

JAPAN ENGINE CORPORATION

SERVICE ENGINEERING DEPARTMENT, SERVICE ENGINEERING SECTION
1, MINAMIFUTAMI, FUTAMI-CHO, AKASHI-CITY 674-0093, JAPAN

TEL. +81-78-949-0804 (direct), e-mail: sales2@j-eng.co.jp (parts & engineer order), service@j-eng.co.jp (technical inquiry)

(1/1)

Subject : Guidelines for SOx scrubber application	Application	UEC Diesel Engine
	Type	All UEC
	No.	USI-10017E R1
General		

International Marine Organization (IMO) plans to reduce the sulfur content regulation value of fuel oil step by step, which will become 0.5% or less from the current 3.5% or less in and after Jan. 2020 in General Areas (Global).

Therefore, it is necessary for all vessels to use fuel oil conforming to this regulation or to apply an exhaust gas scrubber (SOx scrubber) after year 2020.

In the case of applying the SOx scrubber to UE engine, it is necessary to modify the specification of turbocharger to obtain NOx approval from the viewpoint of securing the performance and reliability of the engine.

And, we also recommend the measures in order to improve the reliability of the combustion chamber components according to the engine model and specifications.

For the guidelines on this matter, please refer to the attached "WMS-F075".

For further inquiries about the application of SOx scrubber, please contact the following information desk.

(Information desk)

Japan Engine Corporation

After-Sales Department

Tel.: +81-78-949-0808

Common E-mail address: sales2@j-eng.co.jp

The action priority indicated at the upper right corner is settled by Japan Engine Corporation originally and it does not decide the action of users.
Further, it is not guaranteed the every action carried out according to this service information.
The service information issued by Japan Engine Corporation included not only copyright but also all rights is reverted on Japan Engine Corporation.

Plan record	Newly issued. 9th Aug. 2018 <i>T.Y, T.N, D.Y</i> Rev.1 Revised the attached material. 8th Feb.2019 <i>T.Y, T.N, D.Y</i>	Approved	<i>T. Yamamoto</i>	SERVICE ENGINEERING DEPARTMENT
		Checked	<i>T. Nasu</i>	SERVICE ENGINEERING SECTION
		Designed	<i>D. Yasuda</i>	DATE OF ISSUE : 8th Feb. 2019

Guideline for SOx Scrubber application

21st Dec. 2018, 5th edition (revision D)
30th Jul. 2018, 4th edition (revision C)
14th Feb. 2018, first edition

Development & Design Department

Japan Engine Corporation

Revision D
- Page 3 modified
- Page 6 added

WMS-F075/D

© 2018 Japan Engine Corporation. All Right Reserved.

Introduction

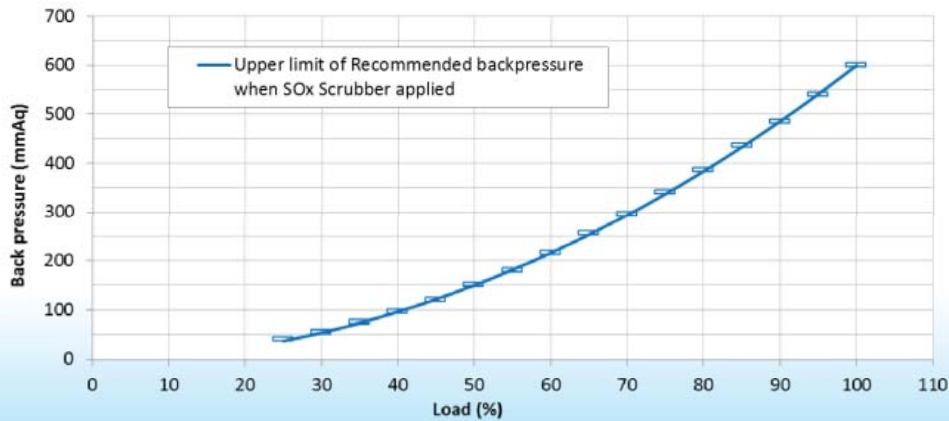


Regarding SOx scrubber application, we would like to explain our guideline and recommendation as follows.

- Acceptable Exhaust gas back-pressure when applying SOx scrubber
- Main Engine's concerns and solutions for them
- Turbocharger re-optimization by changing parts
- Effect of back-pressure rise on Main Engine
- Engine performance when bypassing SOx scrubber
- Max tolerance of back-pressure to comply IMO-NOx regulation

Acceptable Exh gas back-pressure for SOx scrubber

- Turbocharger specifications of UE engines are selected and optimized in order to obtain a planned scavenging air pressure under condition that Upper limit of back-pressure at MCR is 300mmAq. Therefore when back-pressure exceeds 300mmAq (at MCR), the turbocharger spec, change is required.
- Acceptable Exhaust gas back-pressure for SOx scrubber (Upper limit of recommended back-pressure) is as below.
Scrubber is to be selected under the upper limit of back-pressure.
600/485/435/340/255/150mmAq at 100/90/85/75/65/50%Load respectively.



Acceptable Exh gas backpressure for SOx scrubber

Note)

- In case of Scrubber is bypassed at high engine load, back-pressure drop can lead T/C outlet gas temperature decrease.
- Above back-pressure drop is acceptable for the engine.
- If this temperature decrease is not acceptable for vessel's operation, the pressure drop can be compensated by providing an equivalent resistance in the bypass line.

1. Engine Performance and Reliability

- Exhaust gas back-pressure rise → Scavenging air pressure (Ps) drop
→ Reliability degradation of Combustion chamber components (Hot parts)

【Basic measure】 Turbocharger Nozzle spec change

- Ps is to be adjusted equal or higher than the original condition

【Optional measure】 Hot parts upgrade or replacement is recommended.

It depends on engine type and its specifications

- Please contact us for more details.

Periodical maintenance and parts replacement for Fuel Valve, cylinder lubricating quills (SIP valve, ECL valve), ECL distributor and Turbocharger consumable parts are also recommended.

- Exhaust gas back-pressure rise → T/C surge margin decrease
→ Risk of T/C surging increase

(Not critical, but to be confirmed on each engine group)

【Basic measure】 Turbocharger Diffuser spec change (case by case)

- Proper surge margin is to be secured.

- Turbocharger spec change is required when Exhaust gas back-pressure exceeds 300mmAq (at MCR). Turbocharger matching test for new manufacturing engine or T/C Spec re-select and change for in-service vessel is required.

For new building engines, the shop test (including Turbocharger matching test and NOx approval test) will be carried out according to following scheme.

	(Reference) Scrubber Not applied	Scrubber READY (Not fixed)	Scrubber READY (When, Pback etc., are decided)	Scrubber Applied
T/C spec: normal Pback : normal	☑	☑	-	-
T/C spec: normal Pback : High	-	-	-	-
T/C spec: For scrubber Pback : normal (Scrubber By-pass)	-	-	-	-
T/C spec: For scrubber Pback : High	-	-	☑	☑

Regarding “Scrubber READY”, if application date and back pressure are decided, the shop test with turbocharger specification for scrubber and high back-pressure is recommended.

2. IMO-NOx regulation

- Turbocharger spec parts ,which are one of NOx mandatory components, are to be optimized.

【Basic scheme】

- ▣ Main Engine for new building vessel

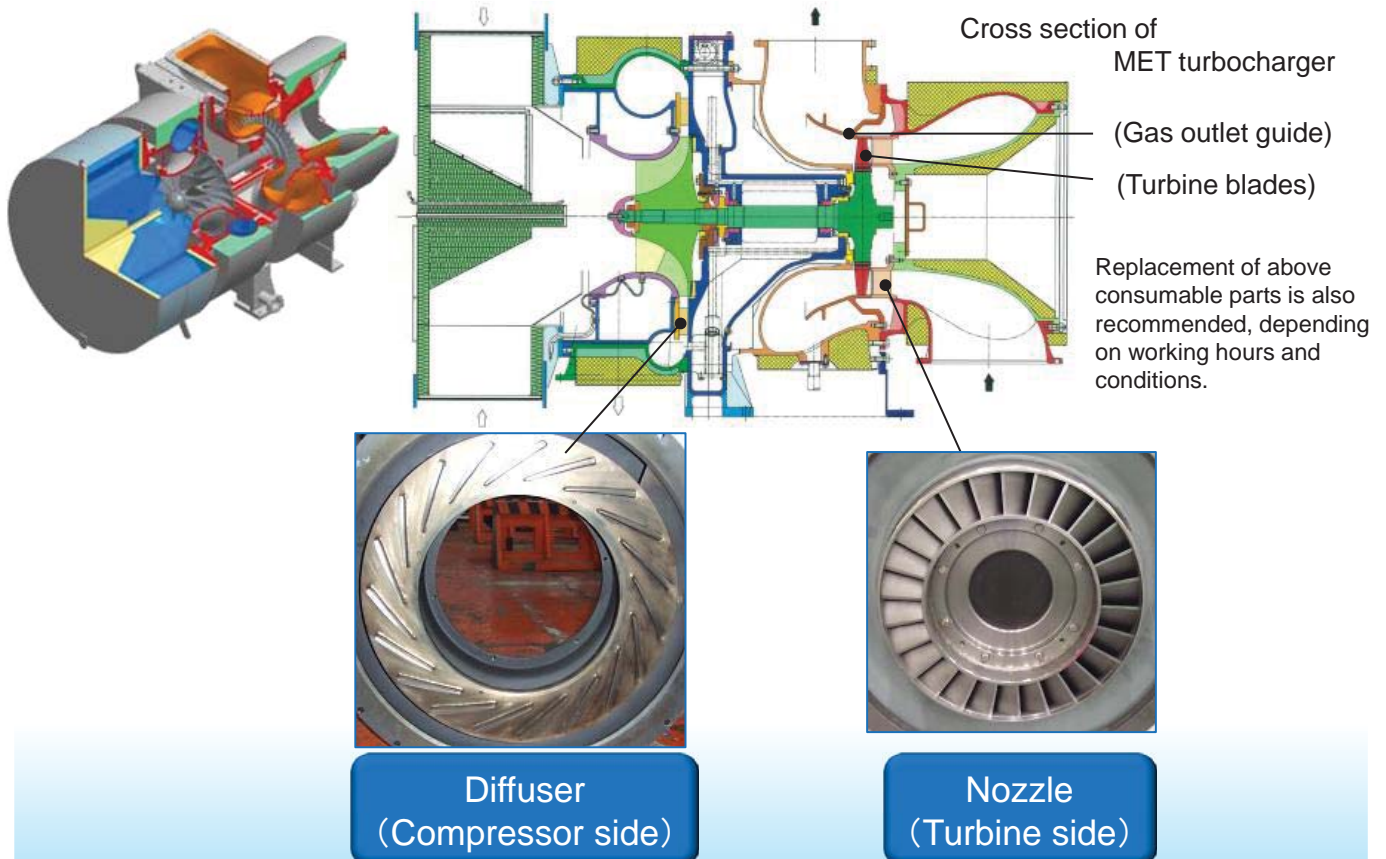
NOx approval test under new planned back-pressure is required.

- ▣ Main Engine for in-service vessel

Submission and approval obtainment of
“Amendment to NOx Technical File”. (Under discussion with Class NK*)

(*Remarks: To be discussed with other classes after receiving owner's requirement.)

Turbocharger spec change parts

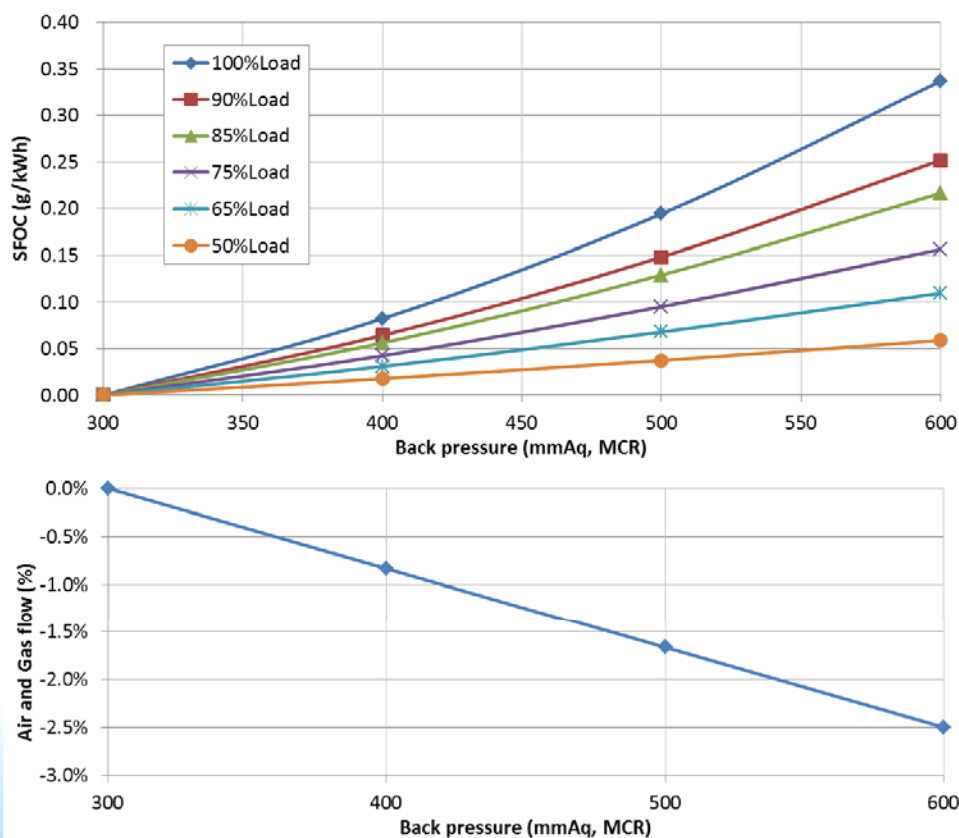


Effect of back-pressure rise on Main Engine performance is shown as below table. Graphs are also available for referred.

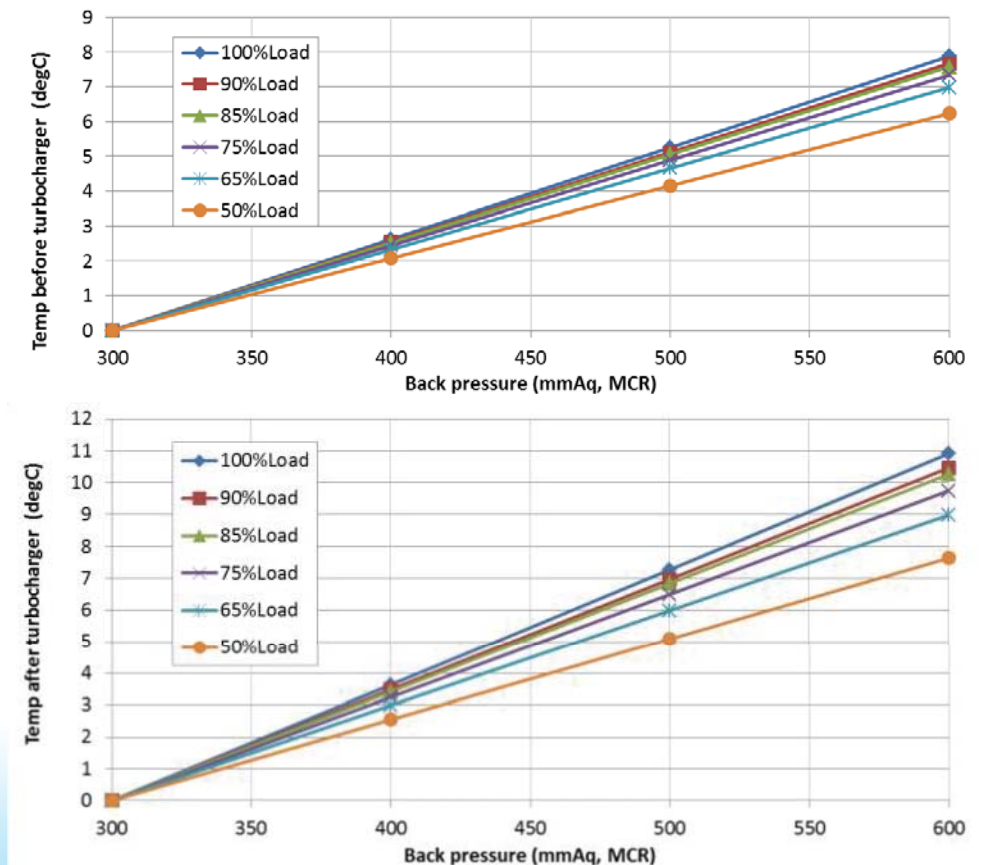
(ISO condition)

Backpressure Rise (MCR)	+300 mmAq	+200 mmAq	+100 mmAq	+300 mmAq	+200 mmAq	+100 mmAq
Load	SFOC[g/kWh]			Air and Gas flow [%]		
100%	0.35	0.20	0.10	-2.5%	-1.7%	-0.8%
90%	0.25	0.15	0.05	-2.5%	-1.7%	-0.8%
85%	0.20	0.15	0.05	-2.5%	-1.7%	-0.8%
75%	0.15	0.10	0.05	-2.5%	-1.7%	-0.8%
65%	0.10	0.05	0.05	-2.5%	-1.7%	-0.8%
50%	0.05	0.05	0.00	-2.5%	-1.7%	-0.8%
Load	Temp before T/C [degC]			Temp after T/C [degC]		
100%	8	5	3	11	7	4
90%	8	5	3	10	7	3
85%	8	5	3	10	7	3
75%	7	5	2	10	6	3
65%	7	5	2	9	6	3
50%	6	4	2	8	5	3

Effect of back-pressure rise on Main Engine



Effect of backpressure rise on Main Engine



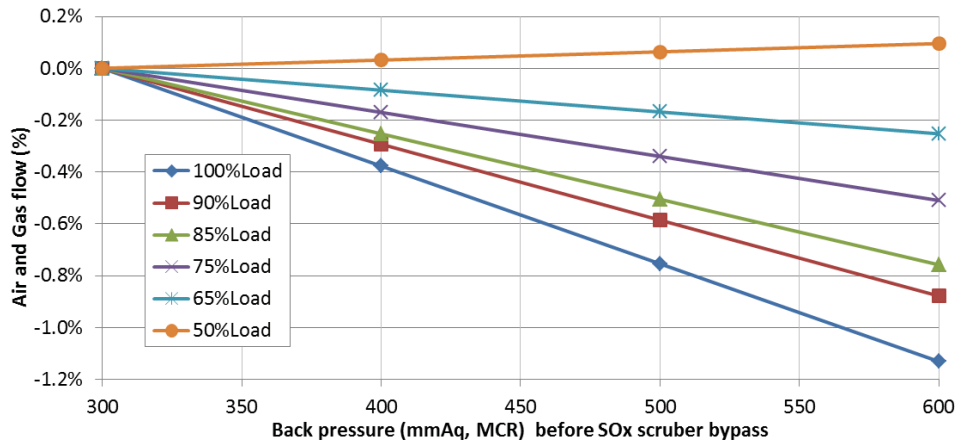
Engine Performance when bypassing SOx scrubber

For vessel with SOx Scrubber and Turbocharger spec has been changed, when the Scrubber is bypassed, back-pressure can drop to the original/normal levels and engine performance may change as below. Below values show difference from the original engine performance under the original back-pressure and the original turbocharger spec.

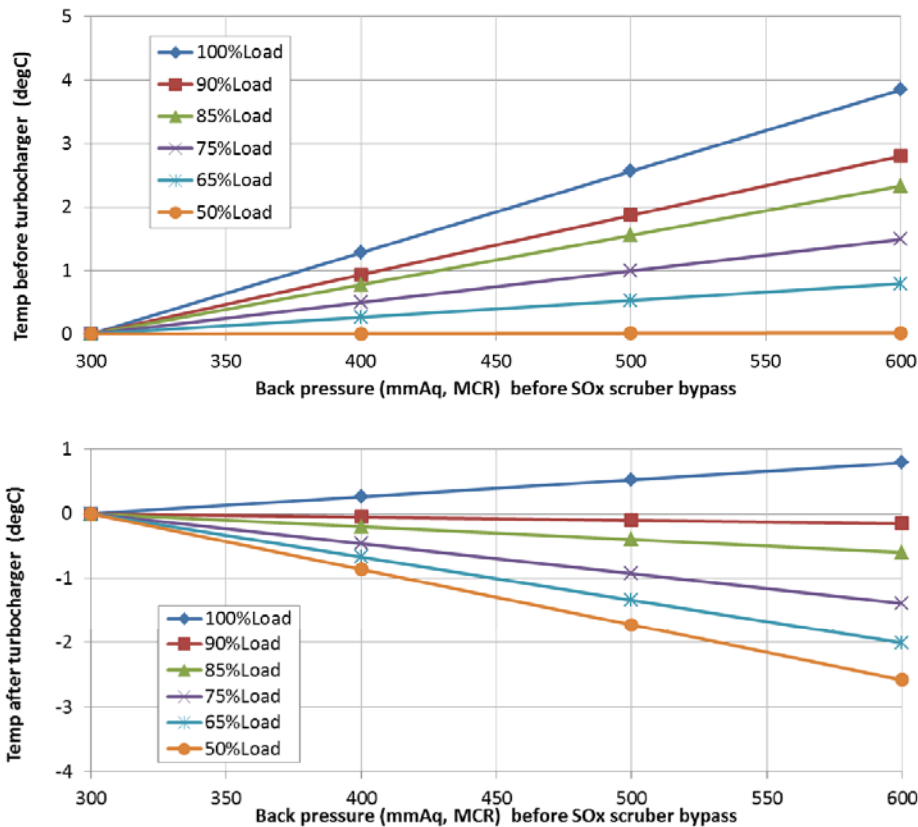
(ISO condition)

Backpressure Rise before Bypass (MCR)	+300 mmAq	+200 mmAq	+100 mmAq	+300 mmAq	+200 mmAq	+100 mmAq
Load	SFOC[g/kWh]			Air and Gas flow [%]		
100%	0.0	0.0	0.0	-1.1%	-0.8%	-0.4%
90%	0.0	0.0	0.0	-0.9%	-0.6%	-0.3%
85%	0.0	0.0	0.0	-0.8%	-0.5%	-0.3%
75%	0.0	0.0	0.0	-0.5%	-0.3%	-0.2%
65%	0.0	0.0	0.0	-0.3%	-0.2%	-0.1%
50%	0.0	0.0	0.0	0.1%	0.1%	0.0%
Load	Temp before T/C [degC]			Temp after T/C [degC]		
100%	4	3	1	1	1	0
90%	3	2	1	0	0	0
85%	2	2	1	-1	0	0
75%	1	1	0	-1	-1	0
65%	1	1	0	-2	-1	-1
50%	0	0	0	-3	-2	-1

Engine Performance when bypassing SOx scrubber



Engine Performance when bypassing SOx scrubber



Max tolerance of back-pressure regarding IMO-NOx

- T/C back-pressure may be limited according to IMO-NOx documents. For Engine Groups which NOx emission test was held after 1st July 2010 (NTC2008(*) validated), the max tolerance of backpressure is referred to NOx emission test report.

(*) NTC2008 :

NOx Technical Code 2008. It entered in force from 1st July 2010. “Max tolerance” is required when NOx emission evaluation and It was set by each Engine maker and applied to Engine Groups which NOx emission test was performed after 1st July 2010. Max tolerance back-pressure of UE engines (IMO-NOx Tier I and II) is 450mmAq at MCR.

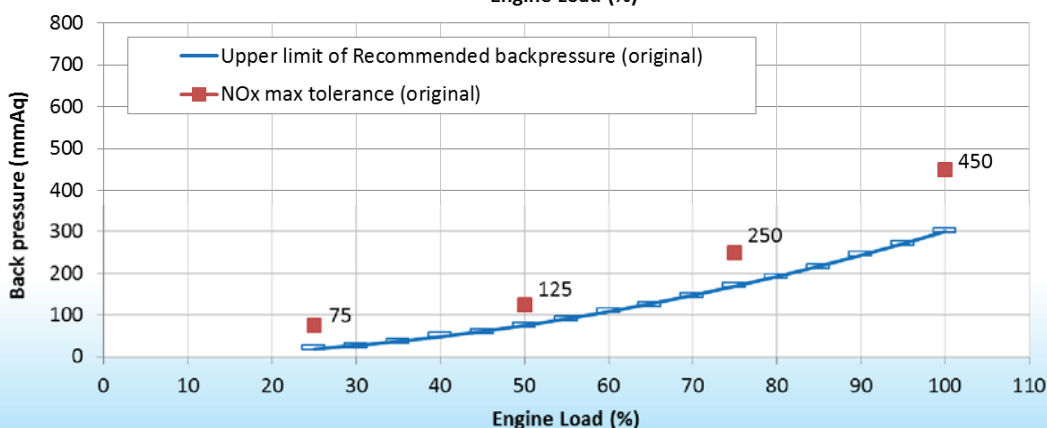
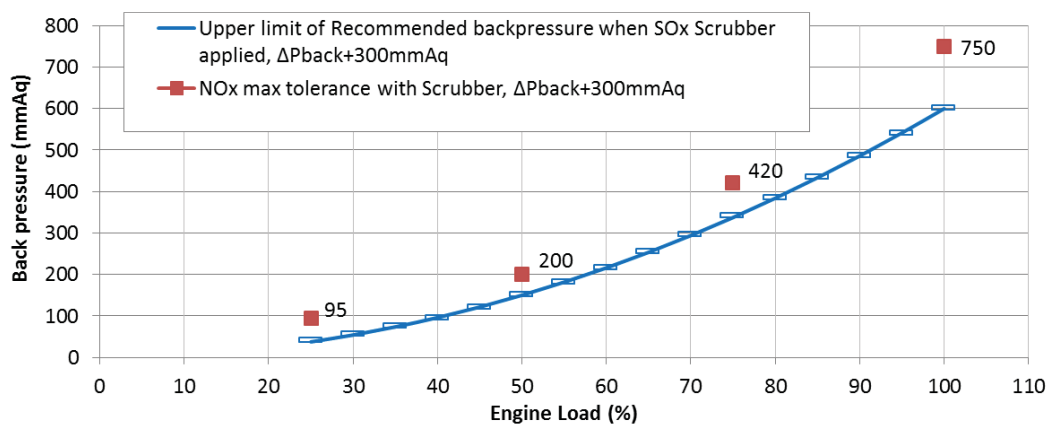
- When SOx Scrubber is applied, above max tolerance will be changed, depending on back-pressure increase level. Referred to next pages.

Attention:

Max tolerance is the worst case after in-service and not to be used for Scrubber planning. Therefore, when back-pressure rise over 300mmAq (at MCR), even it is lower than max tolerance 450mmAq, turbocharger spec is to be changed.

When scrubber planning, back-pressure should be lower than e below than “Acceptable Exh gas back-pressure for SOx scrubber (Upper limit of recommended backpressure)”.

Max tolerance of backpressure regarding IMO-NOx



Max tolerance of backpressure regarding IMO-NOx

