



Low Force Concept



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Low Force Concept

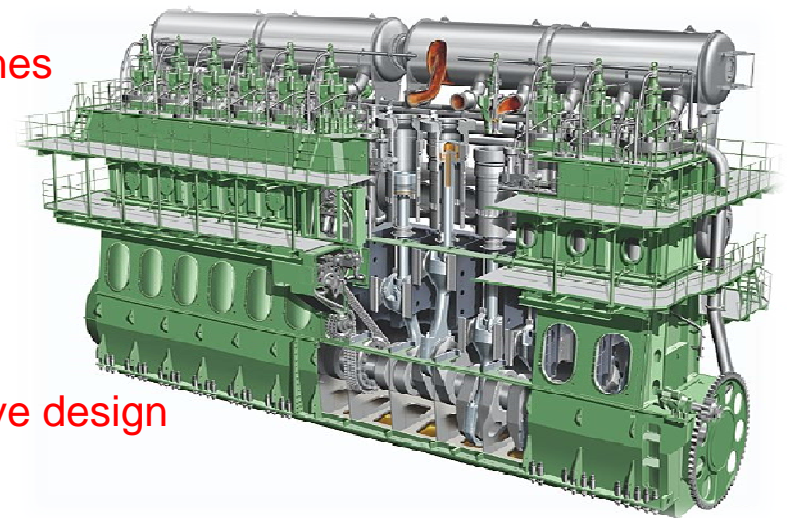


Purpose

- Avoiding the open damper and consequently complex design and expensive Nimonic spindle
- Using same design of exhaust valve on ME and MC engines
- Introducing the "Dura Spindle" exhaust valve on ME engines

Requirement:

- Avoid any further increase of SFOC related to exhaust valve design



Low Force Concept



Low Force concept in brief

Focus on reliability

- Cavitation and cracked drain pipes.
- Removal of sealing oil unit.

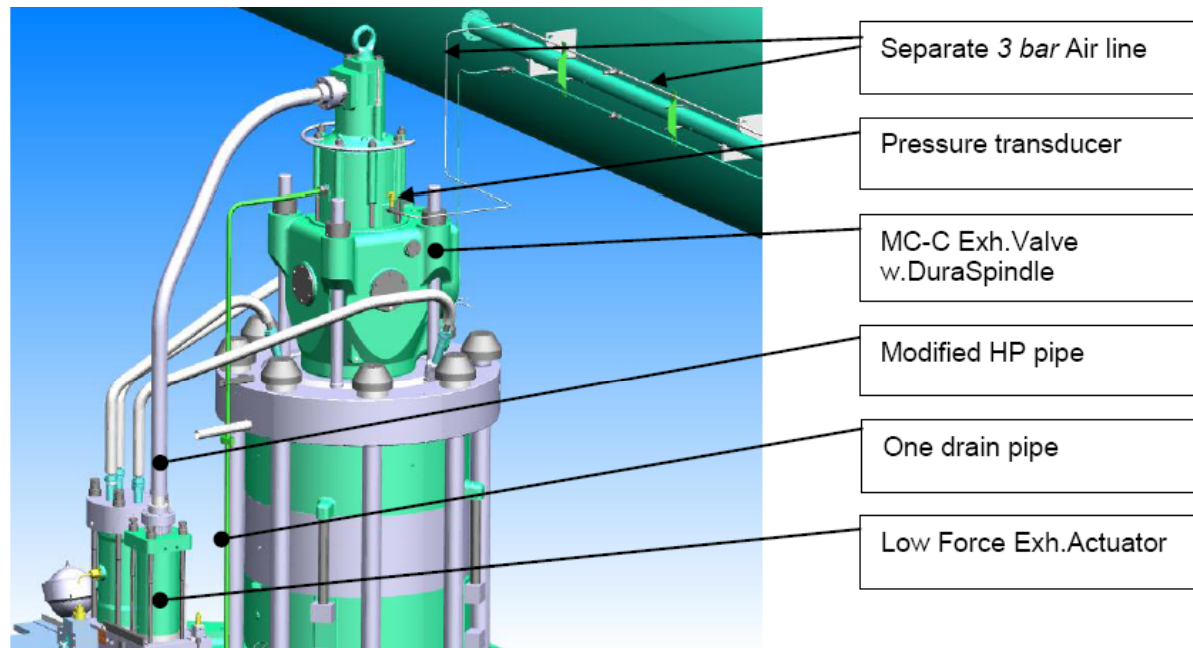
Focus on cost:

- DuraSpindle application for ME engines.
- COL instead of sealing oil unit.
- Unified design on MC/-C & ME-C

Focus of SFOC:

- Lower Force
- Lower loss
- Lower hydr. flow

Low Force general concept



Low Force Concept

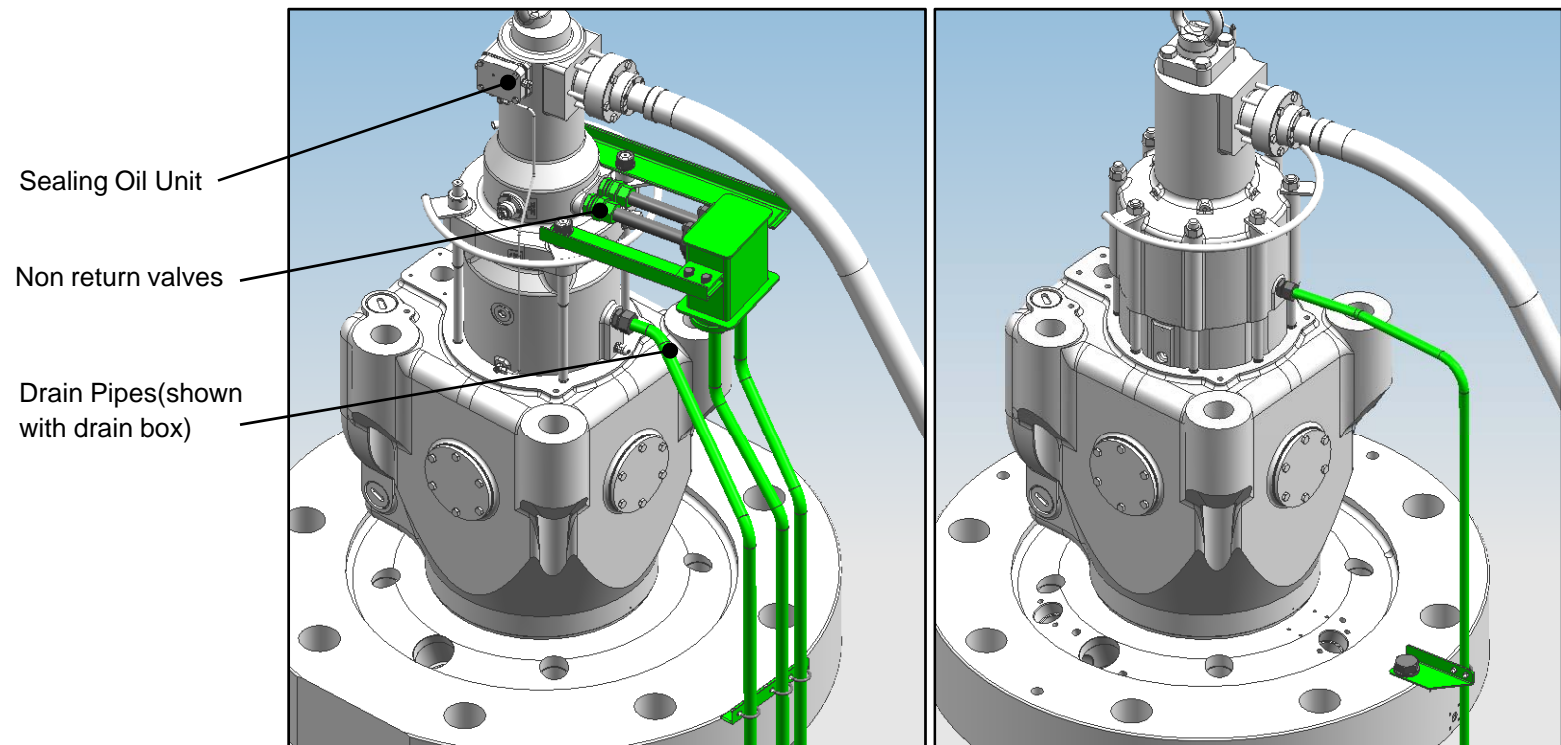


Low Force Exh.Valve

- **Drain pipe arrangement removed** – *simple, with less potential failures*
- **Non return valves removed** – *simple, with less potential failures*
- **Sealing Oil Unit replaced by Controlled Oil level(COL)** – *simple & more reliable lubrication of the spindle guide.*

Present ME/-C design.(High Force)

Low Force

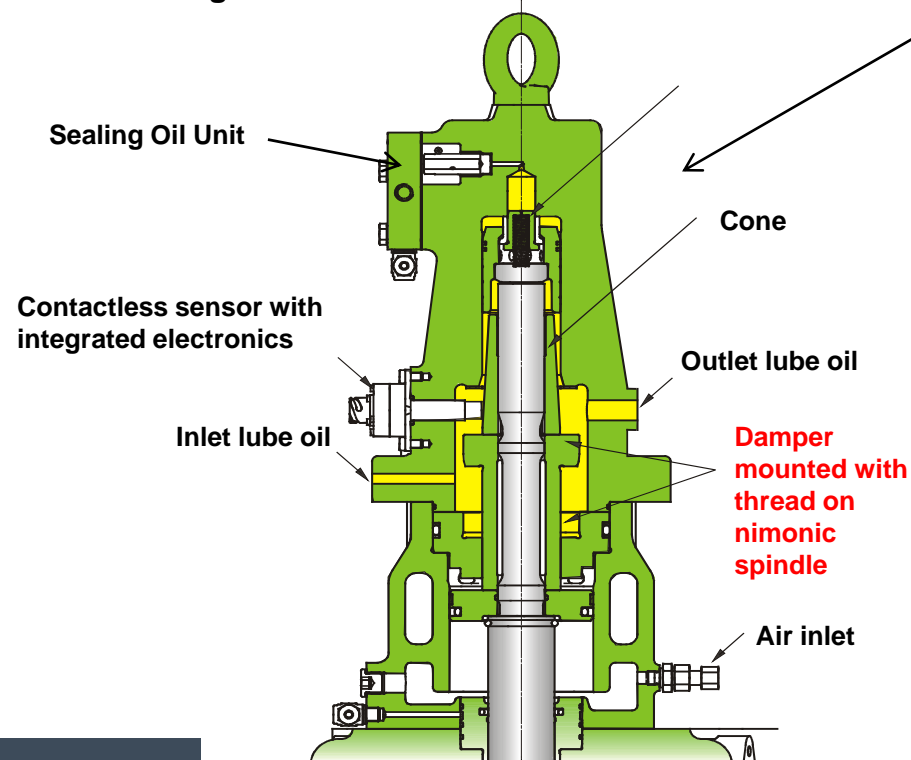


Low Force Concept



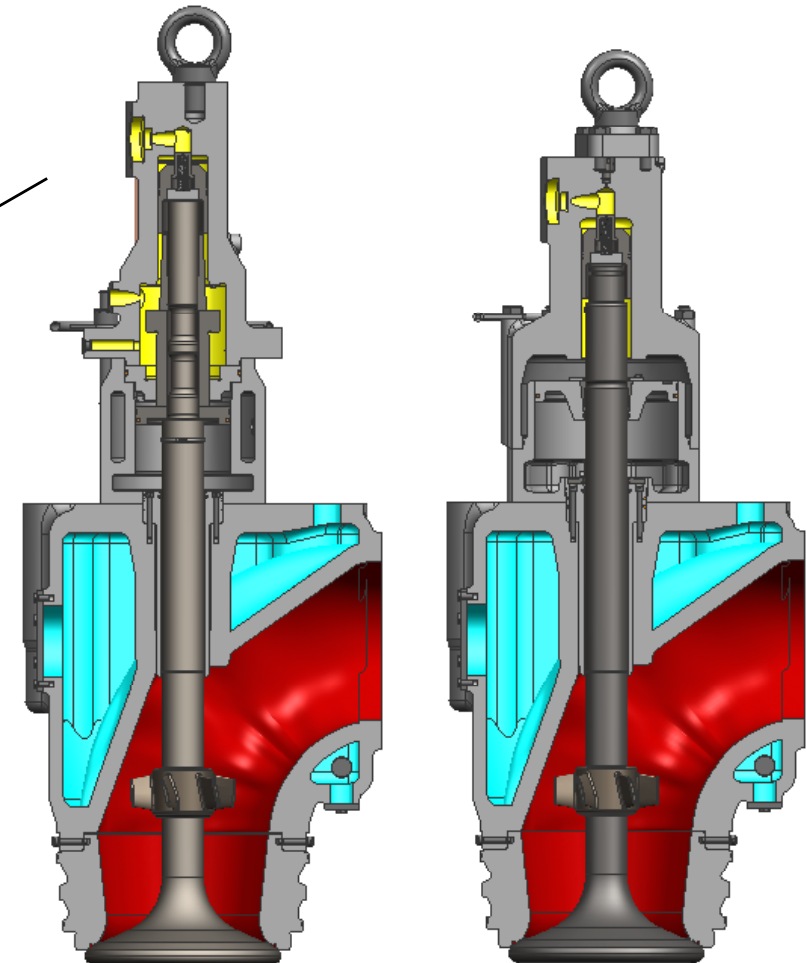
Low Force Exh.Valve

- **DuraSpindle application for ME engines.**
 - Potential cost saving of 200000USD for a 12K98ME/-C .
- **COL instead of Sealing Oil dosage unit.**
 - fewer components.
- **Unified design on MC/-C & ME-C**



High Force

Low Force(MC/-C)

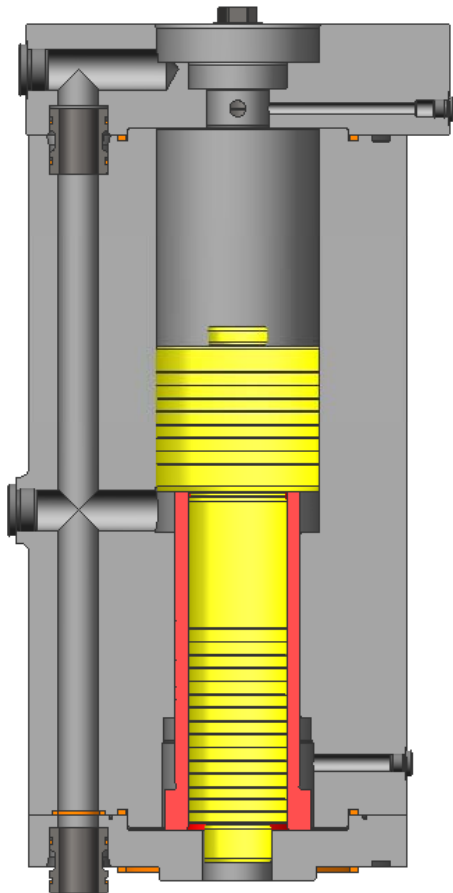


Low Force Concept

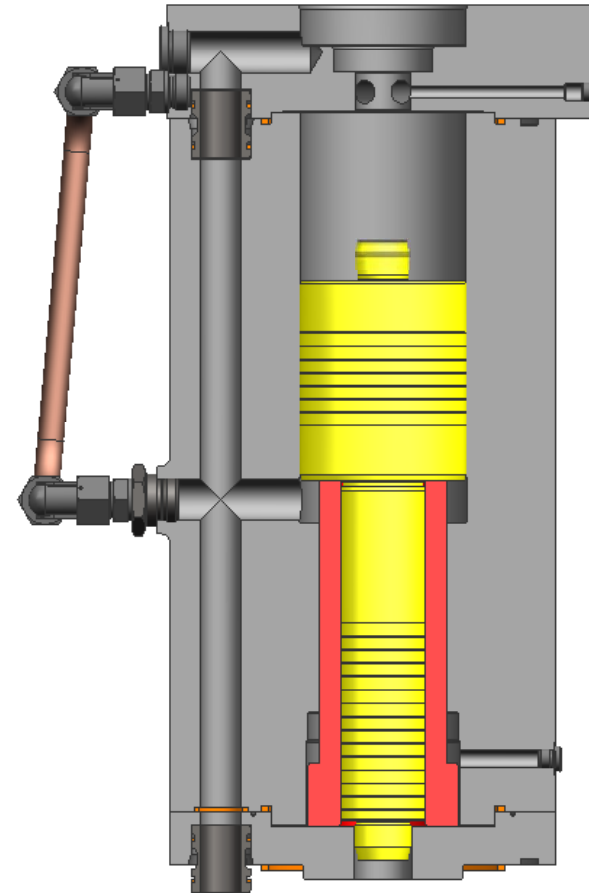


Low Force Exh.Actuator

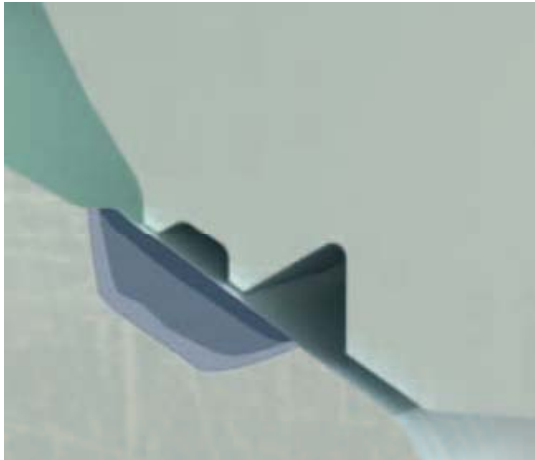
High Force actuator



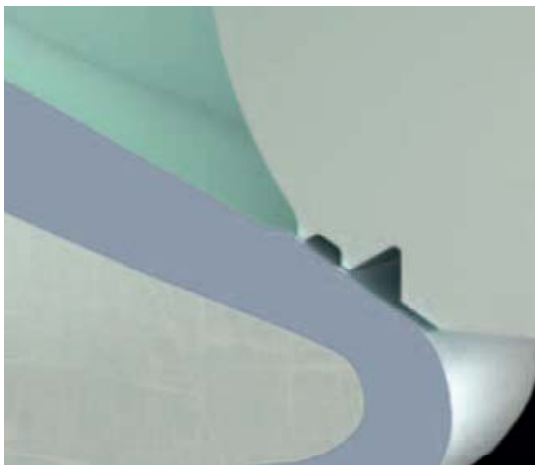
Low Force actuator



Low Force - DuraSpindle



Hardness of DuraSpindle - ■ 400HV ■ 450HV ■ 500HV

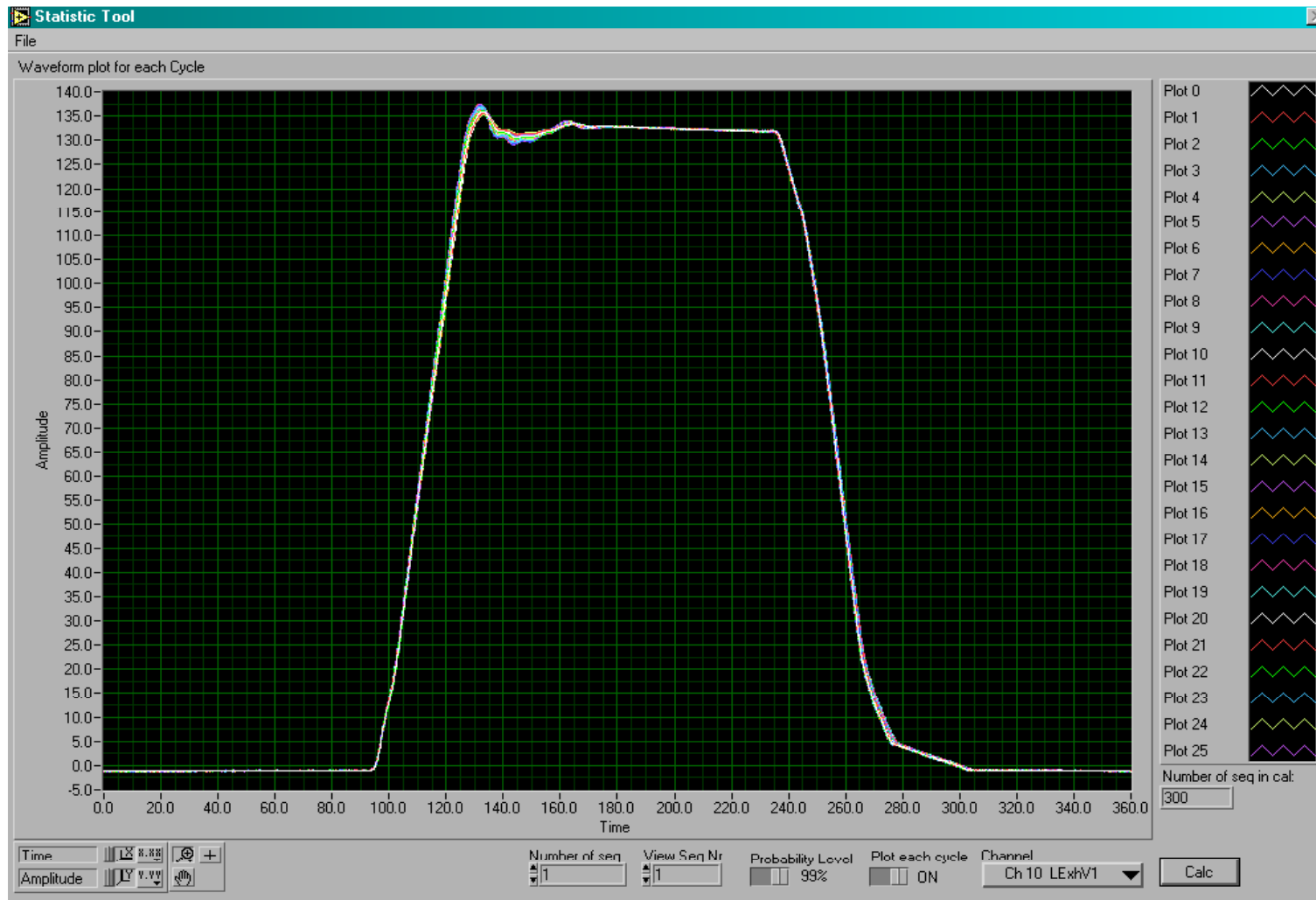


Hardness of Nimonic valve - ■ 400HV

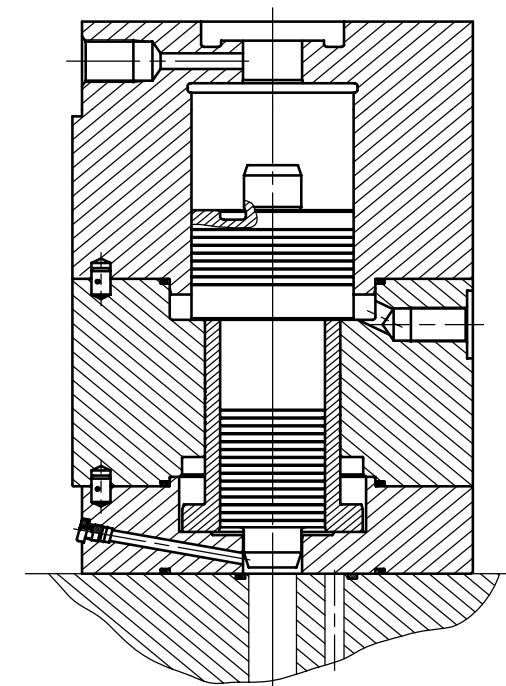
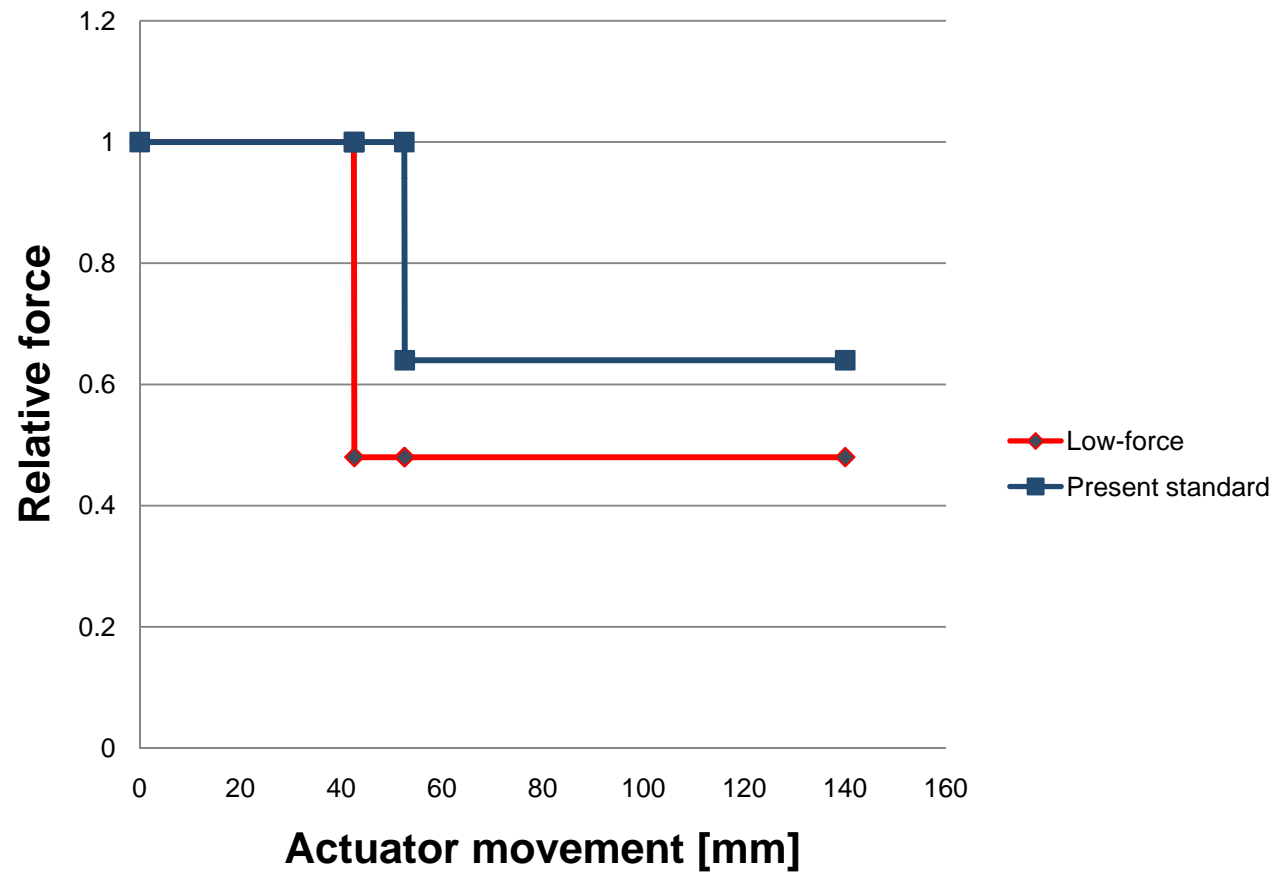


Low Force - Full Scale Test

-H2095, 12K98ME, 300 cycles v. 100% load



Actuator force: “Low force” and present ME standard.

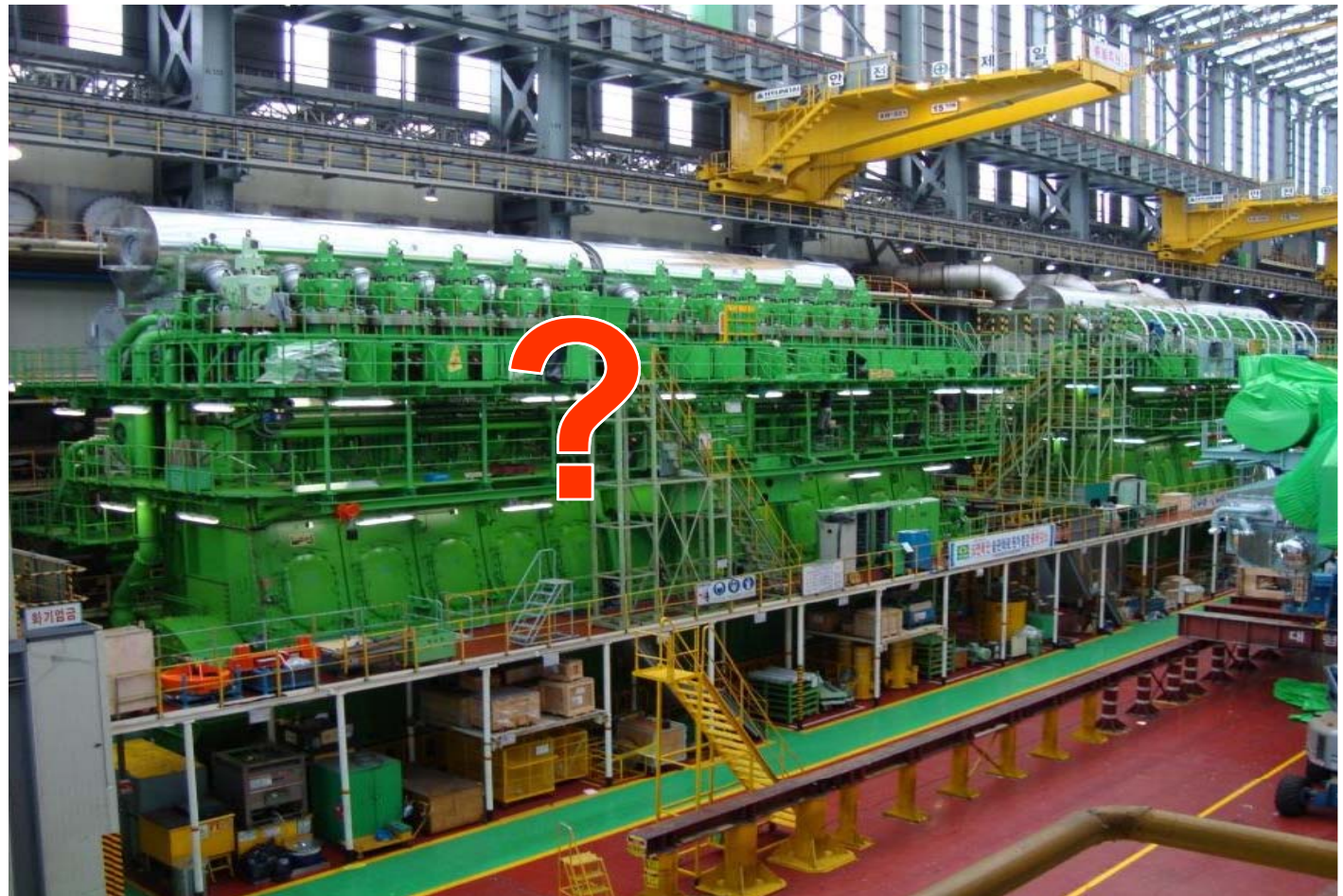


Low Force Concept



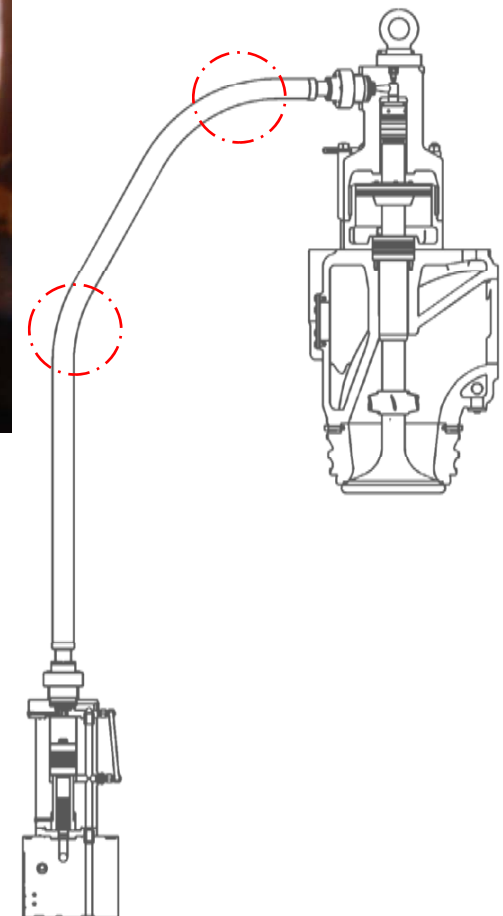
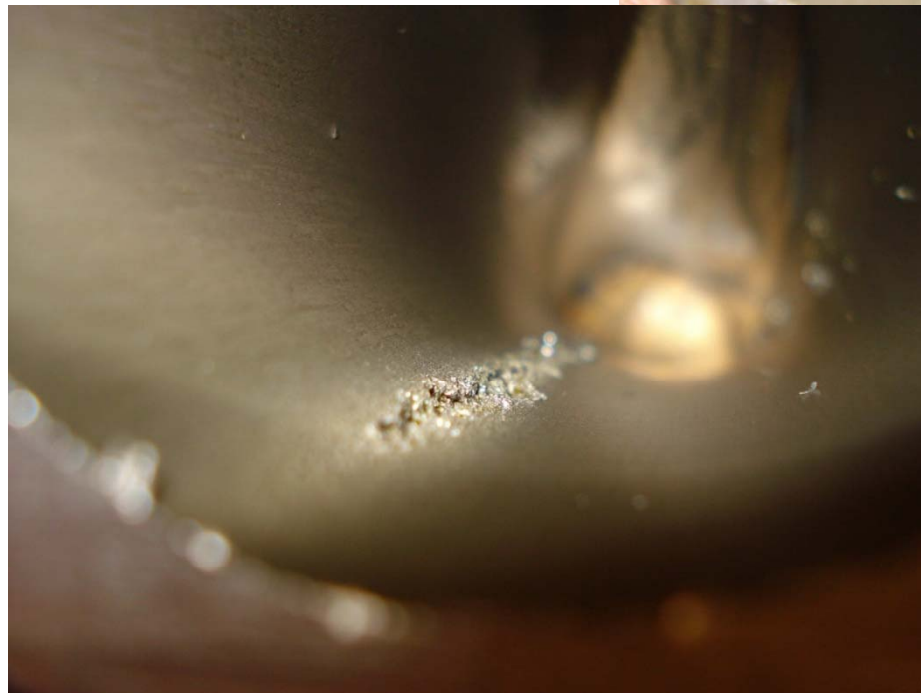
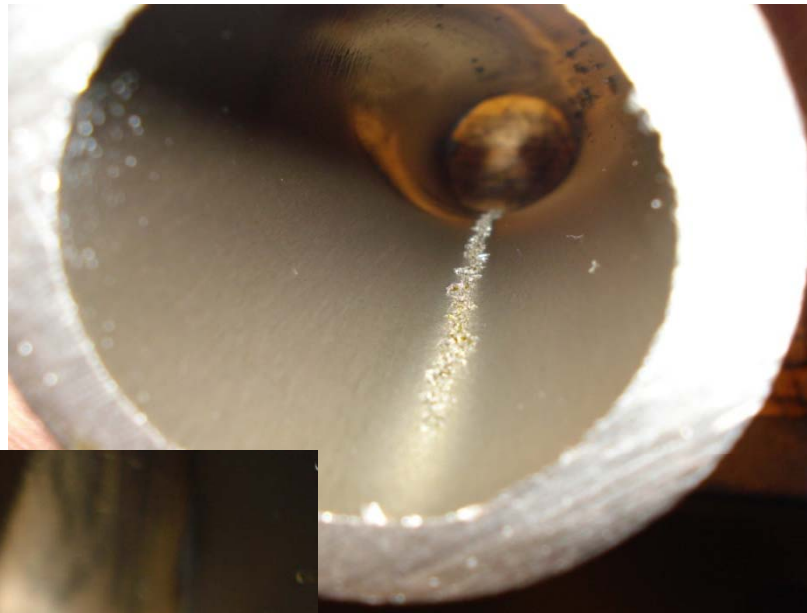
”Things we hope to eliminate”

– *or solve...*



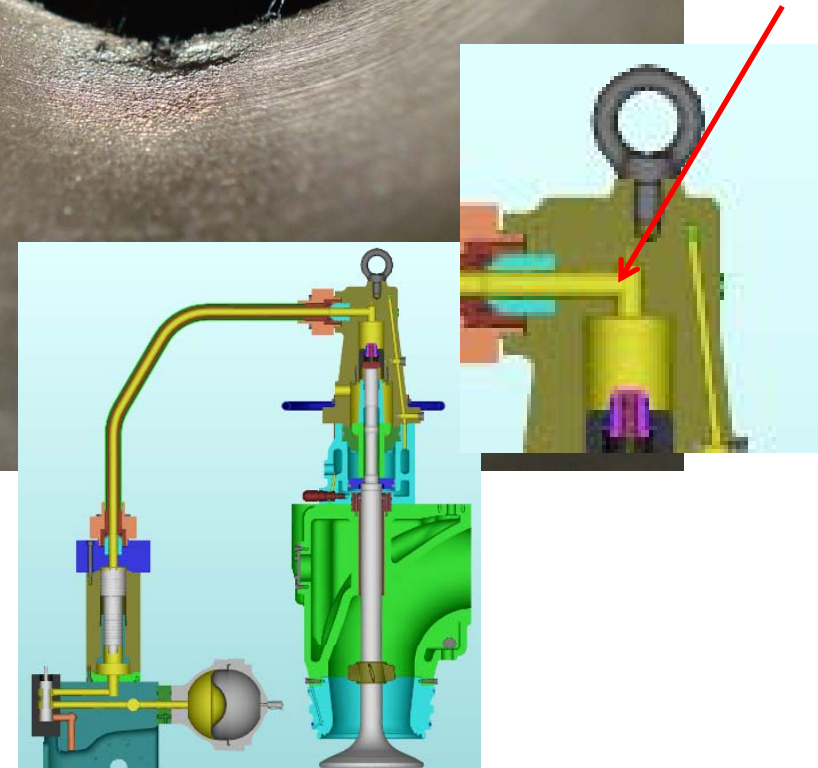
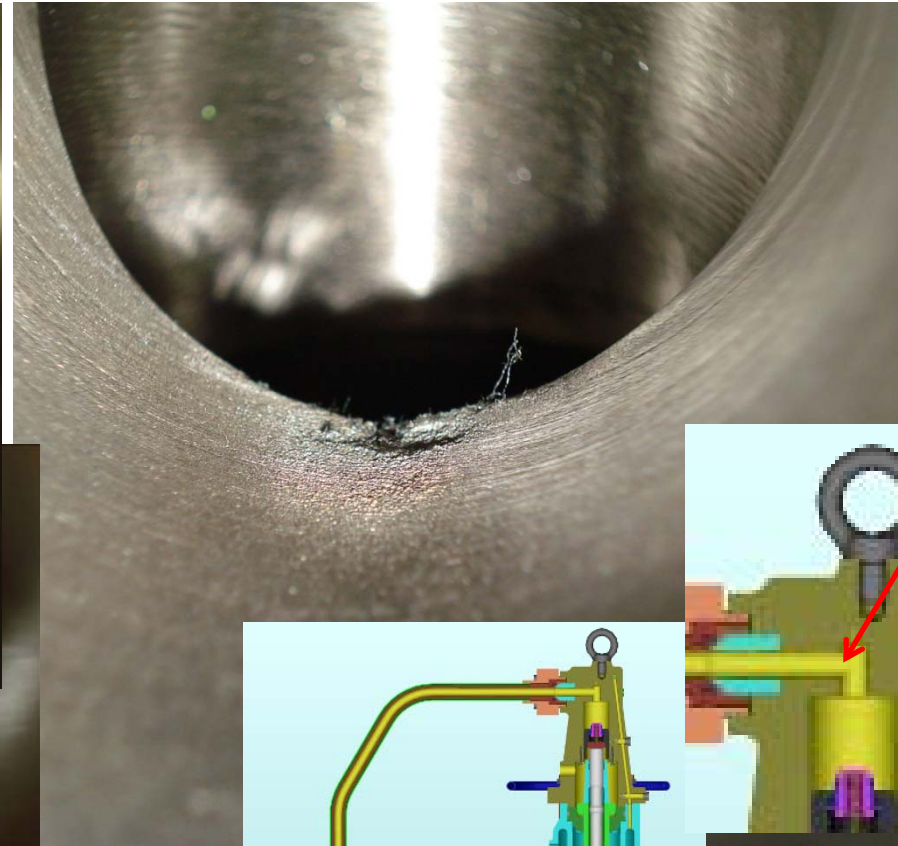
High Force Exh.Valve

Cavitation in Hydr.Pipe



High Force Exh.Valve

Cavitation in Oil Cylinder



- after rectification.



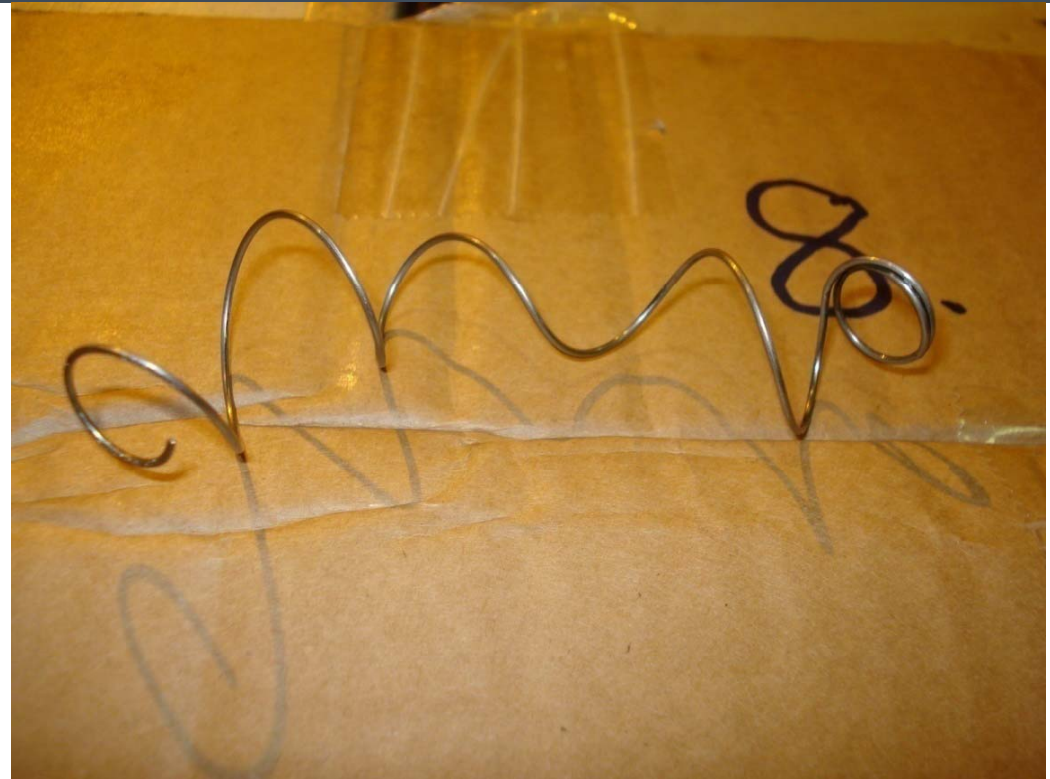
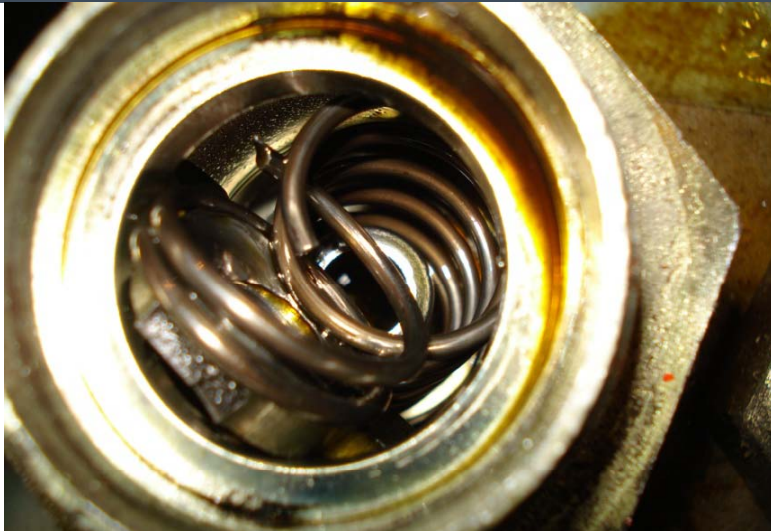
High Force Actuator

Cavitation in Oil Cylinder



Non return valve

Exh.valve + Actuator



Low Force Concept - status



In service:

5 x 10 & 12K98ME

= 66 cylinders

Passed shop test:

1 x 6S90ME-C8

Scheduled engines:

46 x K90ME-C6 & S90ME-C8

- or 364 cylinders



High Force



Low Force





Thanks for your attention!



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