

Technical Meeting on the use of 0.1% Sulphur Content Marine Fuel at Berth under Directive 2005/33/EC

- Sulphur control for international shipping
- Operational conditions/requirements
- Consideration of low sulphur (marine) fuel
- Shipboard installation and equipment concerned
- Example: VLCC
- Potential need for inspection/approval/certification before using low sulphur distillate fuels

Sulphur Control for International Shipping

- **International Regulations:**
 - phased sulphur content reduction globally until 2020
 - phased sulphur content reduction in Emission Control Areas (ECA) until 2015
- **Regional Regulations:**
 - California Air Resources Board (CARB): phased sulphur content reduction until 2012
 - European Union:
0.1 % from 1st January 2010 at berth

Operational conditions approaching Ports in Europe related to Fuel Change Over

Destination : Port inside an ECA

- Global cap 4.5 (3.5)(0.5) % S , Heavy Fuel, heated
- ECA 1.5 (1.0)(0.1) % S, Heavy Fuel or Dist. Fuel, heated or unheated
- At Berth 0.1 % S, Low Sulphur Dist. Fuel, unheated or cooled

Destination : Port outside an ECA:

- Global cap 4.5 (3.5)(0.5) % S, Heavy Fuel, heated
- At Berth 0.1 % S, Low Sulphur Fuel, unheated or cooled

Consideration on Low Sulphur Marine Fuel

- **Lubricity** : important especially for fuel injection and gear type pumps,
- **Viscosity** : fuel oil cooler or chiller might be necessary in the supply system
- **Compatibility** : solubility of asphaltenes has to be considered, (change over process)
- **Addition of bio fuels (FAME)** could create additional problems (compatibility, stability, fouling, hygroscopic)
- **Different flashpoint** for distillate marine fuel and for fuel used landbased for trucks and for inland water vessels. (60/55 °C)

SOLAS II-2 , Reg. 4, 2.1.1 : min. flashpoint 60 °C, (43 °C outside machinery space cat. A, e.g. emergency engines)

- **According to the current revision of ISO 8217** the min. Viscosity @ 40 °C for DMA and DMB is 2.0 mm²/s(cSt), only for DMX the min is 1.4 mm²/s

Shipboard Installations and Equipment affected

- Fuel tank capacity and arrangement for the different grades of fuel
- Fuel oil supply system: e.g. pipes, pumps, cooler/heater, fuel oil booster systems
- Main propulsion and auxiliary engines, at berth normally auxiliary engines only
- Main and auxiliary oilfired boilers

Fuel Tank Capacity and Arrangement

Depending on whether the approach to the port is via an ECA or not 2, or even 3 different fuel oil grades might be in use

For an existing vessel the following options exist:

- Sufficient fuel & lube oil tank capacity and arrangements for the different grades
- Subdivision or addition of service tanks
- Dumping and refilling of DO service tanks

Service Tank Arrangements

- SOLAS Reg. II-1/26.11

**IACS Unified Interpretation SC 123
Machinery installation – Service Tank
Arrangements**

- ECA

**IACS Recommendation
Machinery installations of ships intended to
navigate in SO_x Emission Control Areas –
Service Tank Arrangements**

Fuel Tank Capacity and Arrangement

- Structural modifications or subdivision of fuel oil tanks are subject to Class approval
- As a consequence, SOLAS and Class requirements for valves, fittings, filling, venting, and overflow but also level and temperature alarms must be verified.
- LSD fuel or MGO tanks should not be located directly adjacent to hot HFO tank walls
- Free standing tank solutions and temporary fuel oil systems, e.g. by hoses, are not acceptable

Fuel Oil Supply System: e.g. Pipes, Pumps, Cooler/Heater, Fuel Oil Booster Systems

- The fuel oil supply system must to be in compliance with fuel change over procedure as specified by the engine and boiler/burner manufacturer for the relevant fuel grades
- For LSD fuel a fuel oil cooler or chiller is recommended
- For existing pumps loss of delivery pressure at different viscosities
- Additionally installed fuel oil supply systems have to comply with the class requirements for unattended machinery spaces in terms of alarms, redundancy and stand-by pumps
- Fuel return lines have to be considered to avoid possible contamination of low sulphur fuel by other fuels

Main Propulsion and Auxiliary Engines, at Berth normally Auxiliary Engines only

- **Lubricity** : important especially for fuel injection and gear type pumps, the experience of marine diesel engines on LSDO with less than 0.1 % S is limited
- **Viscosity** : fuel oil cooler might be necessary in the supply system to achieve the required viscosity for injection
- The fuel change over procedure may vary from engine type to engine type
- Operation of the engine and the choice of lubricants has to be in compliance with the engine manufacturers specification

Main and Auxiliary Boilers, especially Burners and Burner Control System

The manufacturer of the boiler or the burner control system has to assure that the system is suitable for the burner operation with the different fuel grades. In particular:

- The flame monitoring sensors must be suitable for the different spectral emission ranges
- The prepurging process has to take LSD fuel operation into account
- The fuel oil/ air ratio might have to be corrected
- The nozzles of steam, air or pressure atomizing burners have to be selected in accordance with the specification of the manufacturer for the different fuel grades

Main and auxiliary boilers, especially burners and burner control

- The heat flux in the different boiler areas has to be considered by the manufacturer for the fuel grades to be used
- Fuel oil shut off valves /quick closing valves have to be checked for leakages and proper and safe operation on LSD fuel
- Any fuel change over has to be carried out in accordance with the specification of the boiler/burner manufacturer
- For air atomizing burners for LSD fuel sufficient compressed air has to be available

**Example: VLCC 319 174 dtw,
Double Hull Oil Tanker, Built in 2003**

Main engine: 6 S90 MC-C 29340 kW

Aux. engines: 3x 6L28/38H 1250 kW

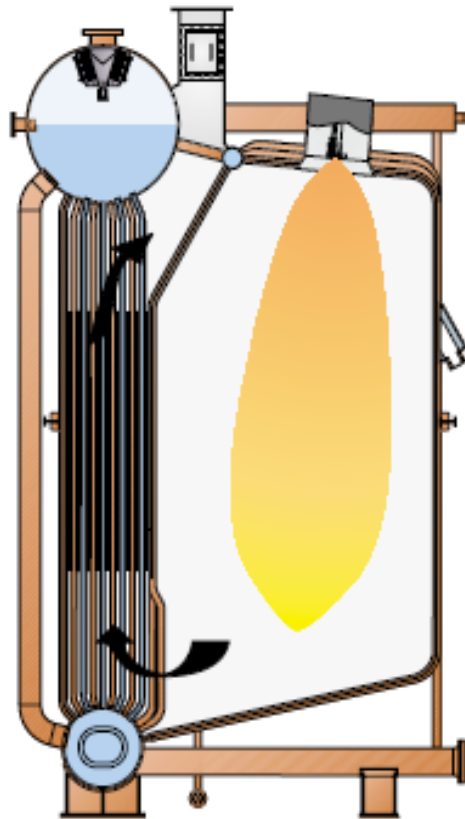
**Boilers: 2x Aalborg, Mission TM D,
Steam capacity 45000 kg/h, 18 bar each**



Operational Conditions at Berth VLCC Example

- Main engine stopped
- Auxiliary diesel engines for electrical consumers
- Both boilers for cargo discharge (major fuel oil consumers)

Example VLCC , Boiler

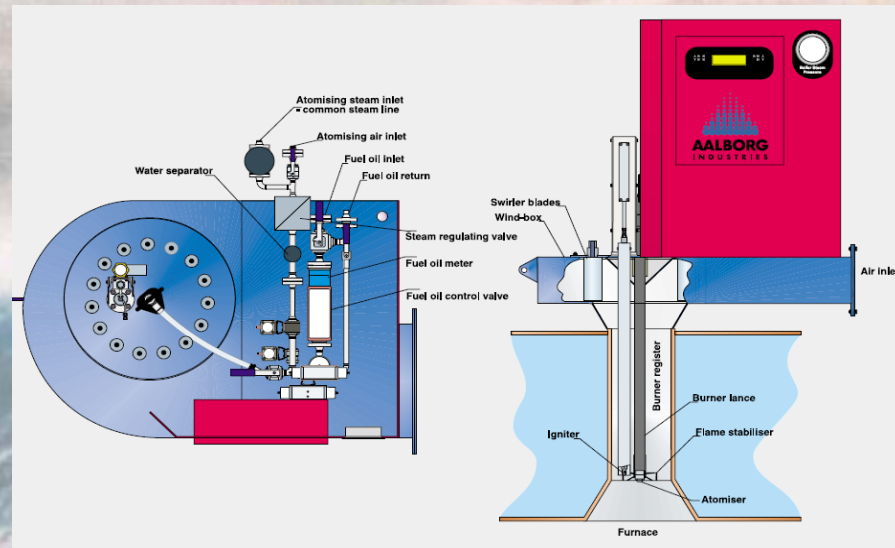


STANDARD PRODUCT RANGE

Capacity and dimensions

Steam capacity	Design pressure	Thermal output at 100% MCR	Height K (incl retraction of burner lance)	Total length L	Height H	Width B (steam drum+200)	Boiler dry weight *	Boiler operation weight
kg/h	bar (g)	kW	mm	mm	mm	mm	ton	ton
45,000	18	31,800	9,870	5,050	8,080	4,875	44.2	57.0

Example : Burner



STANDARD PRODUCT RANGE

Capacity and dimensions

Burner type	Guideline boiler output kg/h	Capacity Min. - max. MW	Diesel oil consumption kg/h	Heavy fuel oil consumption min. - max. kg/h	Combustion air consumption max. Nm³/h	Combustion air consumption min. Nm³/h	Atomising steam consumption kg/h	Atomising air consumption kg/h
KBSD 3350	45,000	3.7-37.4	3,220	335-3,350	40,710	5,260	170	310

General burner data

Heavy fuel oil data

Max. viscosity at 50°C	700	cSt
Max. viscosity at burner inlet	15	cSt
Calorific value	40.2	MJ/kg

Diesel oil data (for ignition burner)

Viscosity	1.3-12	cSt
Calorific value	42.2	MJ/kg

General data

Atomising steam/air pressure, min	6.5	bar (g)
Excess air ratio	1.15	—
Combustion air temperature, design	45	°C
Fuel oil delivery pressure	2.5	bar (g)

NO _x emissions	0.6	g/kWh
Particulate emissions	0.3	g/kWh

Prerequisite for Class

- All machinery shall be operated in accordance with design limitations, including also fuel specifications
- It will be the sole responsibility of the operator to ensure that his vessel is suited for operation on the fuels required by the EU Directive 2005/33/EC
- Prior to the operation of any equipment on such fuel oil, the suitability of the equipment e.g. pumps, engines, boilers and burners for such operation outside the normal range of marine fuels has to be clarified with the equipment manufacturer or in consultation with the associated system provider.

Potential need for Inspection/Approval/Certification before using Low Sulphur Distillate Fuels

It is recommendable to carry out a HAZOP (hazard and operability) study or similar to identify need for modifications with associated approval and survey by Class.

As a minimum the following items should be considered:

- Service tank operation
- Low sulphur distillate (LSD) fuel supply system including pump capacity, stand- by functions, by-passing of heaters and optional cooling
- Operational modes for all equipment concerned,
- Load limitation on LSD fuel operation, including low and max. load
- Fuel change- over procedures for the different types of equipment
- Boiler/ burner control and safety equipment including flame monitoring sensor
- Software modifications for burner and boiler control due to the different fuel properties , e.g. pre-and post purging sequences and fuel/air ratio, but also for diesel engines and automated fuel change over, if applicable

Resultant modifications are to be reviewed, approved and surveyed by the Classification Society

Approval before using Low Sulphur Distillate Fuels

- Any structural modification on fuel tank as well as modification of the fuel oil system are subject to class approval, material- and component certification and survey including e.g. pressure test after modification.
- In general all modifications of safety systems, hardware and software, are subject to class approval and survey, in this case especially the boiler and burner control and safety system is concerned.
- Components and systems are to be arranged with redundancy as per class requirements.
- Any additional requirement for unattended machinery spaces (e.g. control & automation, redundancy etc) apply as applicable.

Surveys required:

A Survey shall include:

- A demonstration of the operation of boiler /burner on LSD fuel, the following tests should be carried out during this demonstration:
 - Testing of alarm and monitoring
 - Testing of the safety system / flame detector / shut-off
 - Testing of the boiler control system
 - Testing of pre-purging and ignition
 - Demonstration of the boiler operation at various loads on LSD fuels including low load with stable flame.
 - Demonstration of max. load on LSD fuels as specified by the boiler/burner manufacturer
- A verification that fuel change-over procedures for all equipment concerned are documented and available onboard
- A test to demonstrate the capability to change-over from heavy fuel oil to LSD distillate fuel as per the onboard fuel change-over procedure.

Manuals and Training of Crew/Operators

- All relevant operation and service manuals have to be updated for LSD fuel operation, covering as applicable revised specification of fuel qualities (e.g. minimum viscosity and low sulphur content) and maximum permissible wear (e.g. of fuel pumps).
- Detailed fuel change over procedures and manuals have to be developed in consultation with the equipment manufacturers and the crew/operators have to be trained accordingly



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Thank you for your attention

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