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ADVANCED DIGITAL LINER DIAMETER MEASUREMENT TOOL

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1. ABSTRACT-*Accurate measurement of cylinder liner diameter is critical to ensuring optimal performance and longevity of marine engines. This project uses an advanced - marine liner diameter measurement device (LDM) to assess wear, ovality and taper in the cylinder liners of ship engines. Electronic LDM equipment provides accurate and reliable measurements by capturing data at multiple depths and angles within the liner, reducing manual errors. The process involves preparation, calibration, and systematic recording of liner dimensions, which are then analyzed using integrated software. The results are used for condition monitoring, maintenance planning and compliance with manufacturer standards. By lever aging Marine's innovative technology, the project achieves significant improvements in measurement accuracy, efficiency and documentation, contributing to effective maintenance and performance optimization of marine engines.*

2. KEYPOINTS

- **The project uses an advanced *Liner Diameter Measurement (LDM) device to measure cylinder liner wear, ovality, and taper accurately.**
- **It captures precise data electronically, reducing manual errors through integrated software analysis.**
- **This improves condition monitoring, maintenance planning, and overall marine engine performance. Ellipse measurement**

3. INTRODUCTION

In marine engineering, ensuring the reliability and performance of engine components is essential for the safe and efficient operation of ships. One of the most important components is the cylinder liner, which plays a vital role in the combustion process of the engine. Over time, cylinder liners undergo wear and deformation, including changes in diameter, taper, and ovality. These issues can significantly impact on engine performance, fuel efficiency and overall operating costs.

The Marine Liner Diameter Measurement Device (LDM) is an advanced electronic device designed to accurately measure the diameter of the cylinder liner in marine engines. Designed to be measured objectively. This instrument is particularly valuable for measuring wear, ovality and taper, which are indicators of liner degradation. By providing accurate, real-time data, LDM helps identify early signs of engine problems, enabling timely maintenance and repairs. This project focuses on the use of Marine's LDM equipment to assess and monitor the condition of cylinder liners Marine engine The goal is to improve the accuracy and efficiency of maintenance practices, reduce downtime, and increase engine reliability. By taking advantage of electronic measurement technology, this method reduces human error, increases the consistency of measurements, and facilitates digital data storage for long- term maintenance planning.

The implementation of marine LDM equipment represents a significant advancement in marine engine diagnostics, offering a modern solution for monitoring liner wear and ensuring the continued optimal performance of ship engines.

4. BACKGROUND AND THEORY

- New feature for measuring the cylinder liners of medium- and large-bore two-stroke engines provides gains in timing and accuracy. The Swedish specialist's Liner Diameter Measuring (LDM) equipment can be inserted into the cylinder unit through the scavenging port, without removing the cylinder head.

- Quick and efficient inspection, including setting-up, can reportedly be completed in less than an hour. Alternative methods require cylinder head removal, which
- Typically takes several hours, says Chris- Marin, and there is a risk of inaccurate reassembly after measurement.

- The LDM apparatus is described as simple in construction, consisting of a few elements: a fold-in measurement unit of variable length for insertion into the top of the piston through the scavenging port; A piston height measuring device that is attached to the bottom of the piston with a magnet and connected to an interface box via a cable; Interface box with input and output signals; and a PDA with software to collect measurement data for transfer to PC by Bluetooth, USB or SD-card.

Fig. LDM TOOL

- Easy condition-based maintenance can be performed, saving man hours and spare parts, reports Chris-Marine project manager Per Svensson.

- Measuring four diameters at nine height levels total measurement time per liner is approximately one hour, including instrument set-up time of approximately 20 minutes; A measurement accuracy of 0.03 mm is stated.

- In operation, the system is first calibrated, and the piston is placed in its lowest position; then a piston height measuring device is attached to the bottom of the piston, and the measuring device inserted and placed on top of the piston.

- The piston is moved to the desired position and the first of a pre-determined number of diameter readings is performed; The piston is then moved to the next position and the diameter is measured again

- The process is repeated until all measurements have been taken. Data measured in the handheld terminal can be evaluated or transmitted to a PC for further analysis, storage or report generation.

- Special tests were prescribed to meet the standards of various countries regarding the radio transmitter components of the LDM equipment. The equipment thus meets European and Turkish requirements and has a CE-label documenting that it meets EC standards.

- Measuring range includes two-stroke engines with 500 mm to 900 mm liner bore or four-stroke engines (cylinder head removed). Liner bore of 500 mm and above; and the height measuring range is 0-2.5m (0-3.5m optional). Charging equipment for battery-powered power supplies is included in the package.

5. INSPECTION LDM PROCESS:

- The lube oil pump was turned off and the gear was put on.
- Cylinder liner temperature was found to be below 70 degrees
- The scavenge port doors were opened. The scavenge space and the underside of the piston were cleaned.

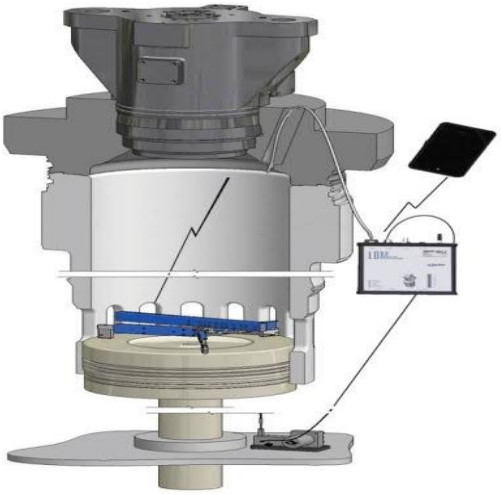

Fig: LDM TOOL measuring method

- Air starting valves removed for LDM antenna cable insertion.
- The measuring arm is adjusted according to the nominal diameter of the cylinder liner and the measuring arm is calibrated.
- The depth gauge is installed under the piston. The antenna communication cable is inserted. The measuring arm is installed on top of the piston and adjusted to the center.
- The cylinder liner measuring position was programmed. The measuring position is taken from the manufacturer template.
- Cylinder liner wear and clover measurements completed.
- Photos of the cylinder liner running surface were taken using a liner condition camera.

6. PRODUCT FEATURES:

- Innovative measuring tool for 500-980 mm bore 2-stroke cylinder liners
- Safe, fast and accurate measurement of cylinder liner wear and clover page
- No need to remove the cylinder cover first Measurements
- Supplied with report generation tool that presents measurement results
- Approved as checked baggage according to IATA 2015 regulations

- Long lasting battery user time: About 13 hours of continuous use without recharging.

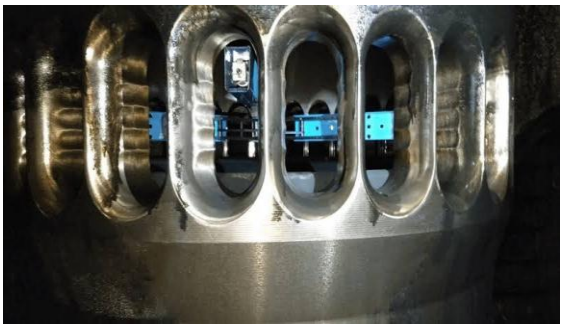

Fig: LDM TOOL inside liner

7. TECHNICAL SPECIFICATIONS

7.1 Diameter Measuring Range:

- stroke engines 500-980 mm liner diameters or 4-stroke engines (cylinder cover removed) >=500 mm liner diameters

7.2 Measurement capability

- Cylinder wear (two diameters) and clover leafing (60 radii)

7.3 Height measuring range

- 0-4000 mm

7.4 Electric power supply

- Battery operated
- Charging equipment included

7.5 Normal measuring time

- One cylinder liner (2 diameters/15 levels): 1 Hr.

7.6 Weight complete with case

20 kg

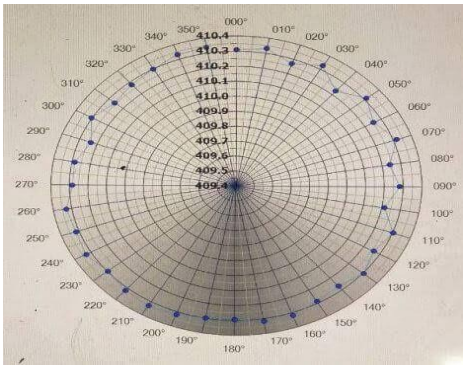

Fig: LDM TOOL measurements

8. ADVANTAGES:

- **8.1 Accuracy and Repeatability:** Digital bore gauges provide accurate readings and reduce human errors, which is important for maintaining tight tolerances.
- **8.2 Time Efficiency:** Faster measurements
- Process, reducing downtime and allowing more frequent checks.
- **8.3 Data Management:** Digital storage enables easy tracking of wear trends, facilitating proactive maintenance.
- **8.4 Future Integration with predictive maintenance:** predicting potential digital issues and delivering interventions. The data can be used in predictive maintenance software for scheduling.

9. CHALLENGES AND SOLUTIONS

- **9.1 Environmental Factors:** The ship's environment, such as temperature fluctuations and humidity, can affect digital readings. Proper instrument calibration and temperature compensation features can minimize this.
- **9.2 Operator Training:** Effective use of digital equipment requires training for accurate measurements. Implementing training programs ensures correct and consistent use.
- **9.3 Equipment Cost:** While digital equipment is more expensive initially, the long-term benefits in reduced maintenance costs and downtime justify the investment.

CONCLUSION:

Digital Liner Diameter Measurement Instrument is a highly effective instrument for accurate, reliable and efficient diameter measurement in a variety of applications. Its digital design eliminates inaccuracies associated with manual measurement, ensuring consistency and repeatability. The tool's user- friendly interface and instant data recording capability increases operational efficiency, making it suitable for industries requiring high precision such as manufacturing, automotive and quality control.

By integrating advanced digital technology, this equipment reduces human error, saves time, and provides accurate results, ultimately improving productivity and maintaining high quality standards. As a result, it stands as an important asset in modern measurement processes.

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