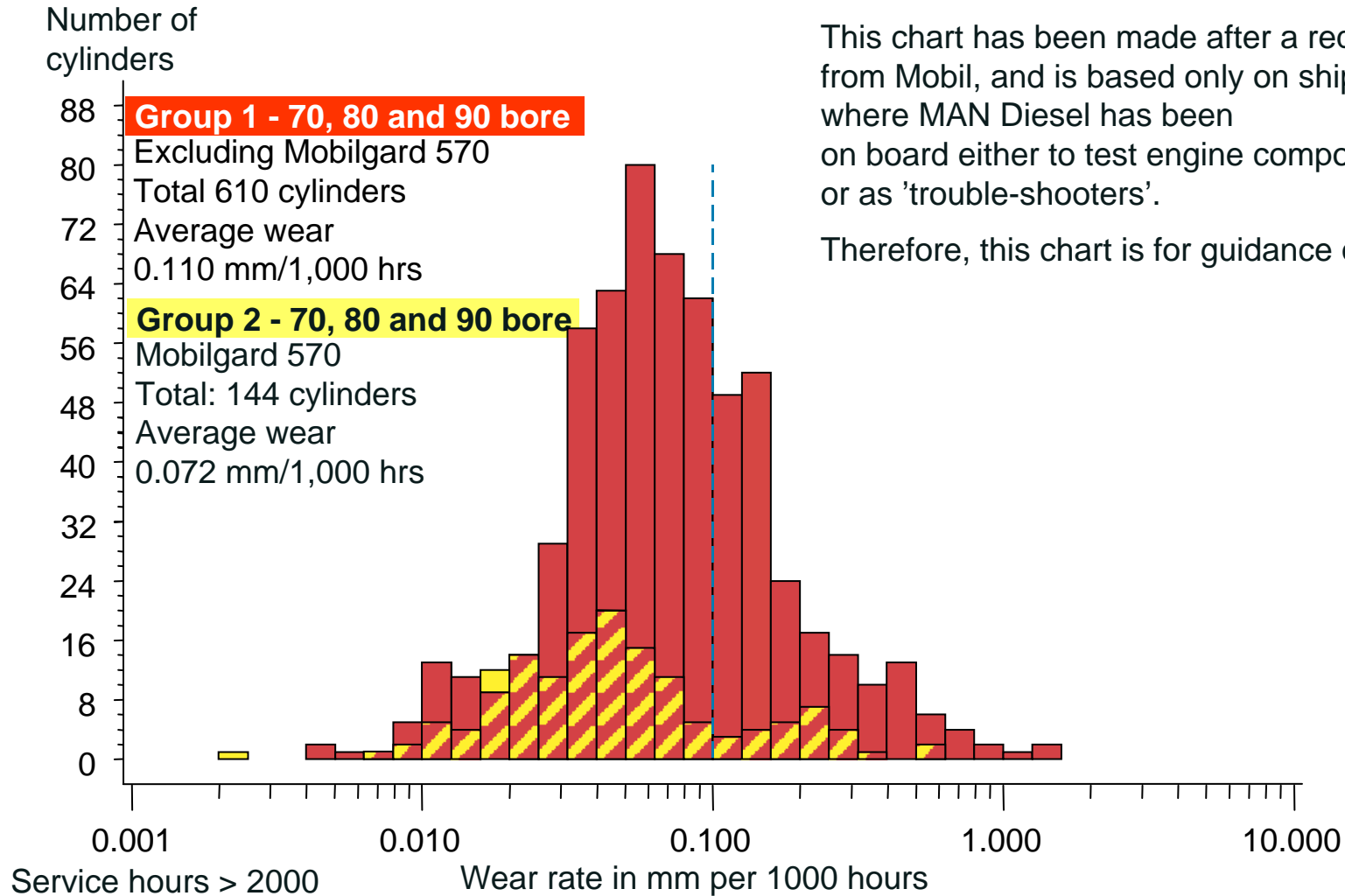
Service Experience



Factors influencing cylinder wear



Cylinder Liner Wear Rate – MC-engines



This chart has been made after a request from Mobil, and is based only on ships where MAN Diesel has been on board either to test engine components or as 'trouble-shooters'.

Therefore, this chart is for guidance only.

Cylinder Liner and Cylinder Frame



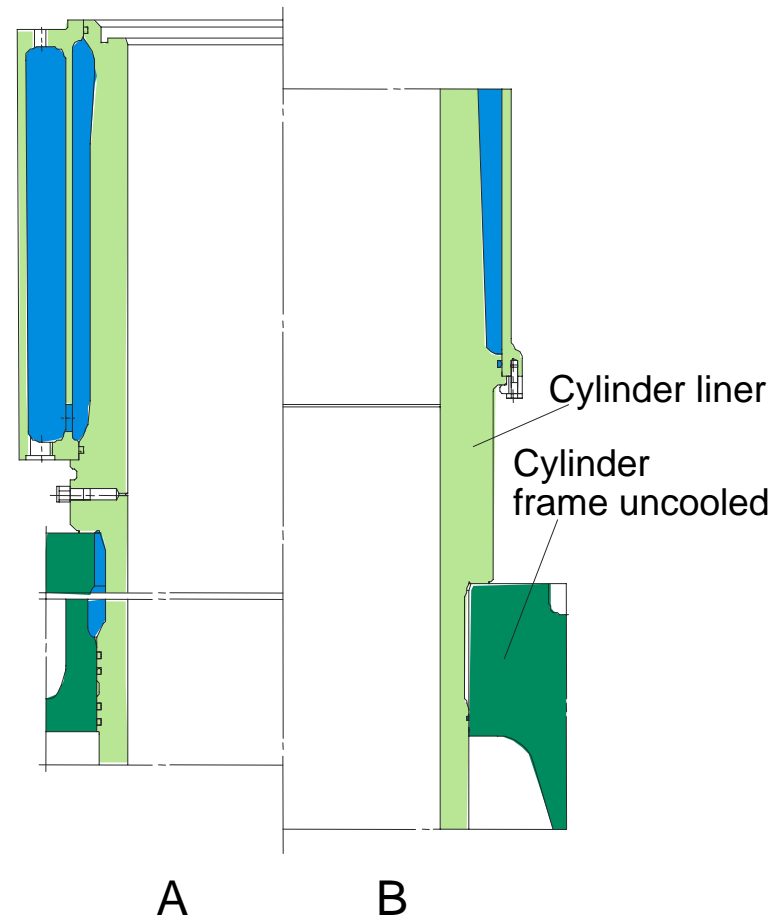
A: Previous design

Cold corrosion on cylinder liners has been experienced in some cases

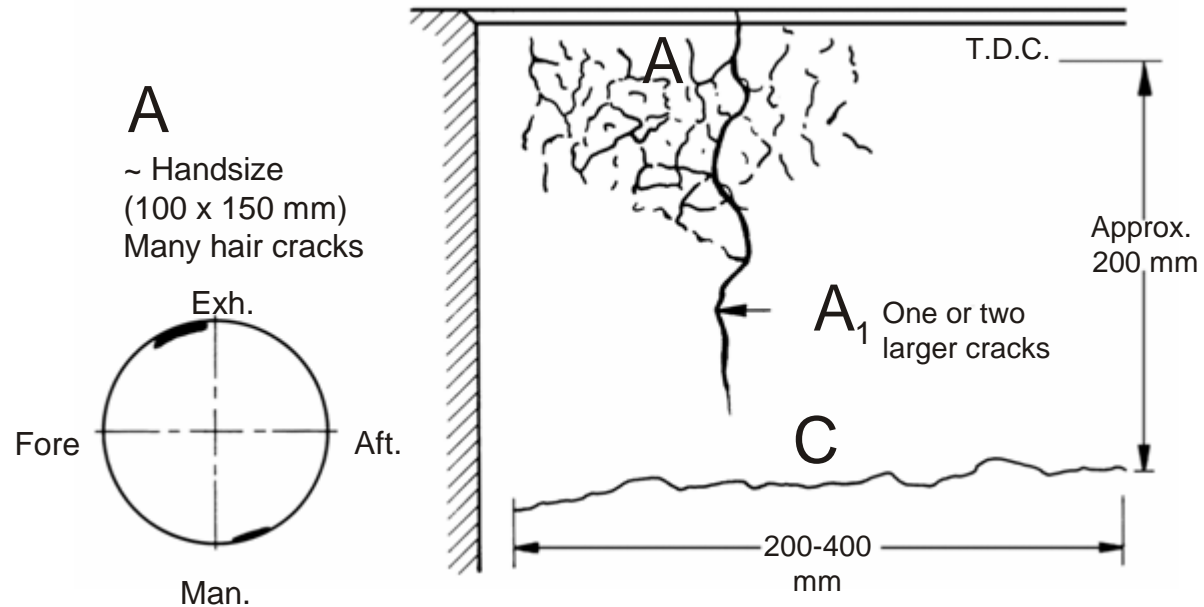
B: New design

Using an uncooled cylinder Frame, the temperature on the running surface has been increased in the lower part of the cylinder liner by about 60°C

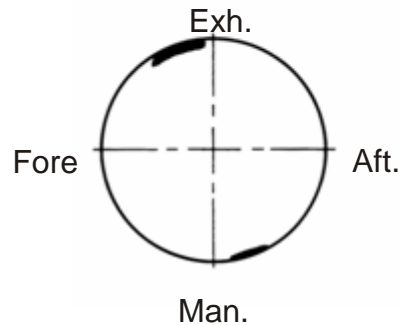
Good experience
The general cylinder condition is improved



Cylinder Liner Crack Types



A
~ Handsize
(100 x 150 mm)
Many hair cracks



C
Blow-by crack:

Position of C-crack approx. between lowermost ring and skirt upper edge.

Two upper rings have lost tension and are possibly also broken.
Furthermore, ring Nos. 3 and 4 might be sticking.

Points to be checked/modified:

- Performance (VIT, TC)
- Atomizers (small holes, rounded inner edges)
- Modified piston ring material

Cylinder Condition



Considerations

Problem	Reason	Countermeasure
Low TBO Sticking piston rings Broken piston rings High wear	Incorrect cylinder lube oil feed rate	For immediate improvements: Increase cylinder oil dosage Grading between S and K/L engines SL 94-318
High cylinder liner wear	Cold corrosion	Cooling water bypassing the cylinder frame
	Bore-polish	Stationary carbon scrape ring
	Insufficient oil distribution	Two-stage lubrication
Insufficient gas sealing Collapsed rings Broken rings	Relatively small gas buffer volume around the top land	High top land
	Increased thermal load of especially top and second rings	High top rings
		Improved material strength of top rings
		GT-CL top ring
High piston ring wear	Increased load on top ring	Ceramic coating of top ring
Running-in problems Micro seizures and scuffing	Material incompatibility	Compatibility between rings and liner material
	Mismatched surface roughness	Semi-honing of liners
		Lube oil performance
		Others?

Cylinder Condition



Piston cleaning ring

