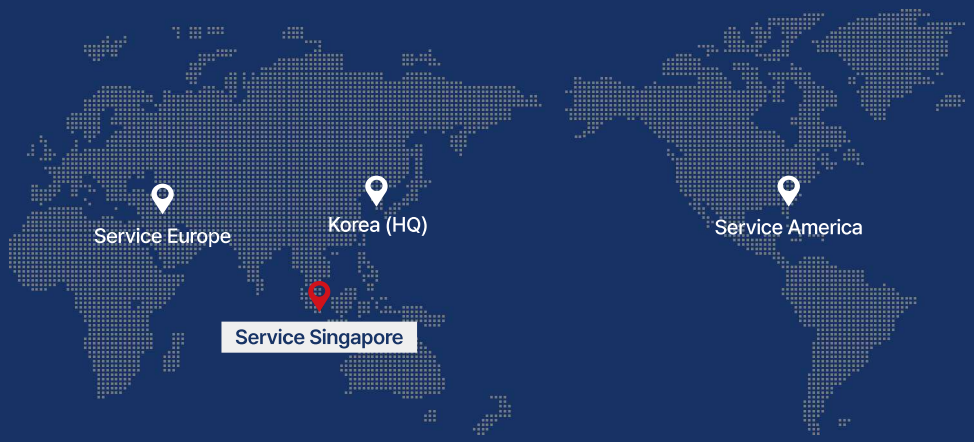
STX Service Singapore Mission

At STX Service Singapore, our mission is to develop innovative solution programs that enhance engine performance and to engineer cutting-edge solution programs that elevate engine performance.
We are excited about the future and the opportunities to innovate together.



STX Service Singapore Pte. Ltd.

stx Engine

✔ Managing Director
Soon Joon, Choi
E. stx-servicesg@stx-service.com
T. +65 9651-9879

A. Parts Sales team
Bong Hyun, Kang(Sales Manager)
E. stx-parts-sg@stx-service.com
T. +65 9019-9015

B. Service Sales Team
Bum Young, Jung(Sales Manager)
E. stx-servicedept@stx-service.com
T. +65 8228-4290

stx Service Singapore

M/E CYLINDER LINER CONDITION MONITORING & RECONDITIONING SOLUTION

Contact STX Service Singapore for Main engine Cylinder Liner Solution Service

The STX Service Singapore's Main Engine Cylinder Liner Solution Service enables time-effective data collection for cylinder liners and piston rings, ensuring the cylinder liner remains in optimal condition.

Solution 1.
Cyl. liner Inspection & Analysis (Onboard)

· Cylinder liner Measurement (LDM)
· Piston Ring Thickness Measurement (CTM)
· Cyliner liner condition photo (LLC)

✔ Only 1~2 hours is required per cylinder without removing cylinder covers.

Solution 2.
Cylinder liner honing & wavecut grinding (Onboard or Workshop)

· Cylinder liner honing repair (HON2A)
· Cylinder liner wavecut grinding repair (WGM)
· Cylinder liner wear edge milling repair (VKS)

✔ Requiring 8~14 hours for honing and 6~10 hours for wave cutting repair per cylinder.

SERVICE LOCATION

1. STX SINGAPORE WORKSHOP
2. ANCHORAGE IN SINGAPORE
3. SHIPYARD IN SINGAPORE

SERVICE ENGINE MODEL

1. MAN 50 ~ 98 ME/MC
2. WIN GD 58~96 RTA, RT-Flex
3. ETC (Bore size 500 ~ 1000 mm)

STX suggests piston & fuel pump overhaul service along with the honing & wave cut repair

Importance of Cylinder Liner Condition Monitoring

Low-Sulphur Fuel Oil Legislation

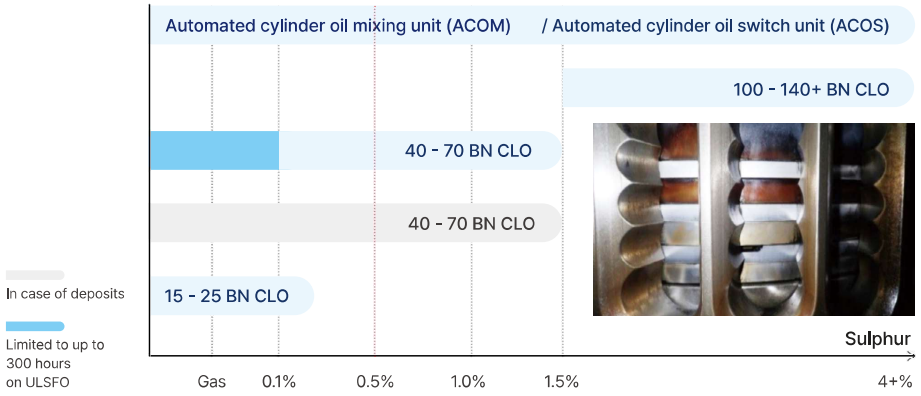
Low-Sulphur Fuel oil

In preparation for the 0.50% S fuel era, it is necessary to update the lubrication guideline for STX-MAN engines. This guideline aims at facilitating lubrication of engines operating on 0.50% S very low sulphur fuel oils (VLSFO), and 0.10% S ultra-low sulphur fuel oils (ULSFO), which include both distillate (DM) and residual grades (RM) according to ISO 8217. Operation using low-flashpoint fuels such as liquefied natural gas (LNG), ethane, methanol and liquefied petroleum gas (LPG) is furthermore included in our recommendation for 0.10% S ULSFO operation. We recommend that engines operating on VLSFO or ULSFO be fitted with cermet coating on all piston rings.

Cylinder Oils

We recommend using cylinder oils which have obtained a No Objection Letter (NOL) from engine maker. Due to the reduced sulphur content in the fuel combined with the current range of cylinder oils on the market, we need to update our lubrication strategy recommendation. For low-sulphur fuels, keeping piston cleanliness is equally important as controlling corrosive wear today when operating on high-sulphur fuel. Cylinder oil performance and cleaning ability are key factors to maintain good cylinder condition.

Monitoring the iron content from drain oil analyses is necessary to obtain good cylinder condition at the lowest possible feed rate in the future fuel environment. In case higher BN cylinder oils are needed to keep the engine clean from deposits, attention must be paid to secure against cylinder liner bore polish. When using a high-BN cylinder oil, the risk of top land deposits increases. The deposits may polish on the cylinder liner surface and cause polished areas which can initiate a cylinder liner scuffing. A way to reduce the risk is to alternate between high- and low-BN cylinder oil using a high-BN oil for one week and a low-BN oil for the next week. The time for using high-BN should be adjusted to what is needed to keep the engine clean from deposits.

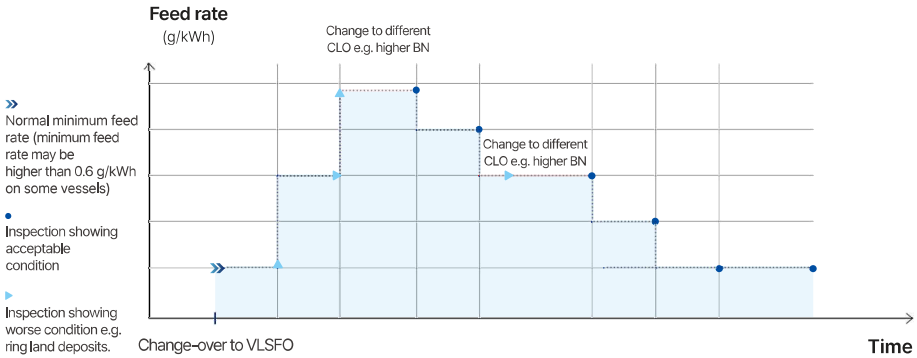


Feed rate

Vessels in service, which have not yet optimised the feed rate for ULSFO or VLSFO operation, should start at the existing feed rate or 1.0 g/kWh and then reduce the feed rate based on inspections until the minimum feed rate is reached.

If signs of hard contact or micro-seizures on the rings, ring land deposits, or other abnormalities are observed before the minimum feed rate is reached, the feed rate has to be kept sufficiently high to avoid micro-seizures.

Deposit control



Monitoring and maintaining of Cyl. Liner condition

Maintaining of Lub.Oil BN and feed rate

The sensitivity of a 2-stroke engine to disturbances caused by inaccurate lube oil feed or type is well-known. To ensure economical operation, it's crucial to balance the alkali content of the lube oil, known as the Base Number (BN), and the oil feed rate with the fuel oil Sulphur content, thus preventing cylinder condition issues while minimizing excessive lube oil consumption.

Insufficient lube oil or low lube oil BN levels can trigger an abnormal phenomenon termed cold corrosion. In this scenario, unneutralized Sulphuric acid from combustion accelerates corrosion, leading to an elevated wear rate due to corrosion.

Conversely, an excess of lube oil or high BN levels may result in a condition known as bore polish. This occurs when the absence of corrosion causes the cylinder liner to glaze over, hindering its ability to act as an effective oil reservoir. In rare instances, calcium deposits can further exacerbate the issue by inducing hard contact between the piston crown and cylinder liner, resulting in liner scratching.

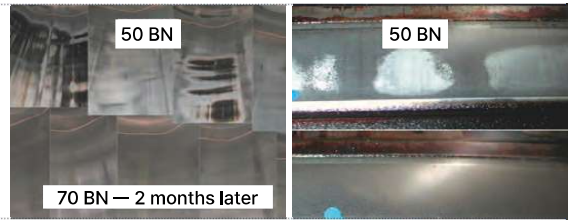
Both cold corrosion and bore polish contribute to increased cylinder wear rates and cylinder scuffing, underscoring the importance of proper lubrication and maintenance practices.

Identifying Cold Corrosion

Cold corrosion stands out as one of the most prevalent factors behind increased wear rates observed in cylinder liners and piston rings in modern engines. Observable corrosion patterns manifest on both the cylinder liner surface and Chromium-coated piston rings. Mitigating this corrosion entails employing a higher lube oil feed rate and/or a lube oil with a higher Base Number (BN), effectively curbing the corrosion process and subsequently reducing wear rates.

Detection of cold corrosion involves a visual examination of cylinder liners and piston rings, aided by the Liner Condition Camera (LCC). Additionally, wear on cylinder liners and piston rings can be quantified using the Liner Diameter Measuring instrument (LDM) and the Coating Thickness Measurement tool (CTM). Utilizing these tools does not necessitate extended engine downtime, typically requiring no more than 15 minutes. Furthermore, available test kits on the market enable the assessment of iron content and residual BN levels in scrape-down lube oil. These kits complement the specialized tools, facilitating adjustments to the lube oil feed rate to achieve an economically optimal level.

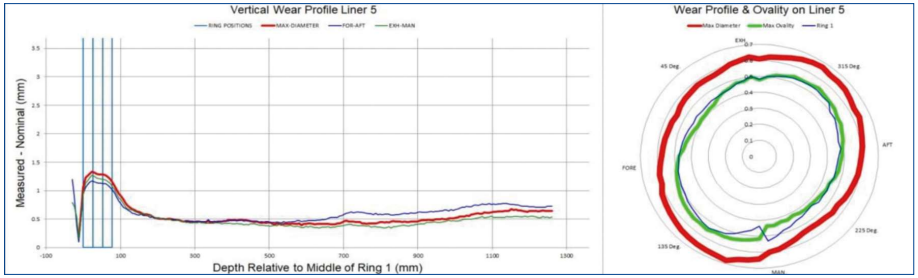
Cold corrosion shown as black lacquer in cylinder liner (Left) and oxidized chromium on piston rings (Right). After introduction of higher BN lube oil during two months of operation, the surfaces have normalized. Source: Castrol (CIMAC 2013).



Wear down pattern on M/E cylinder Liner

A trumpet-shaped distortion will always appear at the top of the cylinder liner after some time in service. A similar distortion can sometimes occur at the lower end of the liner. A steep trumpet shape in the liner will eventually prevent the piston rings from functioning properly. Over time, the cylinder liner will also become non-circular. Modern cylinder liners often attain a harmless oval shape due to thermal and mechanical deformation, with the ovality direction typically shifting along the stroke of the liner.

Under corrosive conditions, the liner shape can erode due to fuel plumes, forming a two-clover or three-clover shape in the upper part of the liner, which can disturb the piston ring function. Insufficient circumferential lube oil distribution can lead to a multi-clover shape that follows the lube oil quill distribution pattern, further disturbing the piston ring function. Consequently, clover leafing can become critical long before the official wear limit is reached, making it challenging to establish general recommendations for cylinder liners for engine designers. STX has extensive experience in interpreting cylinder geometry data and correcting it through honing. We can assist customers by recommending appropriate cylinder liner maintenance actions based on LDM measurement data and microscopy analysis of replica imprints.



Solution 1.
Cylinder Condition Monitoring & Inspection Service

LINER DIAMETER MEASURING INSTRUMENT (LDM)

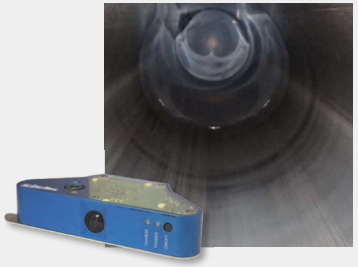
	For 2-stroke liners 500–980 mm bore
	Accurate measurement of cylinder wear and clover leafing without removing the cylinder cover
	Up to 26 measurement levels in about one hour per cylinder
	Easy understanding cylinder liner wearing down pattern and tendency
	Combined solution with piston ring coating measurement (CTM) & Liner wall condition check (Liner wall photo and replica test)
	Checking demand for Cyl. liner maintenance and repair solution (honing & wave cutting repair / Onboard, Workshop)
	Available for several engine makers, such as: Bergen, Caterpillar, MAN DIESEL, Sulzer, Wärtsilä, etc

COATING THICKNESS MEASUREMENT TOOL (CTM)

Measures the wear rate / remaining life time for coated piston rings. Liner time scale: ~1000 Rh. Measurement time: ~15 mins / liner.
Ideal for condition based monitoring of piston rings in 2-stroke engines. It measures non-magnetic coatings on magnetic base materials, such as chromium plated or plasma coated cast iron.

LINER CONDITION CAMERA (LCC)

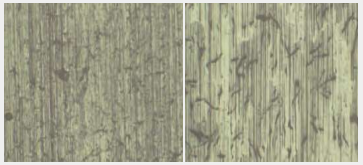
Scans / documents the condition of cylinder liner surface, exhaust valve, piston rings and piston crown.
Liner time scale: ~100 Rh. Measurement time: ~15 mins /liner. The photos are used when evaluating cylinder condition parameters such as cleanliness of ring land, size of cylinder wear edge, cylinder honing mark and wave-cut groove extension, black lacquering from corrosive wear and bore polish.



REPLICA ANALYSIS & MICROSCOPY

Takes an imprint of the liner that is later analysed in microscope in STX laboratory laboratory.
Liner time scale: ~100 Rh. Measurement time: ~15 mins /liner.

Microscopic pictures of the cylinder surface from replicas from a liner on the onset of scuffing (left) and a normal liner (right) from the same engine taken during the same inspection, prior to dry-docking.



Effective monitoring & Analysis reporting service

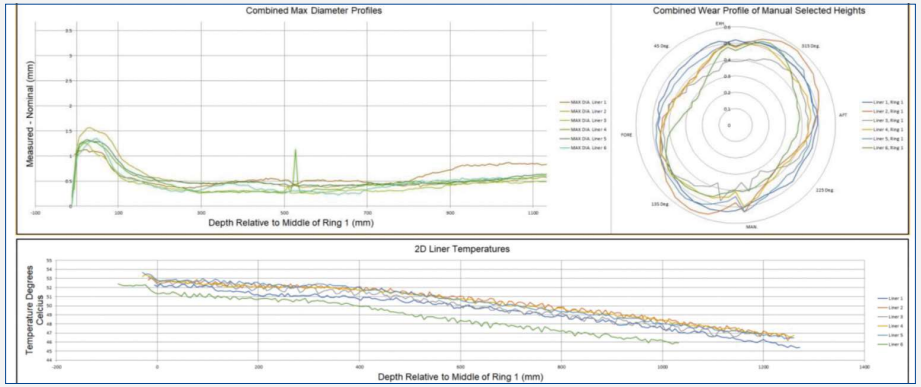
The Monitoring report includes

Cylinder liner wear, life expectancy and clover data collected with the LDM, with recommended cylinder maintenance actions based on findings.

Cylinder liner and piston ring pictures taken with the LCC and analysis of the cylinder condition (under-lubricated / over-lubricated / critical).

Piston ring wear and life expectancy from data collected with the CTM

Cylinder condition and cat fine analysis though microscopic images from replica imprints collected through scavenge air port. This method is especially useful when changing from high-S fuel oil to low-S fuel oil after 2020.

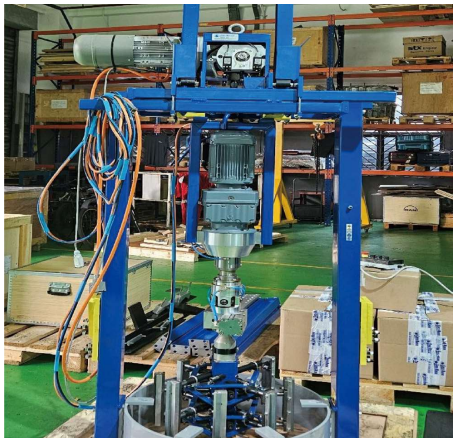


Solution 2.
Cylinder Liner Reconditioning Service

Main Engine Cylinder liner honing & Wavecut grinding service (Onboard & Workshop)

Why Cylinder liner honing work is required?

"The primary objective of re-conditioning a cylinder liner is to rectify its longitudinal and circumferential geometry while restoring its oil-retaining surface properties. Engine manufacturers establish a maximum recommended wear level for each engine type, typically around 0.7%-0.8% of the nominal bore size, which translates to 3.5-4.0 mm for a 500 mm liner. Manufacturers consider a cylinder wear rate below 0.1 mm/1000 hours as normal, providing a life expectancy of 35,000-40,000 hours or 5-7 years in service for 500mm bore liner. Under such circumstances, it is generally more cost-effective to replace cylinder liners during the initial docking rather than reconditioning them. However, when the lubricating oil feed rate and type are appropriately matched, the average wear rate can drop to as low as 0.01-0.02 mm/1000 hours. This implies that cylinder liners of the same bore size could outlast the vessel itself. Cylinder honing during dry-docking emerges as an excellent alternative to extend the liners' lifespan, ensuring compliance with manufacturers' official wear limits without issues. As a rule of thumb, having a remaining liner life expectancy of 50% at the time of docking typically makes cylinder honing more economically favorable than replacement. Furthermore, the larger the bore size, the greater the economic savings from honing compared to replacement. Failure to practice honing increases the risk of not reaching the maximum wear limit specified by manufacturers before cylinder condition issues, such as broken piston rings and cylinder scuffing, arise."



STX CYLINER LINER HONING EQUIPMENT (HON2A)

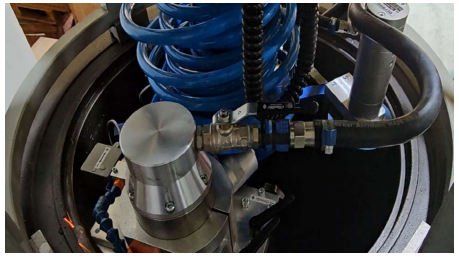
Cylinder honing for 2-stroke engines is carried out using the HON2A machine.
Fully automatic cylinder liner honing machine for restoration of 2-stroke cylinder liner geometry and surface structure.
HON 2A efficiently rectifies the shape of the liner, removes scuffing and restores surface cross pattern. The machine is very easy to operate as it is fully automatic and electrically driven. In addition, it is preassembled, which means that setup-time is significantly reduced.

1. For liners 500–1000 mm bore
2. Fully automatic operation
3. Restoration of 2-stroke cylinder liner geometry and surface structure.
4. Better lubrication of liner and piston rings
5. Life expectancy of liner and piston rings
6. Engine's best performance

WAVECUT GRINDING MACHINE (WGM)

For MAN cylinder liners, wave-cut grinding is recommended after honing. Wave-cut is a spiral pattern in the liner surface that acts as an oil reservoir and oil distributor in the liner surface.
The wave-cut grinding process is particularly suitable for workshops, but it is possible to do wave-cut grinding also during in-situ jobs.
The WGM is used after rough diamond honing and will create a wave pattern as shown above. Following wave-cut grinding, the cylinder liner needs to be finished through honing with fine ceramic stones. The total process time for WGM and find honing is comparable to honing
The wave-cut grinding depth can be fine-tuned with the remote control. The wave-cut pattern can be extended from the top of the liner down to the upper scavenge port level, but not in level with the scavenge air ports.

- For cylinder liners 350–980 mm
- Recovery of 2-stroke diesel engine liners by removing Iron carbide, hardened layer for keeping tribologically superior surface
- Stable and accurate centering with PLC controlling & various size of mounting adaptor
- Machining process within time for piston



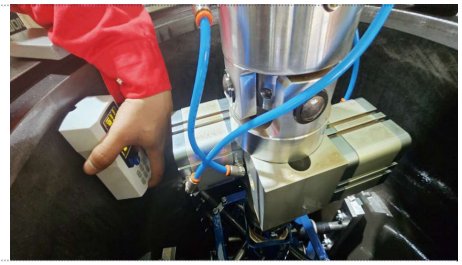
WEAR EDGE MILLING MACHINE

The wear-edge grinder, VKS, is available as multi-bore version (for workshop use) and single-bore version (for on-board use). The VKS is an essential tool during piston overhauls when the wear edge has not been removed through honing. The wear-edge grinder removes some liner material thereby preventing hard contact between top piston ring and cylinder liner wear edge. Removing the wear edge by other means can damage the top piston ring and generate severe cylinder condition issues during running in of a new piston ring pack.

Completion of M/E cylinder Liner reconditioning service

During the reconditioning service of a cylinder liner, wear edges will be removed, and the trumpet shape at the upper and lower ends of the liner will be smoothened. The clover pattern and ovality will also be eliminated before the surface structure is normalized to its original condition. If there are micro-cracks on the liner surface, they will be removed as well to prevent the liner material from breaking loose later. Any damages caused by bore polishing or micro-seizures will be addressed to restore the cylinder liner surface to its original state. All these actions will improve the piston ring function, thereby increasing the lifespan of the honed liners.

Finished honed liner surface roughness:
Ra 0.4 - 1.6.



Condition of running surface after Cylinder Liners, Wave Cut and Honing.