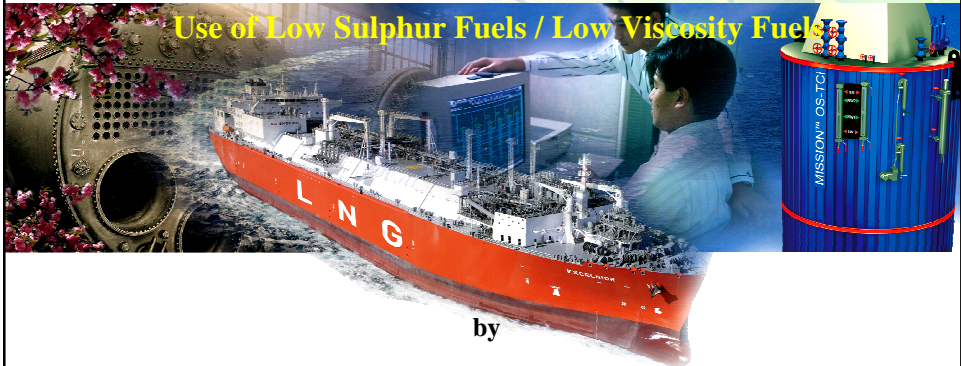


Technical Meeting
European Maritime Safety Agency

Considerations for Boiler Plant Operation in connection with fuel change to LSFO/MGO


Use of Low Sulphur Fuels / Low Viscosity Fuels



by
John Karlsen

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Low Sulphur Fuels & Legislation

Main reason for using low sulphur fuels

- **MARPOL – Annex VI – Regulation 14 - SECA**
 - 1.5% up to 1 July 2010, then 1% up to 1 July 2015, then 0.1%
- **EU Directive 2005/33/EC:**
 - A 0.1% sulphur limit on fuel used by inland vessels and by seagoing ships at berth in EU ports per 1 January 2010.
 - As of 1 January 2010, EU member states shall ensure that the sulphur content in marine gas oils (ISO 8217 grades DMX and DMA) supplied within their territory does not exceed 0.1%.
- **California Air Resource Board – Marine Notice 2009-2**
 - 1 July 2009:
Marine Gas Oil (DMA) <= 1.5 % Sulphur content, or
Marine Diesel Oil (DMB) <= 0.5 % Sulphur content
 - 1 January 2012:
Marine Gas Oil (DMA) <= 0.1 % Sulphur content, or
Marine Diesel Oil (DMB) <= 0.1 % Sulphur content

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Comments on the AEA Report

Service Contract for a Cost Benefit Analysis to Support the Impact Assessment accompanying the revision of Directive 1999/32/EC on the Sulphur Content of certain Liquid Fuels

Report on Task B2: Use of distillate fuels by ships at berth



Association **ASPEN**




Report to European Commission

Restricted Commercial
AEA/ED/E45756
Issue 1
24 June 2009

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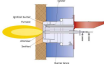
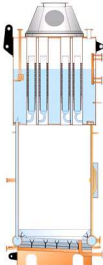
Comments on the AEA Report

Service Contract for a Cost Benefit Analysis to Support the Impact Assessment on the Sulphur Content of Liquid Fuels

Restricted Commercial
AEA/ ED45756/Issue 1

2 Outline of the problem


Boilers that are constructed for the use of Heavy Fuel Oil (HFO) can in general not be used with Marine Gas Oil (MGO) without modifications.



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Comments on the AEA Report

3 Types of ships where the risks may be relevant

Boilers are used on ships either for propulsion or as auxiliary boilers.

Auxiliary boilers may be divided into:

- 1) **small boilers** used on ships to produce steam that can be used to heat residual oil, to produce hot water and for the purpose of heating; and
- 2) **larger boilers used on tankers** for heating cargo and to drive steam turbine pumps.

Auxiliary boilers are used on practically all ocean-going ships. These boilers can be designed to be used with either HFO or distillate fuel. Some boilers can use both HFO and MGO.

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Comments on the AEA Report

5 The nature of the risks

There are reports of boiler explosions due to defects or improper operations. This can occur if the flame is out for some reason and a high pressure of fuel gas is built up in the burner and the control system is malfunctioning or disconnected. In such a case, the furnace must be purged before ignition. Failure to do this may cause an explosion, as for example reported by the British Department of Transport (1983). There are flame supervision and control systems that will automatically purge the furnace so that during normal operation the risks for explosions are small.

There are concerns that these risks may be elevated when switching over from residual oil to distillate fuel.

The reason for the special concerns regarding a fuel switch from HFO to distillates is that the pipes and other parts are heated when using residual oil. When the distillate enters the furnace there are concerns that it will fail to ignite, causing a build-up of gases that in turn is an explosion risk. When introducing distillate fuel in hot piping, vapour locks in pipes may cause irregular fuel flows towards the burners (this may also be an issue for diesel engines). This irregular fuel and vapour flows/bursts towards burners can cause flame extinction. The lighter the fuel, the easier the evaporation and the larger the risk for an air/fuel mix which is potentially unsafe. There are concerns that the crew on many ships may not be familiar with how to handle safely these situations.

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Comments on the AEA Report

6 Technical solutions and costs

For the safety and operational reasons discussed above, all boilers designed for the use of HFO should be inspected before they are used with distillate fuel. Many boilers may be used temporarily with gas oil without modifications, but for others modifications may be needed on fuel pumps, burners or pipes, as well as flame supervision and adjustments in air/fuel ratio, fuel flow and post-purging sequence. These modifications are further described in Aalborg (2009) and DNV (2005). Modifications will have to be approved by a Classification Society.

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Comments on the AEA Report

7 Conclusions


One can state that there are real safety concerns with switching from HFO to MGO in existing boilers. This is supported through knowledge gained through contacts with the industry and authorities. Secondly, there are technical and operational ways to circumvent these risks.

There are technical solutions to solve these issues where fuel piping systems, burners, and flame inspection systems are modified. The control system may have to be modified and new handling routines established.

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Comments on the AEA Report


The costs range from 5 000 € to 25 000 € for small auxiliary boilers, around 150 000 € per ship for tankers and 70 000 € to 1 400 000 € for LNG tankers.

Price indication Steam atomising Burner		
Boiler size	Materials incl. Cooler EUR	Installation & Commissioning EUR
1 x 12 t/h	34,342	33,529
2 x 25 t/h	47,574	34,635
2 x 55 t/h	79,289	35,839

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Oil selection - today


Low Sulphur Fuels:

- Special ordered fuels / RM?...
- Marine Diesel Oil / DMB -ISO 8217
- Marine Gas Oil / DMA - ISO 8217

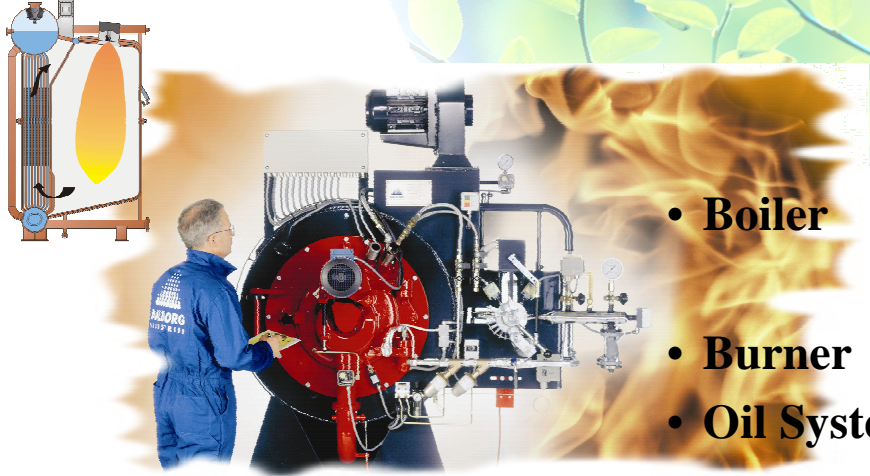
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Fuel change influence




- **Boiler**
- **Burner**
- **Oil System**

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Fuel change influence

Fuel properties:

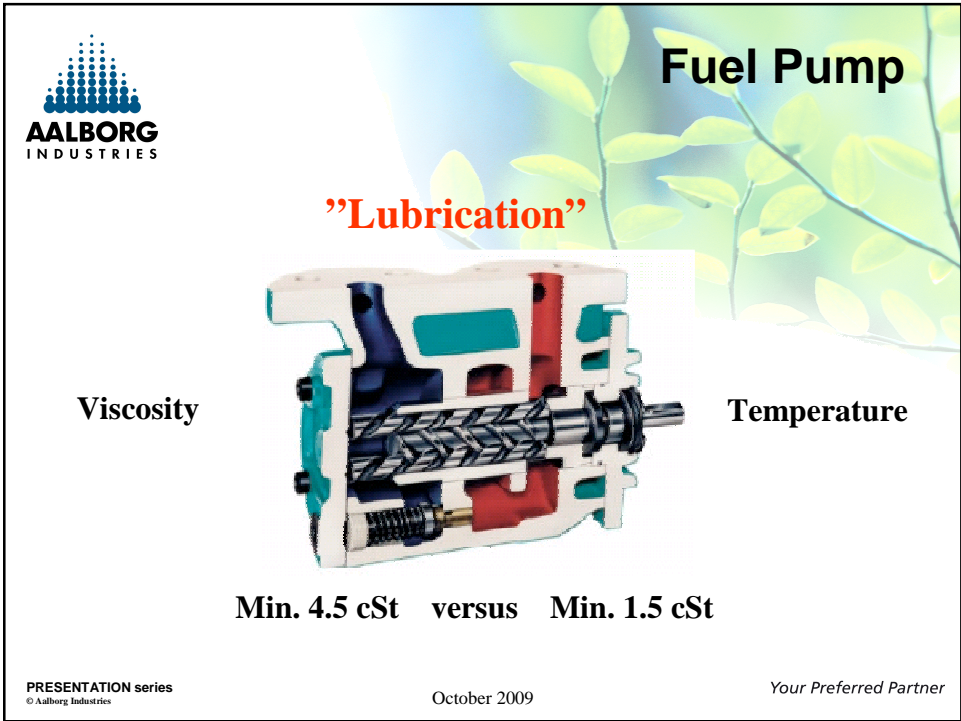
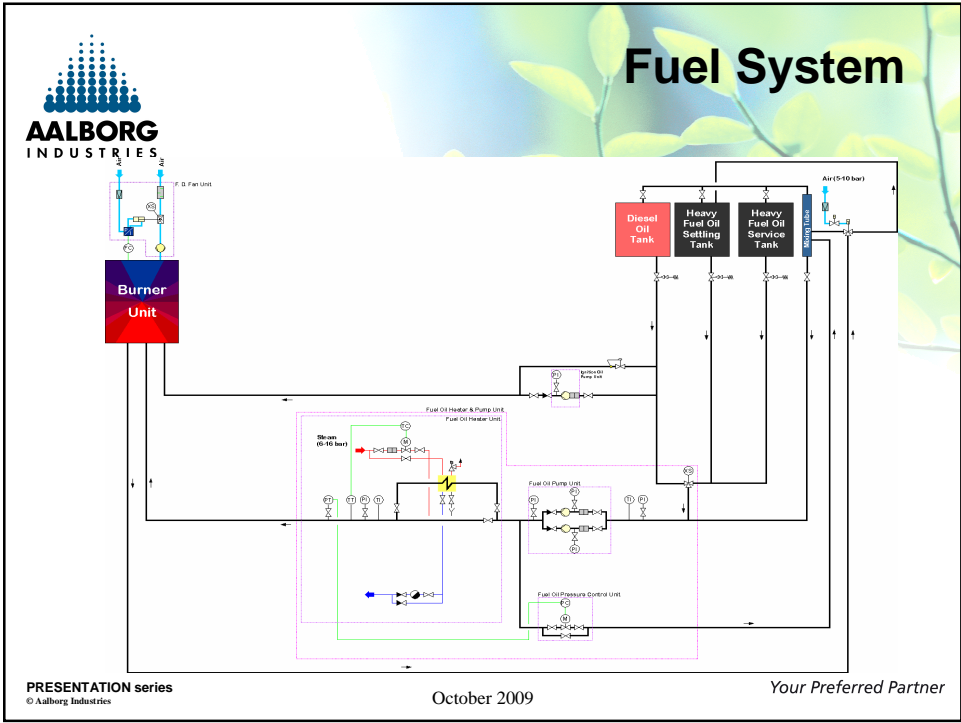
- **Heat value**
- **Viscosity**
- **Density**
- **Flash point**
- **Lubricating properties**




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Burners


- Steam Atomising Burners
- Rotary Burner
- Pressure Atomising Burner



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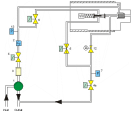
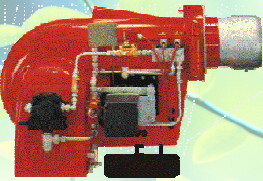
Pressure Jet Burner

Typical data:

- Ring line pump – min. 4.5 cSt
- Burner High Pressure Pump – min. 4 (2.8) cSt
- Pipe heat tracing

➤ Viscosity / Density ⇔ Fuel amount, possible smoke from funnel


➤ Post Purge



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Rotary Cup Burner

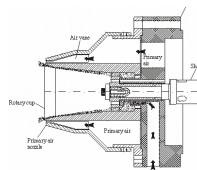
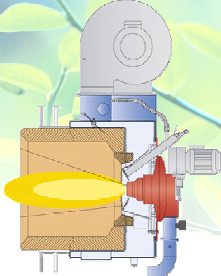
Typical data:

- Ring line pump – min. 4.5 cSt
- Pipe heat tracing

➤ Viscosity / Density ⇔ Fuel amount, possible smoke from funnel

➤ Ignition monitoring


➤ Post Purge



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Steam Atomising Burner

Typical data:

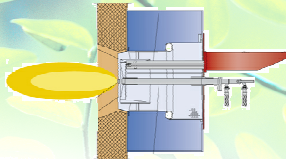
- Ring line pump – min. 4.5 cSt
- Pipe heat tracing

➤ Viscosity / Density ⇔ Fuel amount, possible smoke from funnel

➤ Ignition monitoring

➤ Atomising media: air versus steam


➤ Post Purge



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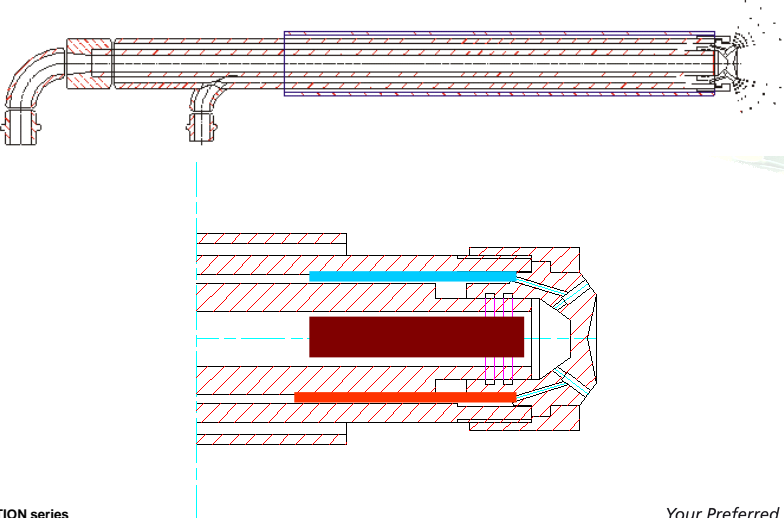
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Steam Atomising Burner

Atomising medium: Steam versus Air




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Steam Atomising Burner

New Lance with separated pipes



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Modifications – Existing Plants

- **Inspection & Investigation**
- **Planning**
- **Execution of modification:**
 - **For safety reasons use authorised part and personnel only**
- **Test of function and plant**

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Considerations & Possible solutions


The Two Main Concerns:

- **Operation Security**
- **Safety**

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ISO 8217 : 2005 (E)

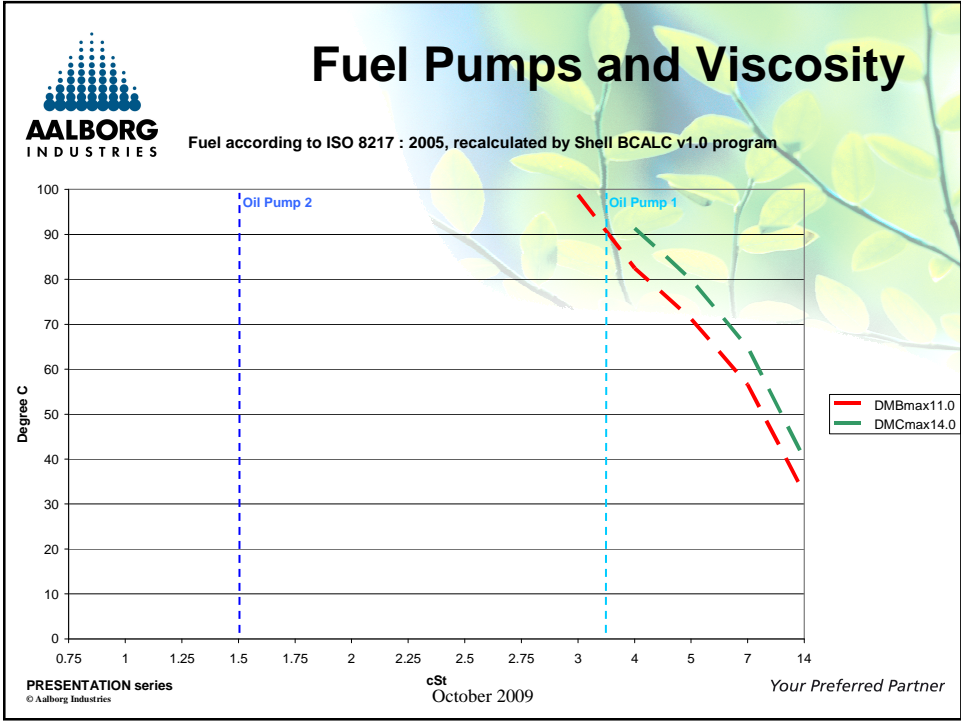
Table 1 — Requirements for marine distillate fuels

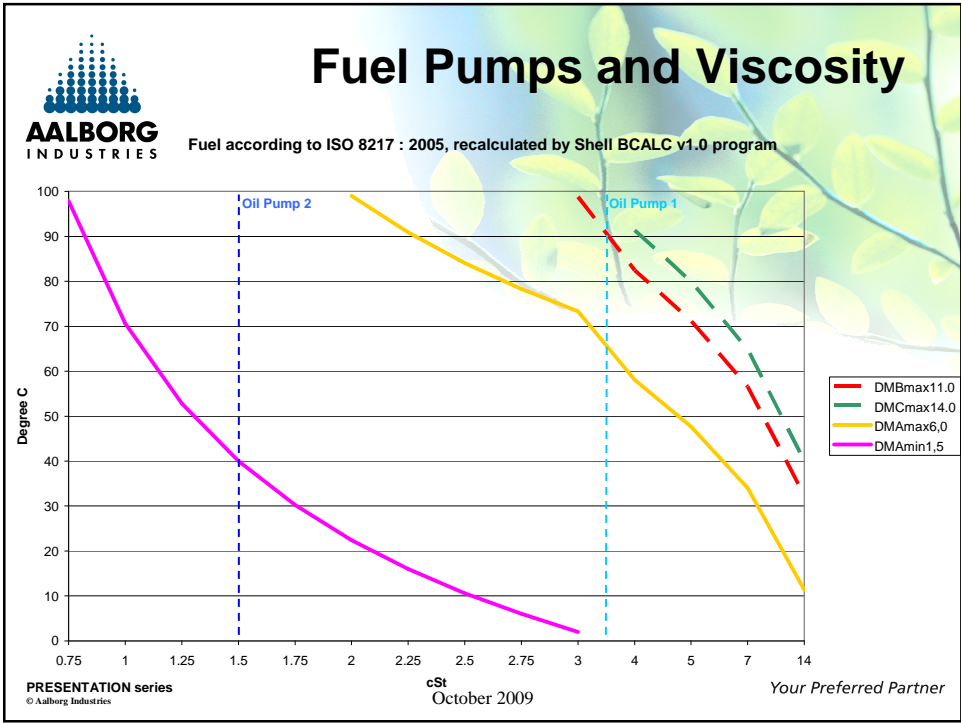
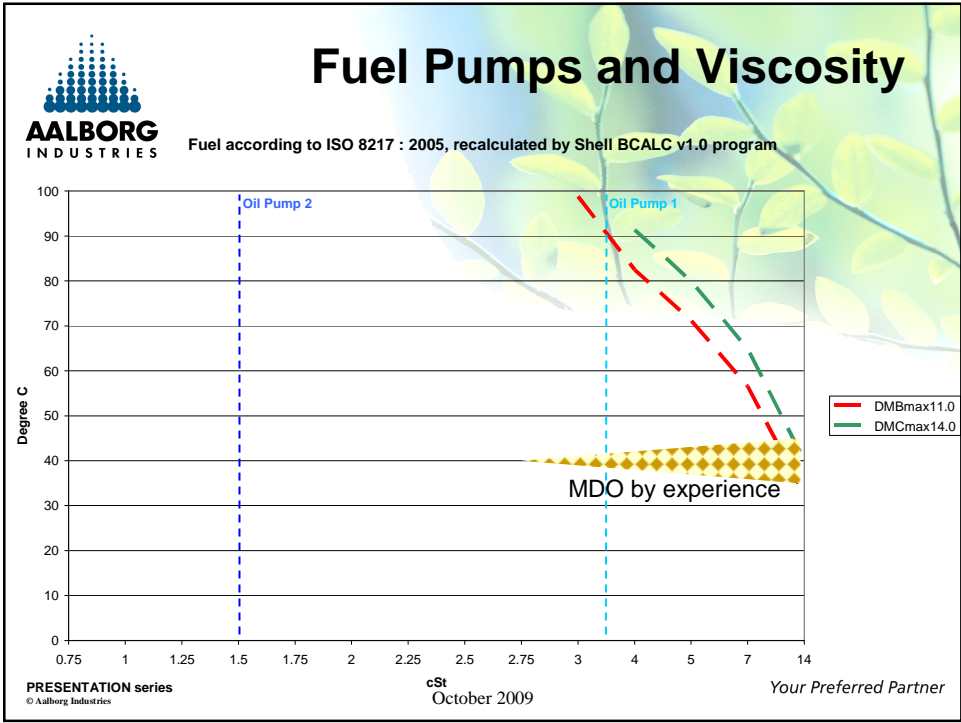
Characteristic	Unit	Limit	Category ISO-F-			
			DMX	DMA	DMB	DMC ^a
Density at 15 °C	kg/m ³	max.	—	890,0	900,0	920,0
Viscosity at 40 °C	mm ² /s b	min. max.	1,40 5,50	1,50 6,00	— 11,0	— 14,0
Flash point	°C	min. min.	— 43	60 —	60 —	60 —
Pour point (upper) c — winter quality — summer quality	°C	max. max.	— —	-6 0	0 6	0 6
Cloud point	°C	max.	-16 ^d	—	—	—
Sulfur	% (m/m)	max.	1,00	1,50	2,00 ^e	2,00 ^e

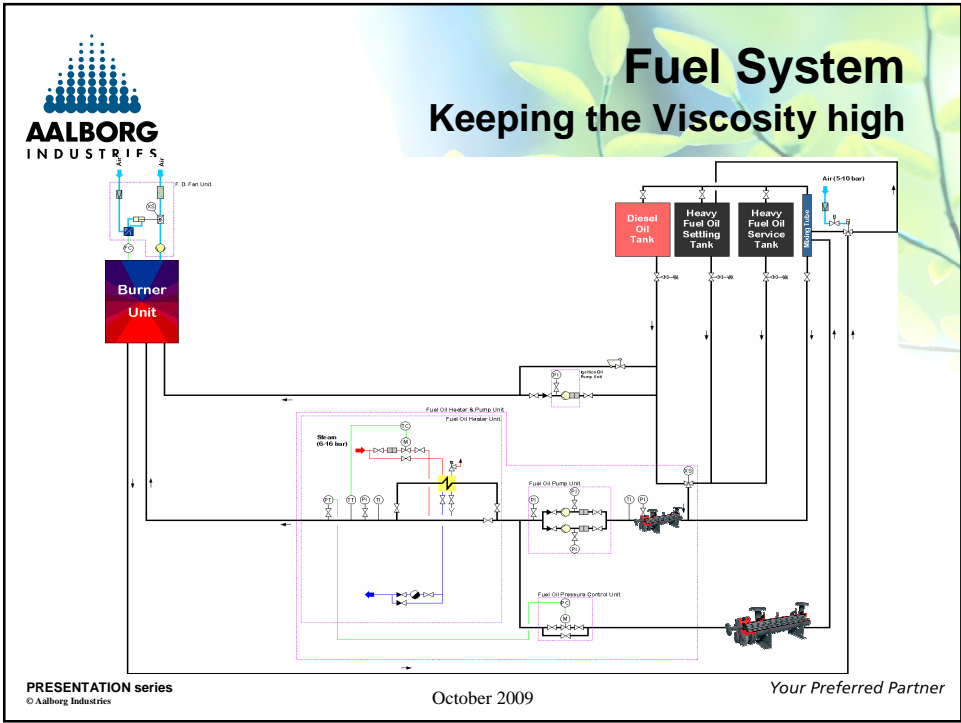
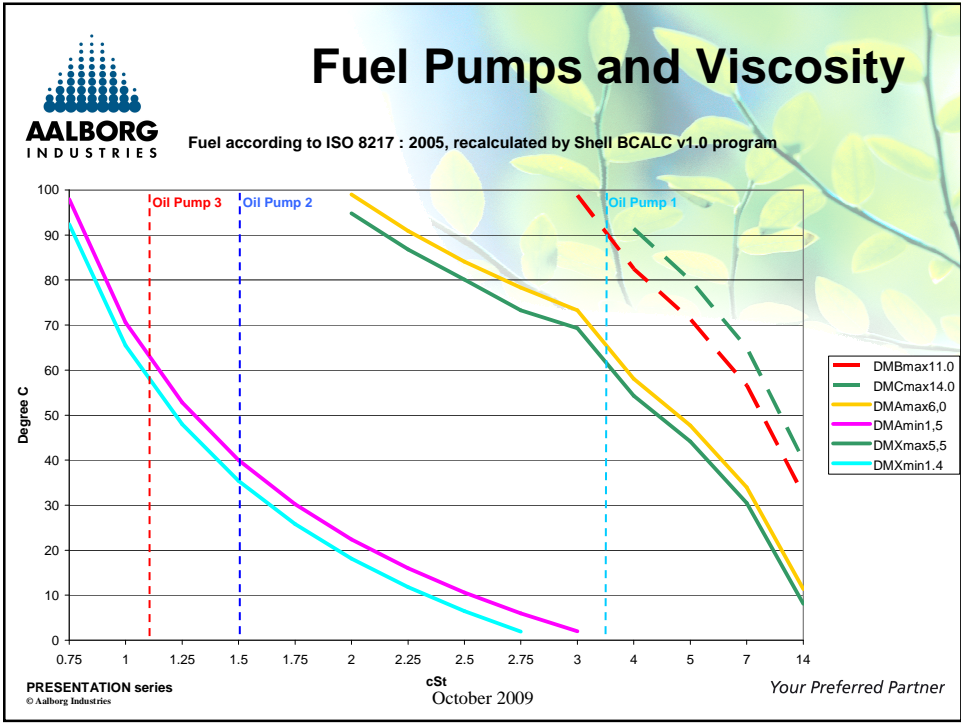
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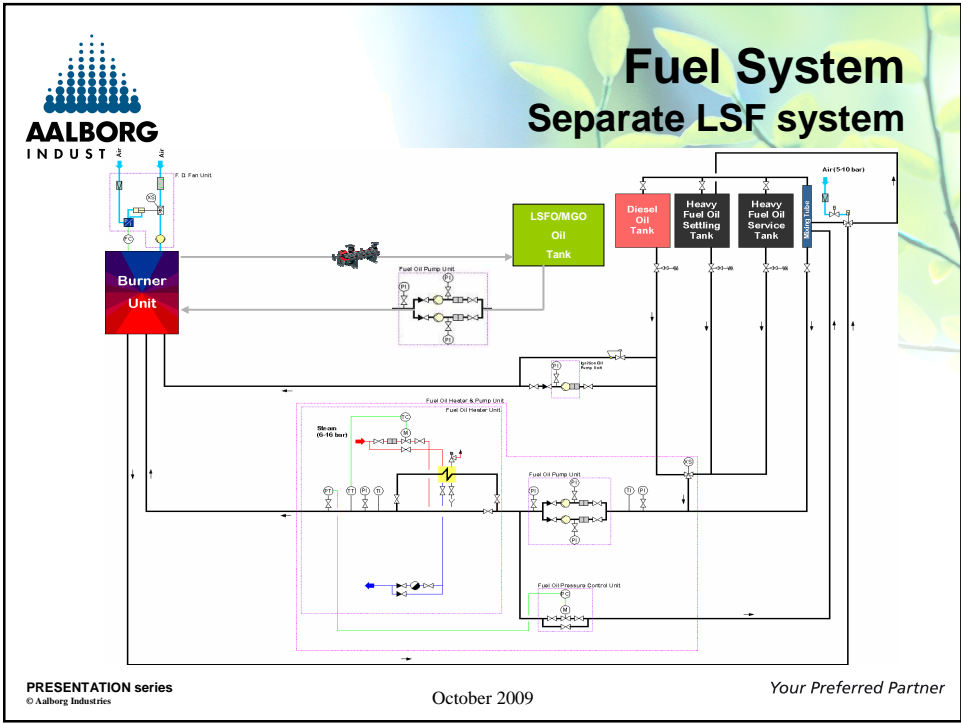
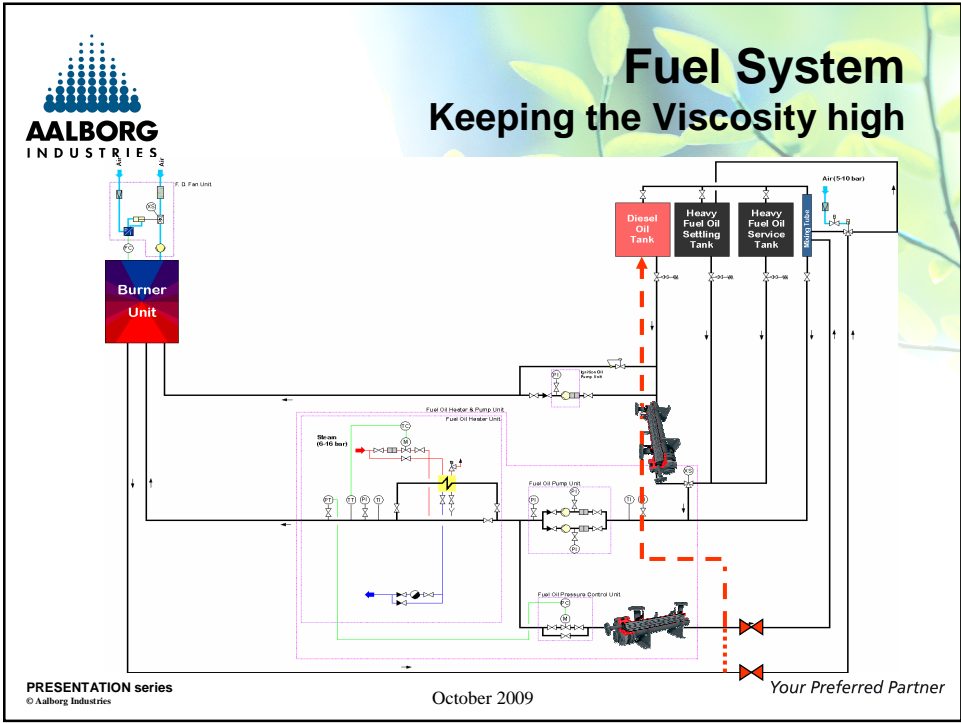
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The coming ISO 8217 ?

DRAFT INTERNATIONAL STANDARD

ISO/DIS 8217


Table 1 — Distillate marine fuels - To apply in conjunction with all clauses of the standard

Characteristics	Unit	Limit	Category ISO-F-			Test method reference
			DMX	DMA	DMB	
Kinematic viscosity at 40°C ^a	mm²/s	max.	5,500	6,000	11,00	ISO 3104
		min.	1,400	2,000	2,000	
Density at 15 °C	kg/m³	max.	-	890,0	900,0	ISO 3675 or ISO 12185 (see also 7.1)
Cetane Index		min.	45	40	35	ISO 4264
Sulfur ^b	mass %	max.	Statutory requirements			ISO 8754 (see also 7.2)
Flash point	°C	min.	43	60	60	ISO 2719 (see also 7.3)

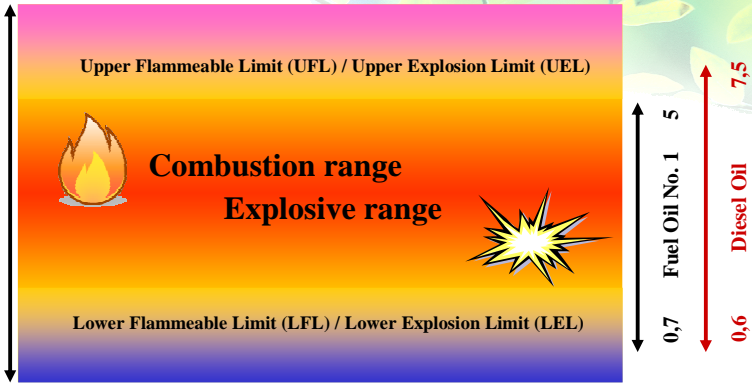
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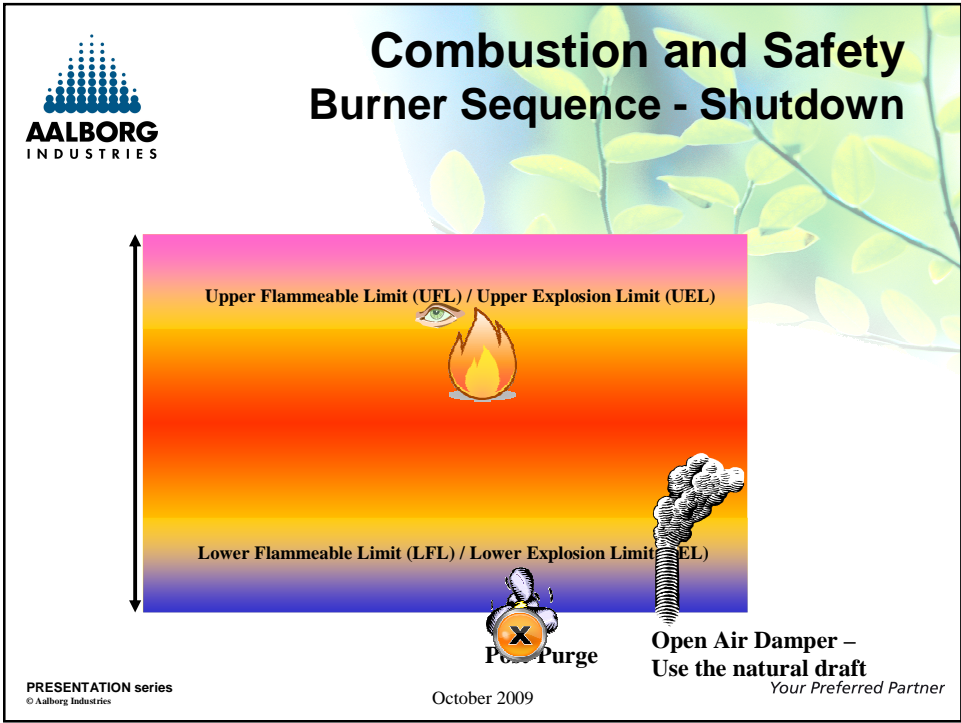
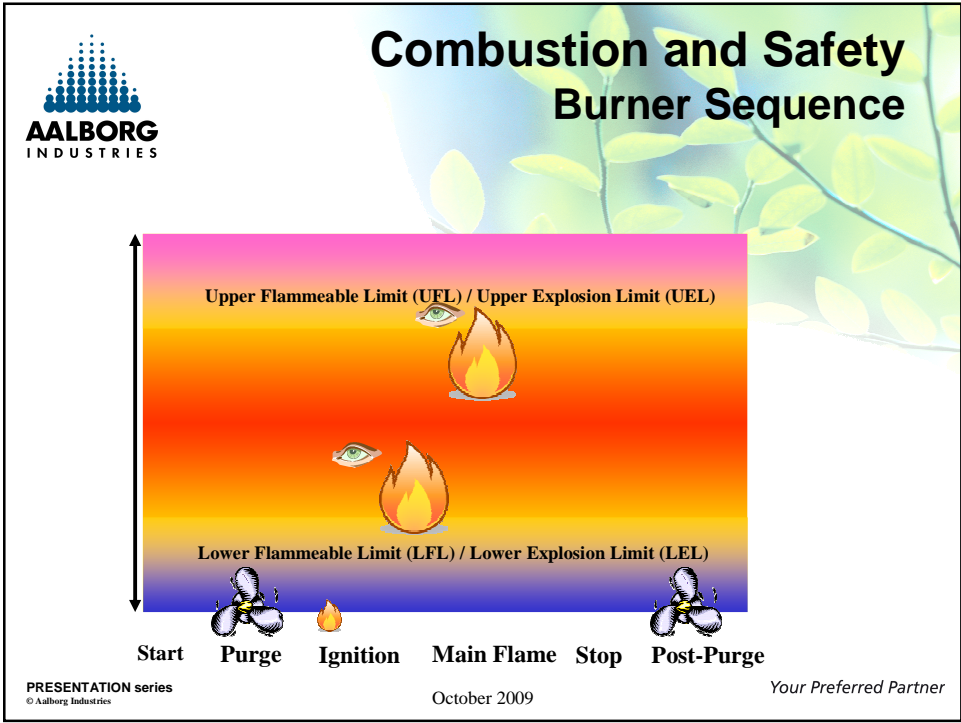
Combustion and Safety




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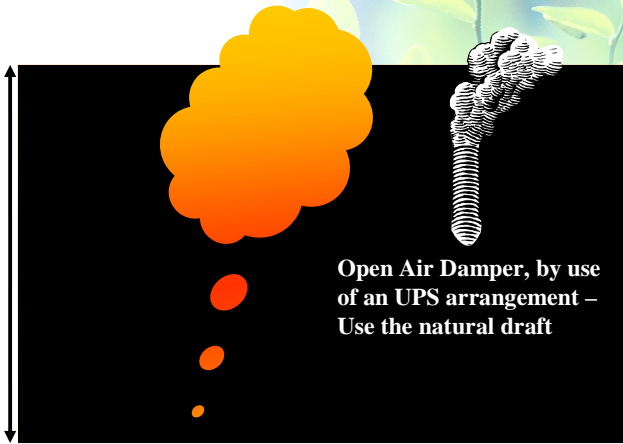
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Combustion and Safety Black out




Open Air Damper, by use of an UPS arrangement –
Use the natural draft

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Combustion and Safety Summary

Monitor Ignition Flame

Perform Post Purge at normal stop

Perform a differentiate Shutdown Post Purge

Open Air damper when Combustion Fan is not available


Use Air atomizing, or a suitable steam atomizing lance

Close/Stop Pipe tracing

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The Green way – NO_x/SO_x/CO₂ reduction

- **Reduce the oil consumption – Install an Exhaust Gas Boiler –after the Aux. Engine**
- **Use of Electrical Heaters**
- **Combination of Steam producing sources**

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