

MITSUI SERVICE NOTE



MITSUI ENGINEERING & SHIPBUILDING CO., LTD.
DIESEL TECHNICAL INVESTIGATION GROUP.

for MITSUI –MAN B&W engine Guideline for using Low Sulfur Fuel Oil (Distillate Fuel Oil)		NO. 174	
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ENGINE TYPE	All engines	DATE	May, 31 st , 2010

We would like to inform you of our guideline for operation of Distillate Fuel Oil (MGO, MDO) on Mitsui-MAN B&W diesel engine as follows.

1) Background

Recently, the limit of SOx emission from the vessel becomes more and more strict due to the environmental requirement.

The regulation of book VI attached to the MARPOL73/78 treaty adopted in MEPC60 (Marine Environmental Protection Committee) of IMO held in March, 2010 acknowledged to appoint additionally the sea area within North America and Canada coast 200 nautical miles as well as Baltic sea and North sea as new ECA (Emission Control Area, that is, the sea area that regulates a NOx discharge and sulfur of the use fuel oil strictly). It will be published on August 1, 2011. The regulation of sulfur content of fuel oil in mentioned these ECA and the other global sea will be strengthened as below chart.

In addition, the local regulation has movement of the reinforcement separately from regulation of book VI attached to the MARPOL73/78 treaty mentioned above. The regulation of the State of American California establishment which took effect from July 1, 2009 regulated sulfur content of fuel oil within California waters and 24 nautical miles of the California as below chart.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025		
IMO SOx Regulation																				
Global	S ≤ 4.50%				≤ 3.50%								≤ 0.50%							
in ECA	≤ 1.50%		≤ 1.00%				≤ 0.10%													
				↑	in North America & Canada from Aug. 1 st , 2011															
Local SOx Regulation																				
CARIFORNIA			≤ 1.5% S MGO or ≤ 0.5% S MDO		≤ 0.1% S MGO or ≤ 0.1% S MDO															

The low sulfur fuel mostly means the usage of distillate fuel oil such as MGO (Marine Gas Oil) and MDO (Marine Diesel Oil). This guideline is prepared for general guideline using the distillate fuel on Mitsui MAN B&W engines.

2) MES service experience

We use the MDO of which sulfur content is app. 0.1% for the shop test of Mitsui-MAN B&W engines since 2007. The typical fuel properties used in our shop are shown in Table 1. We also use TBN70 Cylinder Lub. Oil (CYLINDER LUBRICATION OIL.) during the shop test including the initial running-in period of new engines.

Table1 Typical Fuel specification at the Shop test of Mitsui-MAN B&W engines

Contents	Unit	Value	Analysis
Density (15°C)	g/cm ³	0.8492	JIS K2249
Calorific value L.	J/g	42610	JIS K2279
Viscosity (50°C)	mm/s ²	3.236	JIS K2283
Water by Dist.	wt%	< 0.05	JIS K2275
Sulfur	wt%	0.07	JIS K2541
Carbon residue (10%)	wt%	0.33	JIS K2270
Cetane index	wt%	51.3	JIS K2280

3) Cylinder Lubrication oil (See also MN082)

When using the low sulfur fuel and high TBN (Total base number) cylinder Lubrication oil, the deposit is increased due to the excessive alkalinity in cylinder lubrication oil. Therefore, in principle, lower TBN cylinder Lubrication oil such as TBN40 is preferred for the operation with low sulfur fuel.

According to our experiences from our engine shop and actual operation in SECA area, It was confirmed that Mitsui-MAN B&W engine has few problem under operation with low sulfur fuel and TBN70 cylinder lubrication oil in short time (max. two weeks), if not over dosage of cylinder lubrication.

However, over dosage of cylinder Lubrication oil, which may result in bore polishing (mirror-like surface indicating a cylinder lubrication oil used liner structure) and deposit formation on the piston and accordingly may increase the risk of scuffing, is to be avoided.

We would recommend checking the cylinder condition at the earliest opportunity after app. 48 hours operation with low sulfur fuel. If the deposit is remarkably increased, the cylinder lubrication oil feed rate is to be reduced and further careful inspection would be requested.

To get more specific recommendation about the cylinder lubrication oil feed rate, please contact our Techno Service Department described in MN082.

4) Fuel oil viscosity

Mitsui-MAN B&W engine allows using the distillate fuel oil such as MGO and MDO according to ISO 8217 (2005) without any modification on current fuel system.

Most of available fuel oil with lower sulfur content have a property of lower viscosity. In case of too low viscosity fuel oil, there is a risk such as fuel pump seizure and stick due to the less lubricity in the fuel oil. In order to ensure a satisfactory hydrodynamic oil film on fuel pump sliding surfaces, Mitsui-MAN B&W recommends to keep a fuel oil viscosity at min. 2cSt measured at the engine inlet.

In case of marine diesel engine applied for CPP or power source for stationary plant, i.e., use the high revolution and low load condition, it is especially risky moreover for fuel pump seizure and stick. Further careful inspection would be requested.

The fuel oil of which viscosity is on or above 2.2 cSt at 40 deg.C for purchase approximate figure can be applied on all Mitsui-MAN B&W engines.

However, according to ISO8217(2005), the minimum viscosities at 40 deg.C of DMX and DMA grade of fuel are defined 1.4 cSt and 1.5 cSt respectively. To consider allowed minimum viscosity of DMX and DMA, it is difficult to keep 2cSt on current fuel system.

If the engine has to use DMX or DMA grade of fuel, the additive to increase the lubricity in fuel oil is to be considered.

5) Fuel Change over procedure

Prior to the intended change-over from HFO to MGO, we recommend that the compatibility of the two fuels is checked – preferably at the bunkering stage. The compatibility can be checked either in an independent laboratory or by using test kits onboard. Incompatible fuels may lead to filter blocking and extra focus should be on filter operation in case of incompatibility.

In order to protect the fuel equipment from thermal shock resulting in sticking, the process Change-over to/from MGO needs careful monitoring of temperature and viscosity. The operation and caution matter are show as follows,

Caution matters;

- ① The load during this process should be 25-40%.
- ② During change-over, the temperature increase/decrease rate should be less than 2°C/min.
- ③ The viscosity must not drop below 2 cSt and not exceed 20 cSt.

A: Change-over from HFO to MGO

- 1) Ensure that the temperature of the MGO in the service tank is on over 2 cSt and not exceed 20 cSt regarding the expected viscosity at the engine inlet.
- 2) Reduce the engine load to 25 - 40%.
- 3) Stop steam tracing and steam to pre-heater
- 4) Carry out change-over of fuel when the fuel temperature starts to drop.
- 5) While monitoring viscosity and the temperature, if the temperature is dropped rapidly, should adjust the steam valve for the fuel oil heater.

B: Change-over from MGO to HFO

- 1) Ensure that the temperature of HFO in the service tank is about 80 °C.
- 2) Reduce the engine load to 25 - 40%.
- 3) Rise up the temperature of MGO by temperature regulating valve or viscosity controller. During the process, control the difference of temperature between MGO and HFO within 25 °C. The rate of temperature change of the fuel inlet must not exceed 2°C/minute. The viscosity must not drop below 2 cSt and not exceed 20 cSt regarding the expected viscosity at the engine inlet.
- 4) Start changing over the fuel. The rate of temperature change of the fuel inlet must not exceed 2°C/minute. The viscosity must not drop below 2 cSt and not exceed 20 cSt regarding the expected viscosity at the engine inlet.
- 5) Start steam tracing when the viscosity reaches 5 cSt.

6) Fuel pump maintenance

In case that the low sulfur fuel oil is used with poor maintained fuel system, the engine cannot increase the load or cannot start in the worst scenario.

We accordingly recommend checking the clearance of fuel barrel and plunger, and to be replaced in case excessive wear is measured.

Also, it should be tested that the engine is able to start on low sulfur fuel before maneuvering in the port area.

If you need further advice and question regarding the above, please contact with the below-mentioned MES TECHNOSERVICE CO., LTD.

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