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Turbocharger protection instruction for High-pressure SCR Systems

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WIN GD <small>Winterthur Gas & Diesel</small>	Product W-2S	Turbocharger Protection Instruction for HP-SCR Systems					
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1 Introduction

According to requirements of the turbocharger supplier, for the Tier II mode of the engine (SCR-System bypassed) a protection grid has to be always mounted in front of the turbocharger. The reason is that the turbine stage of the turbocharger has to be protected from bigger debris flying through the exhaust piping.


In case of a high pressure SCR system an example for debris which could damage the turbine stage is: Cracked catalyst bricks which get loose as a whole or only parts of it, damaged mounting equipment of the support for the catalyst bricks, etc...

This instruction explains how the turbocharger protection is executed for Tier II mode of the engine on the engine side. Also recommendations are shown how the protection of the turbocharger can be possibly executed by the SCR system supplier for Tier III mode.

The final design solution for the turbocharger protection in Tier III mode has to be in accordance with the particular turbocharger supplier. For a first project with a new SCR system supplier it is recommended to get a direct confirmation from the turbocharger supplier for the chosen turbocharger protection approach.

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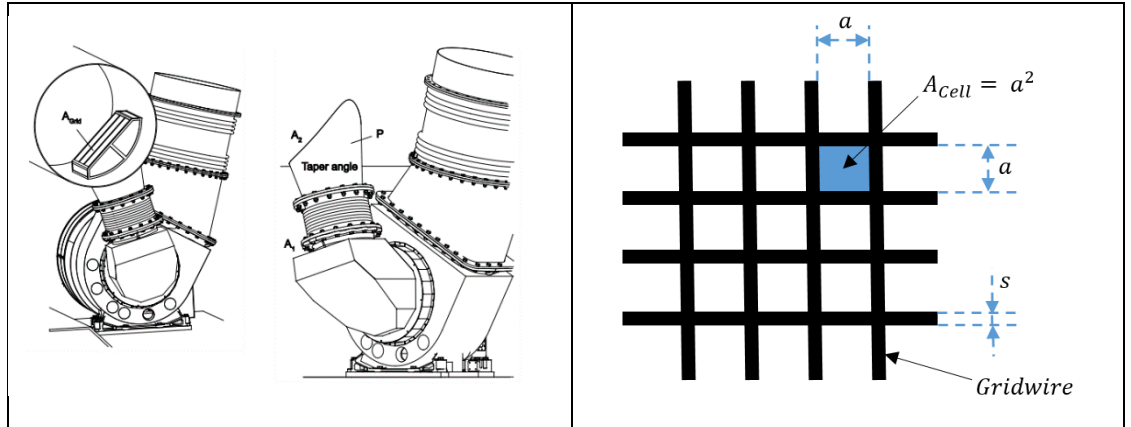
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2 Requirements for T/C protection from turbocharger manufacturer

1. A grid has to be mounted in the exhaust ducting in front of the turbocharger to prevent the turbocharger blades from possible debris.



Definitions:

- A_{Grid} : total area of the grid (including wires)
- A_1 : inlet area of the turbocharger
- a : clear mesh width
- s : wire diameter
- A_{Cell} : clear area of a single grid cell

The total area of a single grid cell including wire is:

$$A_{cell,total} = A_{cell} + A_{wire,cell} = a^2 + 2 \cdot a \cdot s + s^2 \quad (1)$$

With the variables:

- $A_{cell,total}$: total area of a single grid cell
- $A_{wire,cell}$: area which is occupied by wire in a single cell

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The ratio of total area of a single cell to the clear area is:

$$Ratio = \frac{A_{cell,total}}{A_{cell}} = \frac{a^2 + 2 \cdot a \cdot s + s^2}{a^2} \quad (2)$$

2. The clear opening area $A_{Grid,open}$ of the mesh has to be at least three times bigger than the turbocharger inlet area A_1 :

$$A_{Grid,open} \geq 3 \cdot A_1 \quad (3)$$

The clear opening area $A_{Grid,open}$ of the mesh can be calculated as follows:


$$A_{Grid,open} = \frac{A_{Grid}}{Ratio} \quad (4)$$

Hence the following rule:

$$A_{Grid} \geq 3 \cdot A_1 \cdot Ratio \quad (5)$$

$$A_{Grid} \geq 3 \cdot A_1 \cdot \frac{a^2 + 2 \cdot a \cdot s + s^2}{a^2} \quad (6)$$

This area has to be considered for the design of the components.



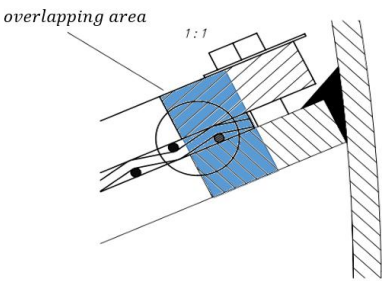
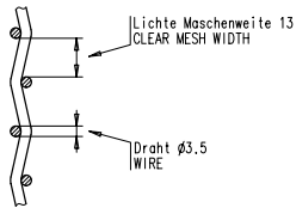
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3 Example of turbocharger protection for Tier II mode

For the Tier II mode the SCR system is bypassed and the exhaust is directly connected with the turbocharger. Therefore a before mentioned protection grid is mounted inside the exhaust manifold at the outlet for the SCR bypass connection.

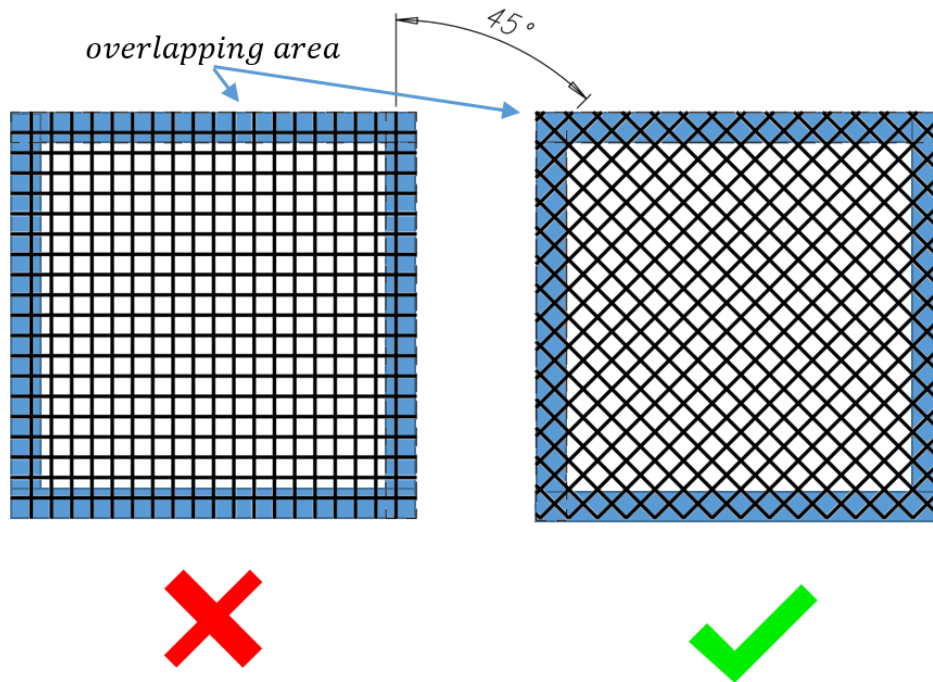
The reason for locating the grid inside the exhaust manifold is the relation of the free mesh area of the grid to the inlet area of the turbocharger. The relation leads to a certain minimum size for the grid.

	
<ul style="list-style-type: none"> • Turbocharger protection grid is located upstream of the bypass valve. • The area is separated in several pieces by ribs so that the grid cannot bend. 	<ul style="list-style-type: none"> • All screws for mounting the grid are mounted on the upstream side of the grid and properly secured. • Screws are heat resistant bolts with thread tolerance according 107.280.320
 <p>overlapping area 1:1</p>	 <p>Lichte Maschenweite 13 CLEAR MESH WIDTH Draht ø3.5 WIRE</p>
<ul style="list-style-type: none"> • The grid is pressed between plates which are connected by a screw connection. 	<ul style="list-style-type: none"> • The clear mesh width is 13 mm. • The commonly used wire diameter is 3.5 mm. • Material of the grid has properties according to DAAD700613.

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Important Notice:



If the grid has a rectangular shape:

- it is prohibited to cut the grid parallel to the shape (see image).
- It has to be cutted diagonally with an 45° inclination to the shape (see image).

Compliance with this rule assures that the grid is safely mounted by the overlapping area and is not likely to get loose by vibration, etc.

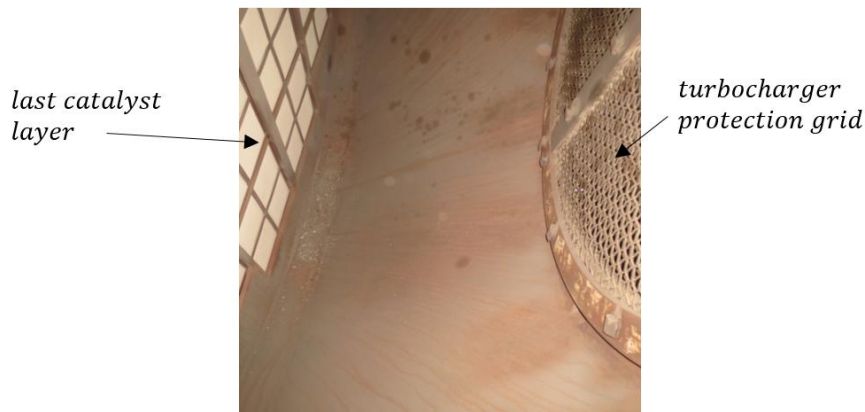
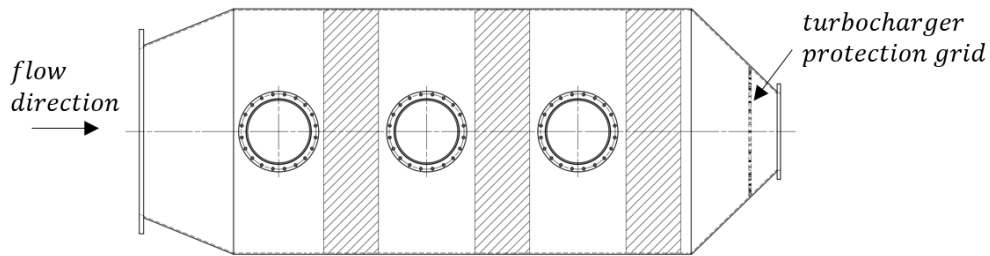
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4 Recommendation for Turbocharger protection in Tier III mode


Due to the needed opening area relation the only reasonable position for the turbocharger protection grid for the Tier III mode is inside of the SCR reactor after the last catalyst layer.

This protection grid is therefore in the responsibility of the SCR reactor supplier.



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WinGD 2-S – SCR Turbocharger Protection Guide

TRACK CHANGES

DATE	SUBJECT	DESCRIPTION
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