Service Information No. 0002M332

Date: 14.10.2014
Subject: Turbocharger type NR24/R

Engine type: **8M282/ 8M332 / 8M332C**

Service Information 0001M332; Update 2014; Containment level of turbocharger type NR24/R does not reflect current safety standards

The turbocharger maker MAN Diesel and Turbo SE informed us about updates of **MAN Alert Service Bulletin ASB 2013/02/18** with the following comments:

August 2014

"With this letter we would like to update you on our progress regarding the validation of containment solutions for NA and NR turbochargers. Since the release of the ASB2013/02/18 we have gained further experience on the operation of the affected NA and NR turbochargers following the safety advice provided by the ASB and its Addendum. In numerous discussions with the different customer groups we learned that some of the given advice should be altered and/or clarified for practical reasons. With this letter we would also like to follow a request from our customers and FutureShip, our external consultant, to furnish our marine customers with a revised perspective of risk as it was described in the ASB and its Addendum. Finally we would like to thank selected representative customers who have provided valuable input to the content of this update."

Please find attached the following documents:

20140808 Update to ASB – Marine.pdf
20140808 Updated Addendum to ASB.pdf

September 2014

"Update of Provisional Testing and Commissioning Instructions

As a measure of precaution to reduce the risk of a compressor wheel failure, we had recommended with our Provisional testing and commissioning instructions to carry out a visual inspection of the compressor wheel for pre-damages after a run-in period of 4 hours. The evaluation of the performed inspections revealed however, that the leading edges of the compressor wheel blades were not in one single case damaged by particles originating from the air cooler. For this reason we came to the conclusion that the compressor wheel pre-inspection can be omitted. We have updated the Provisional testing and commissioning instructions accordingly and are pleased to provide you with the attached revision dated 15.09.2014."

Please find attached the following documents:

20140919 Update of Provisional Testing and Commissioning Instructions.pdf

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To whom it may concern

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Update to the ASB2013/02/18 and its supplement for marine applications (product safety warning for turbocharger types NR12, NR14, NR15, NR17, NR20, NR24, NR26, NR29, NR34, NA29 (consolidation of ASB2013/04/22 and supplement), NA34, NA40, NA48, NA57, NA70)

Dear Ladies and Gentlemen,

With this update, we would like to inform you about the latest developments and observations. In this letter we will in particular describe:

- The technical sequence and pre-requisites which may lead to an actual containment failure.
- The correction of a previously communicated risk reference level for single risks.
- Enhanced safety instructions (intended to be distributed to vessel or plant crews).
- The latest list of available upgrade solutions.
- The integration of NA29/S into ASB2013/02/18 whose relevance was so far covered by ASB2013/04/22.

Our product safety warning via the ASB 2013/02/18 and its supplement remain valid as long as an upgrade kit has not yet been installed on the affected turbochargers.

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1) Sequence which may lead to an actual containment failure

Several customers have raised the question what types of circumstances need to come together in order to cause a containment failure. The following sequence of events describes one of the possible scenarios that could lead in the end to a containment failure with the accompanying risk of bodily or even fatal injury (although no fatal injuries have been reported so far) and the risk of damage to adjacent machines or property, including the risk of fire:

Step 1: An unbalanced rotor is a typical reason for a turbocharger damage. Poor lubrication, contamination of rotating parts or foreign objects entering the turbine/compressor are possible causes for a sudden or slowly developing unbalance.
Step 2: The unbalance of a rotor may in turn cause a severe rotor damage (obviously this risk increases with rotor velocity).
Step 3: This severe rotor damage may then cause fragments of the rotor to break off with substantial impulse velocity and with very high internal forces being applied to the casing and casing connections. The casings might not be able to withstand these forces and may consequently allow some of these fragments to be released from the turbocharger with the remaining impulse energy.
Step 4: If at the instant of this incident a person happens to be in the vicinity of the turbocharger, it is possible that he or she may be hit by a fragment which is released from the damaged turbocharger and which might have a high velocity.

Every step described above has a certain probability which results in a total calculated probability for a person experiencing injury. All steps have to take place to actually experience the worst case scenario of a person being injured whereas the root causes for rotor damages as described in Step 1 and 2 could alter in individual cases.

2) Risk analysis and risk referencing

With the information distributed in August 2013, MAN informed all customers/operators of marine applications

a) about failure risks of specific turbocharger types and calculated risks of getting injured and
b) about a proposed reference level for the above mentioned calculated individual risk values.

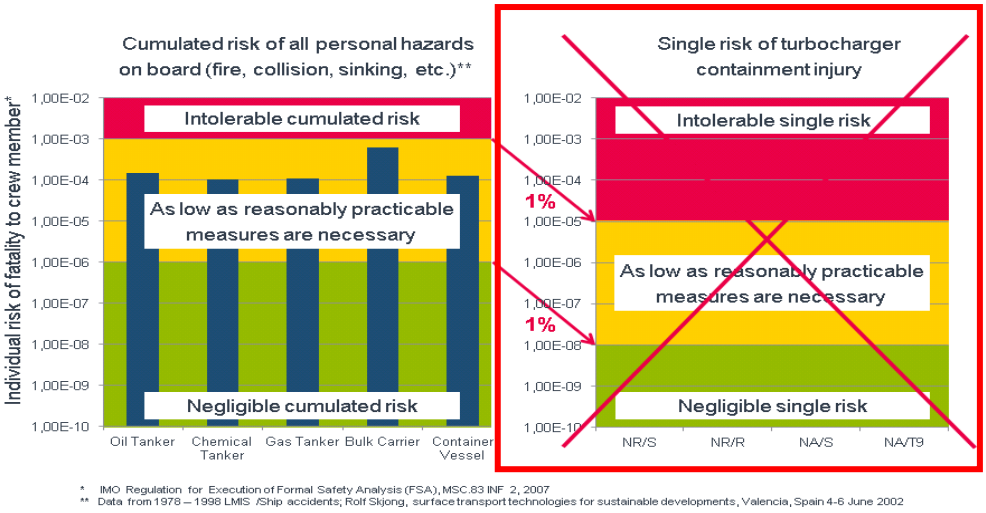
The failure risk numbers of a) remain valid whereas the reference level for individual risk values b) has recently been withdrawn by the external expert engaged to provide a risk based perspective.

We would like to comment on these two aspects.

To a): Customer feedback has confirmed the approach that we have taken together with the consultant firm FutureShip which has been renamed to: “Risk & Safety and Systems Engineering“ team of DNV GL. The failure rate of the individual turbocharger type was made transparent and combined with a possible presence rate of crew members in the hazardous zone of the turbocharger. The resulting risk of being injured was calculated. Based on these numbers, MAN enables customers to perform their own risk assessment. This calculation remains valid.

To b): FutureShip provided a risk reference level for single risks arising from single products which was based on the idea to transfer the cumulated risk thresholds provided by IMO's guideline "Formal Safety Assessment FSA".
However at the end of April 2014, FutureShip withdrew the previously communicated risk recommendation due to the fact that there is no established guideline for risk acceptance of single risks. FutureShip has asked us to inform you accordingly about the inapplicability of the previously communicated risk recommendation which we do hereby expressly.

Consequently, without this proposed risk reference it is up to the individual customer to individually define an acceptable risk level.



* IMO Regulation for Execution of Formal Safety Analysis (FSA), MSC.83 INF 2, 2007
** Data from 1978 – 1998 LMIS /Ship accidents; Rolf Skjong, surface transport technologies for sustainable developments, Valencia, Spain 4-6 June 2002

3) Updated "Safety Instruction": Measures to reduce risk

Based upon own experience and customer feedback, we have updated our Safety Instructions. These instructions summarize the major technical as well as organizational risk mitigation measures and are intended to be distributed to plant and ship crews.

4) Upgrade kit development: Overview of available solutions

Since the release of the ASB2013/02/18 in February 2013, a team of interdisciplinary experts has been constantly working on this project full time and with the highest priority to develop and offer upgrade solutions (including the option of retrofits which offer additional operational benefits) wherever commercially and technically feasible as quickly as possible. For the following turbocharger types, upgrade kits are already available and can be inquired from MAN PrimeServ Turbocharger:

- NR12/RS
- NR12/S
- NR14/S
- NR15/R (only for turbocharger with air intake from engine room)

- NR17/S (only for turbocharger with air intake from engine room)
- NR20/S
- NR20/R
- NR24/S (only for turbocharger with air intake from engine room)
- NR24/R (only for turbocharger with air intake from engine room)
- NR26/R (only for turbocharger with air intake from engine room)
- NR34/S (only for turbocharger on V32/40 engine with air intake from engine room)
- NA40/S (only for turbocharger with air intake from engine room)

Once further upgrade kits become available for specific turbocharger types, the concerned customers who have reported their fleet will be notified individually.

Previously considered and communicated “alternative solutions” have not delivered the envisaged risk mitigation for small turbochargers; for larger axial turbochargers the validation program is still ongoing.

5) Turbocharger type NA29/S

In April 2013 the NA29/S type had to be integrated in the warning action; MAN issued ASB2013/04/22 with identical wording as ASB2013/02/18. For effective future communication, the NA29/S is covered by this information update.

Additional remarks

An information platform has been set up on the internet to provide general and turbocharger type specific information about this containment safety issue. Links have been provided to all the customers who have given us feedback on their fleet information based upon the turbocharger population that was reported back to us. In case you have not yet reported back to us on your turbocharger fleet details, we kindly ask you to provide these details in order to enable us to update you with further turbocharger type specific information.

If you should not have received any of the documents or information referred to within this letter or have any additional questions or comments, our Service Department is always at your disposal:

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We thank you for your ongoing co-operation and remain with best regards

MAN Diesel & Turbo SE

Ralf Großhauser
Senior Vice President
BU Turbocharger

Thorsten Lehmann
Vice President
Head of PrimeServ Turbocharger

Attachments:

Updated Addendum to ASB2013/02/18 (Version 2014/08)

Safety Instructions
(please forward to vessel or plant crew)

In addition to the safety instructions of the Turbocharger Instruction Manual and as long as an upgrade kit is not yet installed, organizational as well as technical safety measures may reduce the likelihood of a turbocharger damage as well as the risk of a consequential personal injury. The following text, which replaces the previous versions, will provide recommendations with the goals

- to avoid any rotor failure that might possibly lead to a loss of containment and subsequent fragment discharge and
- to reduce the presence of personnel in the vicinity of the turbocharger who may be exposed to the risk of personal injury if a turbocharger damage with a subsequent containment failure occurs.

1) Organizational safety instructions

Make sure that only qualified personnel who have received instructions on the recommendations listed below enter the engine room.

You can significantly reduce the risk of bodily injury by following the measures listed below:

a) Do not unnecessarily dwell in the vicinity of a turbocharger while it is in operation. MAN has defined a possible hazardous area (see below) which should be avoided while the turbocharger is in operation, unless required for the safe operation of the vessel/plant.

b) Wear appropriate protective clothing as recommended in the Instruction Manual of your turbocharger.

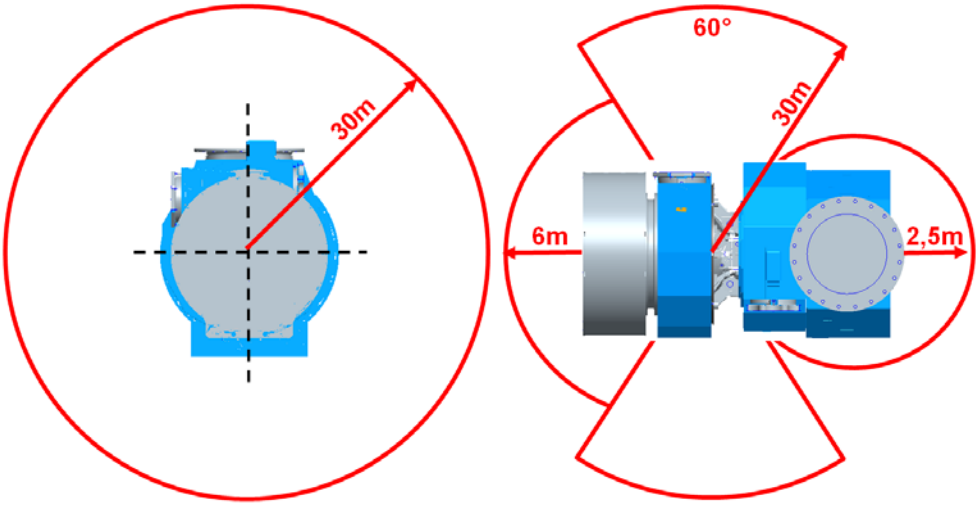

Fig. 1: Red zone = hazardous area (extended compared to the area in the Instruction Manual). We are aware that in most cases the space available around the turbocharger(s) is less than the given 30 m. However it indicates the area where the highest risk is assumed.

Optimize your path through the engine room in order to minimize your stay in the hazardous area. (Please note that in the context of the illustration also the green path can only be seen as the lower risk path)

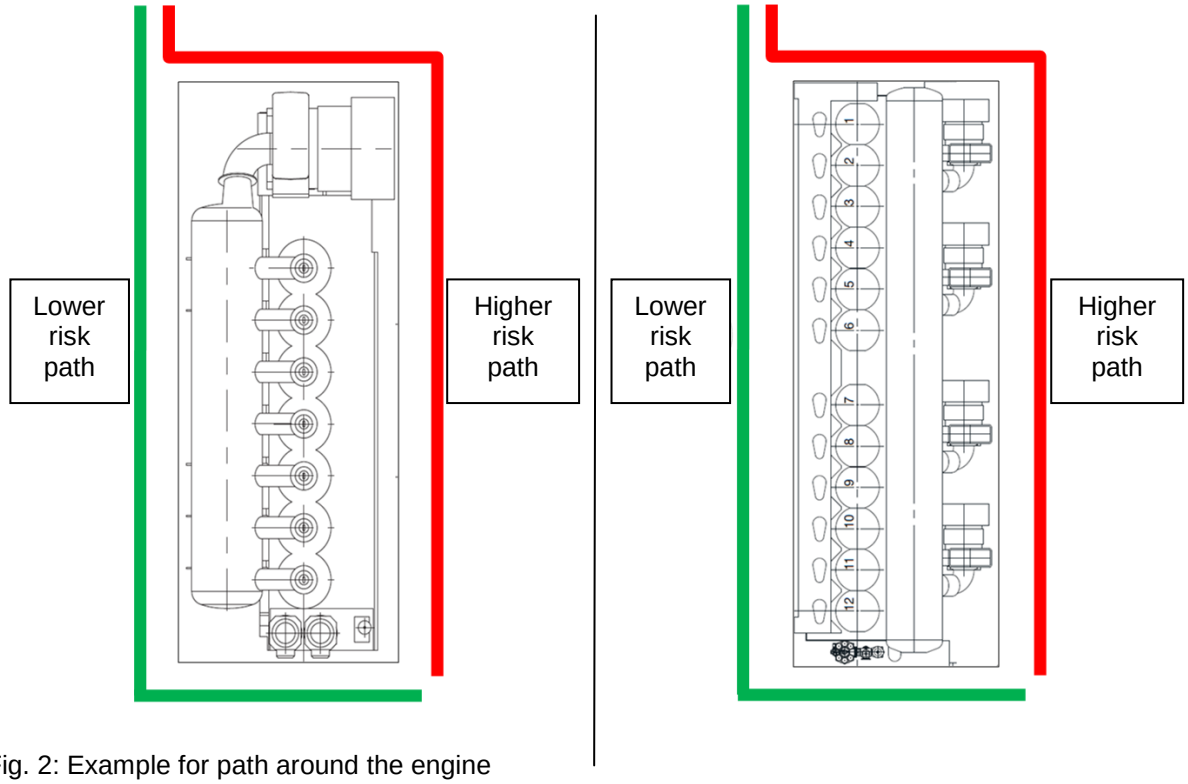

Fig. 2: Example for path around the engine

2) Technical safety instructions

The risk of a rotor damage in general and a compressor wheel damage in particular – as the main source of a possible containment failure – can be minimized (among others) by executing the following steps:

a) Keep the rotor in good condition with a high focus on lubrication and cleanliness.
b) Lack of cleanliness is one of the main reasons for an unbalance; any unbalance increases the risk of a rotor failure and a possible consequential containment failure.
c) Actively avoid overspeed, poor fuel quality and foreign object impact, e.g. by ensuring a clean air supply.
d) Keep the engine, e.g. exhaust valves and injection nozzles, in good condition.
e) Perform regular maintenance work according to the instruction manual of engine and turbocharger, carried out by authorized personnel. Please find supplemental information below in chapters 3 and 4.
f) Only employ original spare parts produced by MAN Diesel & Turbo or any of its licensees and authorized technical service partners.

Please note: Regardless of the turbocharger type, the risk will rise with increasing engine load and turbocharger speed.

3) Change of maintenance work

We recommend to change the content of the maintenance work steps as follows - please refer to the work item number in your turbocharger manual. Please make sure that the Instruction Manual you are working with corresponds with your turbocharger.

Work item	Description in the manual	Recommendation
901 / 501	Inspection for abnormal noise and vibrations	Stay out of the hazardous area (ref. Fig. 1) for this inspection. In case of an abnormal noise stay away from the turbocharger, stop the engine immediately, identify and eliminate the source of the noise before re-starting the engine.
903	Check turbocharger and system pipes for leaks	If possible, carry out this work ideally when the engine is stopped. Oil leaks as well as gas leaks can normally be identified by residues even when the engine is stopped.
905 / 508	Check all the fixing screws, casing screws and pipe connections for tight fit	Carry out this inspection only when the engine is stopped.
911 / 504	Turbine dry cleaning	Use it regularly at reduced engine load of 15% or below. Operating experience has shown that for turbochargers that are equipped with a turbine dry cleaning device only, the dry cleaning of the turbine below 15% engine load (as recommended) may not provide the desired result. In case no wet cleaning device is installed, we recommend to retrofit it for a proper cleaning effect below 15% load.
913 / 503	Turbine wet cleaning	Use it regularly at reduced engine load according to the manual.
915 / 502	Compressor wet cleaning	Stop using the cleaning device. Consider mechanical cleaning during inspections, if necessary.
917 / 505	Cleaning of air filter	Carry out this work only when engine is stopped. Make sure that the filter mat is always installed properly and undamaged. In case a U-pipe manometer is installed on your turbocharger, stop using it; it does not provide value during operation.
931	Compressor wheel inspection	Carry out visual compressor wheel inspection every 3000h (instead of an interval of 6000h).

506	Inspection of sealing air valve	Carry out this work only when the engine is stopped.
	Jet-Assist	Ensure that jet-assist pressure does not exceed 4 bar (as per operating manual).

In case you require further assistance, please contact MAN Diesel & Turbo for recommendations.

4) Additional maintenance work recommended

By carrying out the below mentioned maintenance, you substantially decrease the risk that the compressor wheel of the turbocharger can fail.

a) The suction area of the compressor in front of the silencer and the air intake casing must be free from foreign objects at all times during the operation of the engine.
   - The intake of foreign objects into the suction area of the compressor must be prevented.
   - The operation of the turbocharger is only allowed with a correctly assembled and undamaged filter mat.
   - For all works in the area of the turbocharger, the silencer has to be covered so that foreign objects cannot get into the silencer.
   - The opening at the silencer and the opening in the compressor volute has to be covered when the silencer is disassembled.
   - The surrounding area of the turbocharger has to be cleared of foreign objects before re-commissioning after an engine stop.
   - The silencer must be protected against mechanical damage; it is not allowed to step on the silencer.

b) Based upon field experience, the specific inspection of the compressor wheel for pre-damage as recommended in the former version of “Safety Instructions” is no longer a recommended procedure to reduce a failure risk.

Please forward this information to affected parties and personnel!

Provisional testing and commissioning instructions

1. Measures on compressor side

Make sure that the following is observed during the test operation and the commissioning of series engines:

1. The suction area in front of the silencer and the air intake casing must be free from foreign objects.
2. The introduction of foreign objects into the suction area of the compressor has to be prevented.
3. The operation of the turbocharger is allowed only with a correctly assembled and undamaged filter fleece.
4. For all works in the area of the turbocharger, the silencer has to be covered so that foreign objects cannot get into the silencer.
5. The opening at the silencer and the opening in the compressor volute has to be covered when the silencer is disassembled.
6. The surrounding of the turbocharger has to be cleared from foreign objects before re-commissioning after engine stop.
7. The silencer must be protected against mechanical damages and it is not allowed to step on the silencer.

2. Measures on turbine side

Make sure that the following is observed during the test operation and the commissioning of series engines:

1. The inlet area (exhaust pipe) in front of the turbine must be free from foreign objects.
2. The introduction of foreign objects into the inlet area of the turbine has to be prevented.

3. Further measures

1. We recommend to prohibit all persons to access the hazardous area of the turbocharger, Fig. 1, at least during the first 4 hours of operation (run-in period) of the engine.
2. In our assessment, the risk of a critical compressor wheel damage decreases after the run-in period if the above measures reducing the risk of foreign object damage are observed, so that MAN will, for its own testing and commissioning activities, allow access to the hazardous area to personnel that have been properly and fully instructed about the prevailing dangers.

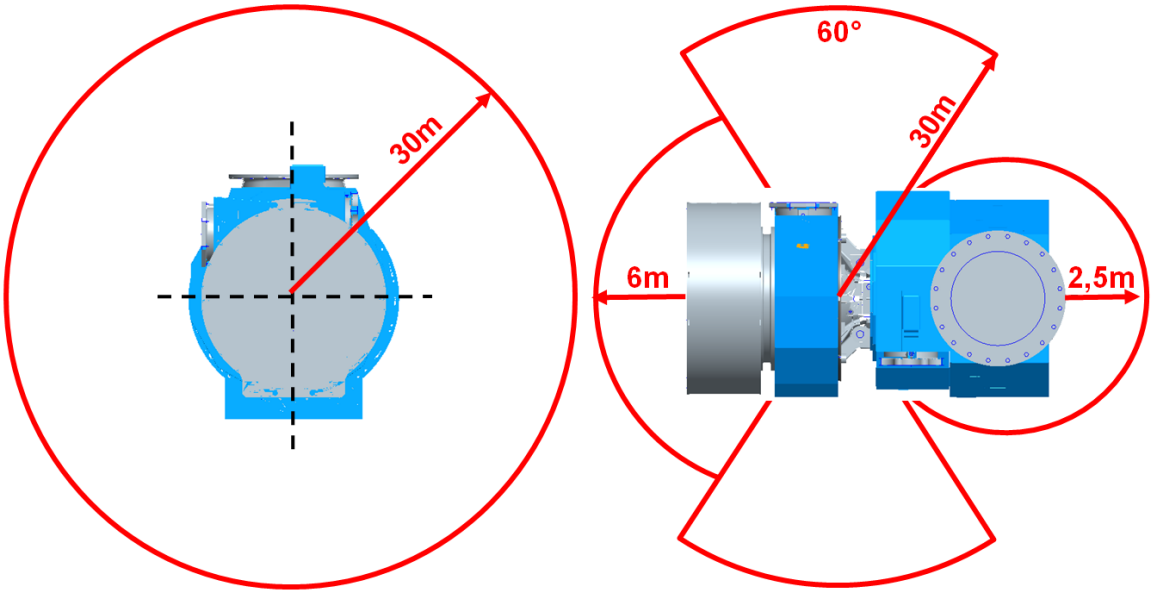

Fig. 1: Red zone = hazardous area (extended compared to the area in the Instruction Manual)

By carrying out the above mentioned measures, you substantially decrease the risk that the compressor wheel and turbine wheel of the turbocharger are damaged during testing and commissioning. As soon as the engine enters regular service, the necessary cleanliness is under the responsibility of the operating personnel.