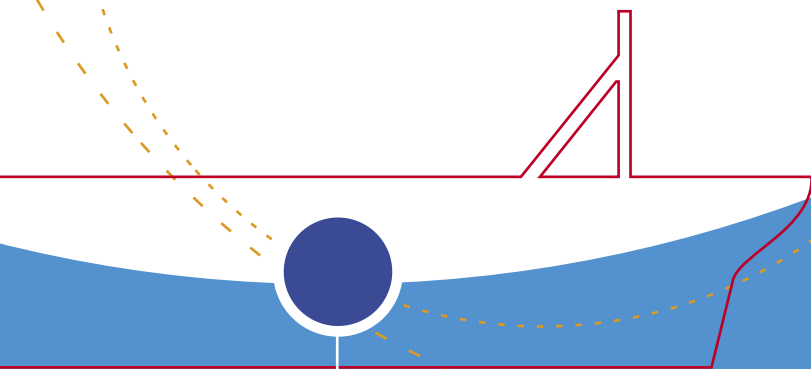


Fremskib



LAB-ON-A-SHIP



L-O-A-S

SYSTEM DESCRIPTION

Fremskib, of NanoNord, is developing a groundbreaking hardware and software platform which enables a range of applications to optimize the economic and environmental management of ships.



L-O-A-S (LAB-ON-A-SHIP)

Fuel, Cylinder and Lubricating Oils present the most significant variable costs in the operation of a ship. These oils also represent the most significant determinants of environmental impact.

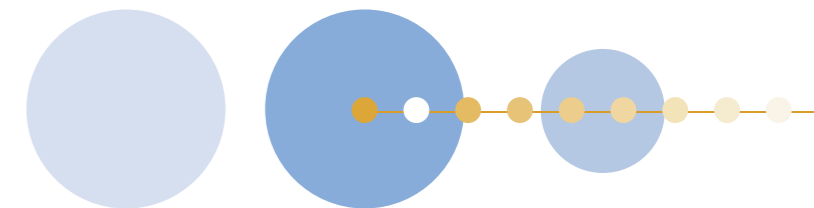
L-O-A-S has therefore been developed as the first application in the Fremskib platform to enable the in-line analysis of these oils on board ship.

L-O-A-S hardware comprises a rack of analytical equipment which provides in-line real time analysis of the ship's fuel oil. L-O-A-S samples the Heavy Fuel Oil in-line at both bunkering and at point of consumption while the ship is operating.

The L-O-A-S system is designed to measure the relevant parameters to ISO (International Standards Organisation) standards including:

- quantity and net specific energy of fuel delivered/consumed
- level of catfines, water and vanadium
- gas content
- sulphur content
- operational parameters like viscosity and density content
- engine parameters measured via optionally available NOx (Nitrogen Oxide)/Lambda/Vibration module
- L-O-A-S can also interface to existing sensors onboard the ship like torque/power, volume in bunkering/consumption line, GPS (Global Positioning System) etc.

In a joint development with Lloyd's Register FOBAS, data is sent from L-O-A-S to the onboard server hosting the interactive database, where alerts accompanied by operational advice are provided by a FOBAS Onboard software application on pre-set limits.



VALUE PROPOSITION

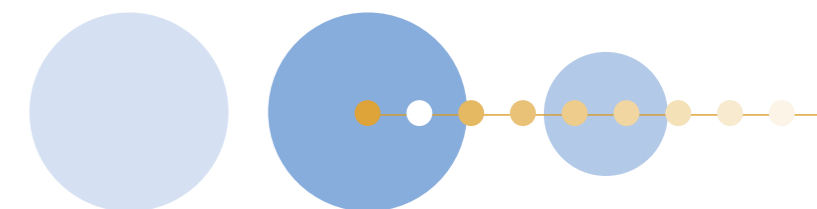
L-O-A-S at Bunkering

- 1 Ensures greater value for money in fuel purchasing**
 - Measurement of volume, density, water content and sulphur enables calculation of Net Specific Energy
 - Information on the energy content of delivered fuel is available real time to Fleet Management. This enables more effective purchasing and control of suppliers
- 2 Eliminate long delays due to de-bunkering**
 - In-line fuel analysis during bunkering enables real-time identification of contaminants such as catfines (silicon/aluminium) and timely intervention
 - Analysis of data by Lloyds Register
- 3 Early availability of low-sulphur fuel**
 - L-O-A-S provides immediate analysis of sulphur content – not necessary to await land based laboratory report
- 4 On-line support to ship's crew**
 - Alerts are accompanied by FOBAS Onboard on-line operational advice 24/7 through the interactive database.



L-O-A-S supporting the ship's operation

- 1 Engine protection**
 - Measure catfines, water, vanadium
 - Monitor Purifier efficiency
 - Analyse Lube Oils and Scrape Down Oils
- 2 Environmental conformance**
 - Measure sulphur content in fuel feed synchronized with GPS and timestamp
 - Measure NOx in exhaust
- 3 Cylinder Oil consumption**
 - Accurately determine cylinder oil dosage requirement based on actual HFO (Heavy Fuel Oil) sulphur content reducing Cylinder Oil consumption
 - Measure engine energy consumption



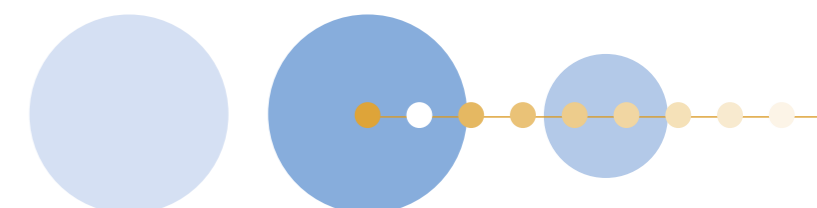
TECHNICAL SPECIFICATIONS

PARAMETER	DESCRIPTION	ACCURACY
Viscosity @ 50°C [10-700 cSt]	Kinematic viscosity displayed in cSt with a referral to 50°C at 1 bar. ISO3104 accuracy guaranteed at ordinary bunkering oil temperature range.	ISO 3104
Density @ 15°C [800-1,200kg/m ³]	Density is measured at the fuel line temperature – referred to 15°C at 1 bar	ISO 12185
Oil Temperature @ 12.5 cSt [°C]	The Oil temperature at which the viscosity is calculated to 12.5 cSt– this is the operation advice at which a chief engineer is looking.	r = 0.025x; R = 0.074x (NN spec)
Gas Contents @ 50°C/1bar [0.0-10.0 % V/V]	The gas contents in the fuel referred to 50°C at 1 bar - In theory the gas amount that will evaporate from the oil if exposed to atmospheric pressure.	r = 0.1x; R = 0.3x (NN spec)
Water [0.03-5.0% V/V]	Distilled contents of water	ISO 3733
Sulphur [0.1-5.0 % m/m]	Measured level of Sulphur	ISO 8754
Vanadium [10-400 mg/Kg]	Measured level of Vanadium	ISO 14597/IP470
Silicon/Aluminium [10-200 mg/Kg]	Measured level of CATFINES (Al +Si) using the XRF spectrum	ISO 10478
Estimated Ash [% m/m]	An estimate of Ash (=2x(2xNa+V+other elements)).	
Net Specific Energy [MJ/kg]	Calculate Net Specific Energy according to ISO8217 annex A using measured values of Density, Water, Sulphur and an estimate of Ash	
CCAI [index]	Calculate CCAI	

TECHNICAL SPECIFICATIONS



- Supply voltage: 230V AC, 50/60 Hz. 13A fuse
- Fuel Temperature: 50-120°C
- Max pressure Inlet: 6 bar
- Max viscosity: 700 cSt @ 50C
- Max humidity: 95% non-condensing
- IP class: IP23
- Approval: Lloyds Register type approval applied for



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in cooperation with

