

for MITSUBISHI—MAN B&W engines, Guidance for retrofitting SOx scrubber Rev.1 : 10 th Sep 2018 Add (Output of engine load)		No. 099	
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ENGINE TYPE	ALL engines	DATE	3rd Aug. 2018

We hereby explain about the guidance for retrofitting SOx scrubber (hereinafter referred as scrubber) for Mitsui-MAN B&W diesel engines as follows.

1. Background

Recently, the regulation of SOx emission from vessel becomes more stringent due to growing demands for environmental protection, and new global limit of 0.5% sulfur in fuel oil used onboard will be enforced in year 2020 consequently. To meet the new requirement, low sulfur fuel oil or gas oil has to be used, or limit the air pollutants by installing exhaust gas cleaning system known as scrubber.

Because of higher price for low sulfur fuel oil, scrubber used together with cheaper high sulfur fuel oil is considered more effective for reducing running cost.

Consequently, demand and number of projects planning for scrubber installation on vessel-in-service are increasing. In this guidance, we explain the influences to main engine with scrubber installed and necessary countermeasures.

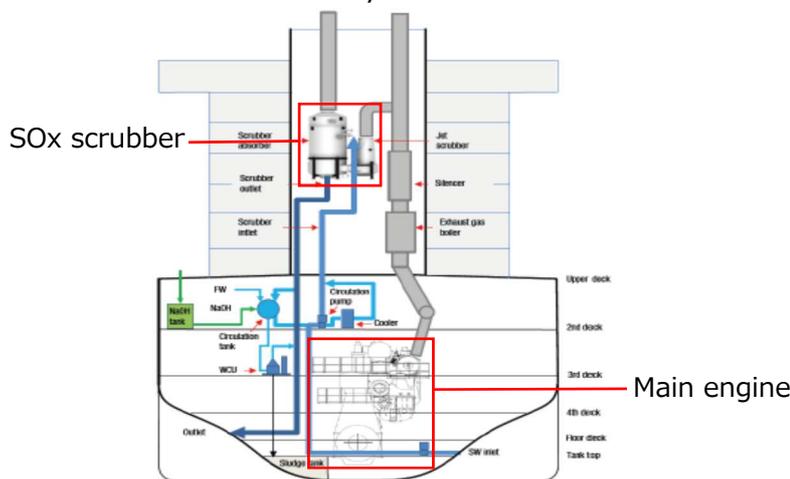


Fig.1: Outline schematic of SOx scrubber installation

PRIORITY

IMMEDIATELY <input type="checkbox"/>	AT FIRST OPPORTUNITY <input type="checkbox"/>	WHEN CONVENIENT <input type="checkbox"/>	OTHERS <input type="checkbox"/>
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2. Planning for scrubber retrofit

It is necessary to consider the following 2 points when planning scrubber retrofit.

① Limit value of turbocharger back pressure.

On normal engine (without scrubber), turbocharger back pressure at MCO is set at 3.5kPa or less. Considering the loss margin due to contamination etc. of the entire exhaust passage at the design stage, it is recommended to keep 3.0kPa or less.

In case of installing the scrubber, we recommend back pressure at 6.0kPa or less at MCO.

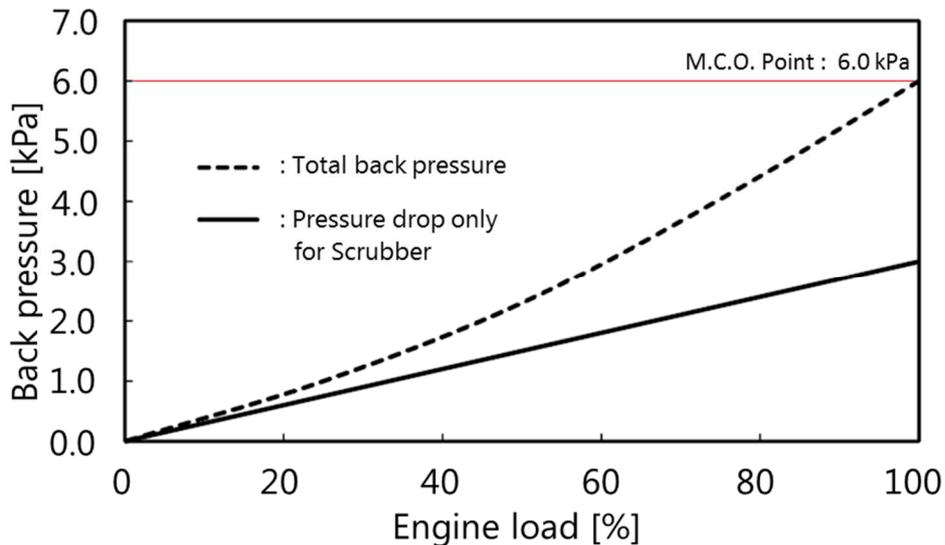


Fig.2: Pressure drop on entire exhaust pipe and SOx scrubber unit

② Scrubber bypass pipe.

According to the classification rules, bypass pipe has to be installed in case of failure or abnormality on the scrubber system. Also, please plan bypass pipe installation in consideration of maintenance on the scrubber when using low sulfur fuel.

If something goes wrong with the scrubber, it is necessary to shut down and bypass the scrubber system automatically in order to maintain engine operation. Therefore, please consider to install control system for switching between scrubber line and bypass line.

When exhaust gas is bypassed, back pressure is decreased due to pressure loss on the scrubber disappears. As a result, scavenge air pressure rises and exhaust gas temperature at turbocharger outlet decreases (it will drop to temperature level before scrubber installation, if no modification on turbocharger as mentioned in Item 4).

If the influence of exhaust gas temperature drop cannot be tolerated, installation of device (e.g.: orifice etc.) to maintain back pressure in the bypass line is recommended.

Table1 shows the influence index on main engine performance due to decrease of back pressure.

Table1 : Influence index for decrease of back press on engine performance

$$\text{factor} = (3.0 - Y) / 3.0 - 1$$

Y : T/C back pressure decreasing value at 100%M.C.O. [kPa]

Output [%]	Scav. air and exh gas amount [%]	T/C inlet temp. [°C]	T/C outlet temp. [°C]
110%	-2.1 × factor	+10 × factor	+10 × factor
100%	-2.1 × factor	+10 × factor	+10 × factor
85%	-2.1 × factor	+9 × factor	+9 × factor
75%	-2.1 × factor	+8 × factor	+9 × factor
50%	-2.1 × factor	+7 × factor	+8 × factor
25%	-2.1 × factor	+6 × factor	+7 × factor
0%	-2.1 × factor	+6 × factor	+7 × factor

③ Output of main engine Load 

Regard to Scrubber control system, in order to record of engine load, it is required to output engine load signal. As necessary, please confirm the necessary signals by scrubber maker beforehand, and contact our Technoservice Division after filling in the attachment sheet "Pre-Inspection for SOx scrubber retrofit".

3. Influence on main engine by scrubber retrofit

Due to pressure loss caused by exhaust gas passing through the scrubber, total back pressure (static pressure inside exhaust gas pipe; or back pressure) inside exhaust system after turbocharger outlet is increased.

Generally, scavenge air amount and pressure are reduced when the back pressure increases, causing higher thermal load on main engine, and negative impact on fuel consumption.

Engine parts inside combustion chamber such as exhaust valve will have higher burning rate when the engine thermal load increases.

4. Modification on main engine

Due to increase in back pressure after scrubber retrofit (refer Item 2), we recommend to alleviate the influence on main engine by turbocharger modification.

For vessels in service, turbocharger performance is likely has deteriorated. By reviewing the turbocharger specification based on this performance degradation, improvement in engine performance can be expected. If the back pressure after scrubber installation exceeds 3.5kPa, we recommend to study the modification of turbocharger.

If the modification of turbocharger is not applied, it is recommended to inspect the exhaust valve and cylinder condition, considering the influence on main engine (refer Item 3), and adjust the inspection interval accordingly depending on the condition.

Increase of back pressure also affects NOx emission rate, so the maximum limit is set for NOx Technical File. Revision of NOx Technical File is necessary if the back pressure exceeds the maximum limit value of 4.4kPa. However, considering the increase of back pressure due to contamination in whole exhaust gas pipes, we recommend to revise Technical File if back pressure is over 3.5kPa.

For inquiries regarding main engine modification and scrubber bypass pipe installation, please confirm the planed back pressure at MCO before and after the scrubber retrofit with shipyard and scrubber maker beforehand, and contact our Technoservice Division after filling in the attachment sheet "Pre-Inspection for SOx scrubber retrofit".

For any inquiries about this technical news, please contact our Technoservice Division. For contact information including domestic and oversea regional offices, please refer to Service Note No.111.

Pre-Inspection for SO_x scrubber retrofit

Vessel Name : _____

Engine Type : _____

Scrubber Maker and type : _____

Scrubber loop type : _____ Open _____ or _____ Close _____ or _____ Hybrid _____

Retrofit plan date & place : _____ & _____

Engine modification for T/C re-matching

In order to study modification T/C, How much level is the planned T/C back pressure at MCO (Max. continuous output) after scrubber installation with modification for Exh gas pipes ?

- Before planed T/C back pressure at MCO (previous condition) _____ [kPa] or [mmAq]

- After planed T/C back pressure at MCO (after scrubber retrofit) _____ [kPa] or [mmAq]

In order to confirm present engine performance, please inform engine performance data including T/C back pressure measured value.

Engine Load Output

In case that it is required to output some signal from engine,

What kind of signal output for SO_x scrubber control system is required?

- Main engine run signal (ON/OFF) _____ YES _____ or _____ NO _____

- Engine Load signal output _____ YES _____ or _____ NO _____

- Fuel index signal output _____ YES _____ or _____ NO _____

- Engine Speed signal output _____ YES _____ or _____ NO _____

- Other Signal _____