



# Dry cleaning

## *Information guide*



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Dry cleaning of the turbocharger Turbine-Side:

The formation of deposits on the nozzle vanes and turbine blades occurs in the exhaust gas turbochargers on engines fired with heavy oil. With two-stroke engines the protection grids installed upstream of the gas inlet also contaminate. The intensity of such contamination is primarily a function of fuel quality as well as the quality of combustion. This problem is not encountered with engines fired with diesel oil.

Contaminated turbines have a poorer efficiency and a lower performance, resulting in increased exhaust gas temperature.


With turbochargers on a four-stroke engines the charging pressure can increase due to constriction of the flow areas and the result is inadmissibly high ignition pressure.

Operating experience and testing have now shown that the turbine-side contamination can be countered by periodical cleaning during operation.

The overhaul intervals can be lengthened. Heavily contaminated turbines, which were not cleaned periodically from the very beginning or after an overhaul, cannot be cleaned by this method.

With sequential turbocharging at high power a second turbocharger will be put in the circuit. If these turbochargers are not often in operation, there is a risk that soot particles will be deposited. At temperatures around 180°C (356°F / 453 K) these particles may lead to sulfuric acid corrosion in the exhaust gas casing or by heavy unequal deposits on the rotor which will cause an undue unbalance when starting the turbocharger.

ABB recommends therefore for sequential turbocharging with longer partial load operation to disconnect periodically the turbocharger which stands still and to clean its turbine, as described.

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### Dry Cleaning

(Also known as solid particle cleaning)

Instead of water, dry solid bodies in the form of granules are used for cleaning. A certain quantity of them, depending on which turbocharger and on which turbocharger size, is blown by compressed air into the exhaust gas lines before the gas inlet casing or protection grid.

On account of their hardness, particularly suited blasting agents such as natural corn granulates (soft blast), broken or artificially shaped activated carbon particles with a grain size of 1,2 to not more than 2,0 mm should be used as solid bodies.

The solid bodies have a mechanical cleaning effect, possible deposits on the nozzle vanes and the turbine blades being thereby removed. However, since it is not possible to remove fairly thick deposits with the comparatively small quantity of solid particles required for each cleaning, this method has to be adopted more frequently than that for cleaning with water.

As a rule, a turbine is cleaned every 24 to 50 hours of operation.

Long-term cleaning tests with natural corn granulates, at gas temperatures of 547°C (1016,6°F / 820K) to 577°C (1070,6°F / 850K) before the turbine during cleaning, i.e. without or only slightly reduced engine load, have confirmed the excellent cleaning effect.



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Installations

Before each gas inlet or each protection grid mounted near to the gas inlet, an adequately dimensioned pipe flange has to be selected and installed in the exhaust gas line welded or cast eye.

Manufacture of containers (same number as gas inlets) as shown on page 6 welded assemblies.

The container size I, II or III required for each type of turbocharger can be seen from the table on page 8.

Mount the fittings such as valves and the like.

The container has to be mounted with the strap provided for this purpose at an easily accessible location, the cock or gate valve being at least 300 mm above the corresponding pipe flange in the exhaust gas line. Maximum distance between cock or gate valve and pipe flange/exhaust gas line: 1 m.

Arrange the compressed-air pipe to the container.

Mount a connecting pipe (outside diameter:  $\varnothing 16$  mm, inside diameter:  $\varnothing 12$  mm, maximum length: 1 m), preferably of stainless steel and possibly with a bend radius R of at least 150 mm.



### Cleaning procedures

For engines with several turbochargers, clean one after the other, and for turbochargers with two or more gas inlets, clean one gas inlet after the other as follows:

1. Close the safety valve, tighten the valve cap. Open the cock/gate valve.
2. Open the compressed-air stop valve. Possible deposits and/or condensate in the connecting pipe are now blown out. Close the compressed-air stop valve after about three minutes.
3. Close the cock/gate valve.
4. Open the safety valve. The exhaust gas pressure in the container is thus relieved. Close the safety valve.
5. Remove the valve cap. Fill the container with the quantity of dry solid particles specified in the table on page 8, 9, 10 and 11. Tighten the valve cap.
6. Check on whether the safety valve is closed. If at all required, reduce the engine output so that the gas temperature before the turbine is 577°C (1070,6°F / 850 K).
7. Open the cock/gate valve.
8. Open the compressed-air stop valve. The previously filled-in solid bodies are now blown in. Close the compressed-air stop valve after 1 to 1,5 minutes.
9. Close the cock/gate valve.
10. Open the safety valve. The exhaust gas pressure in the container is thus relieved. Close the safety valve.
11. This procedure (item 1 to 10) has to be repeated for any further gas inlet of the same and next turbocharger.
12. Cleaning should then be repeated at periodical intervals of every 24 to 50 hours of operation.

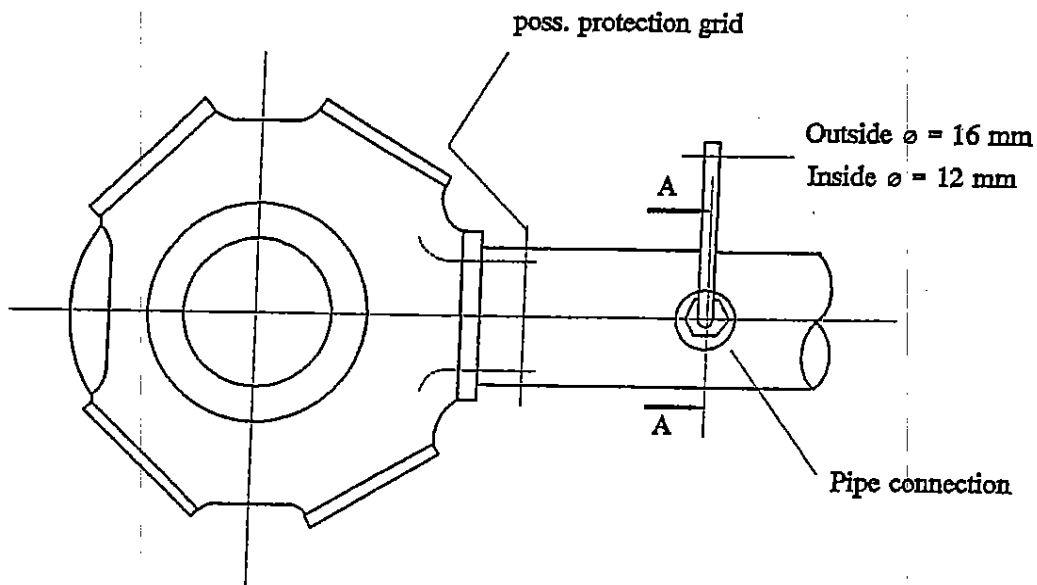
### ATTENTION


The drain openings "O" in the gas outlet casings must be closed during dry cleaning of the turbine!

In the one or other plant it may occur that, during dry cleaning of the turbine, a part of the blown-in solid particles escapes through the chimney in singed condition.

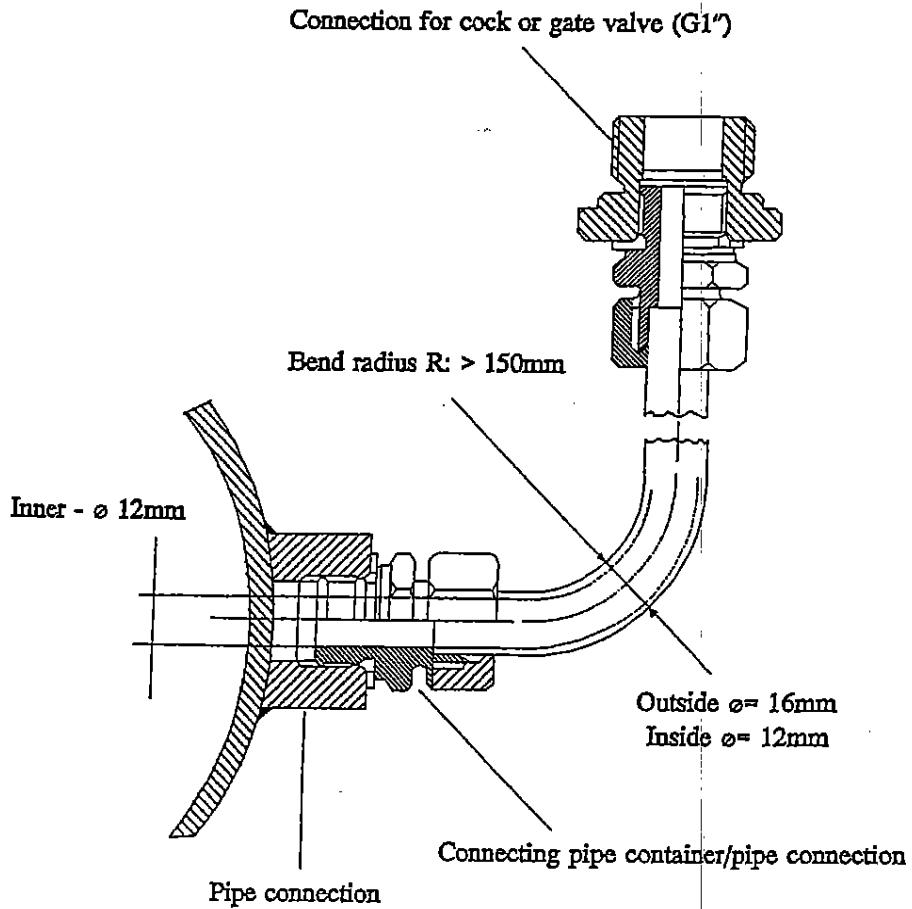
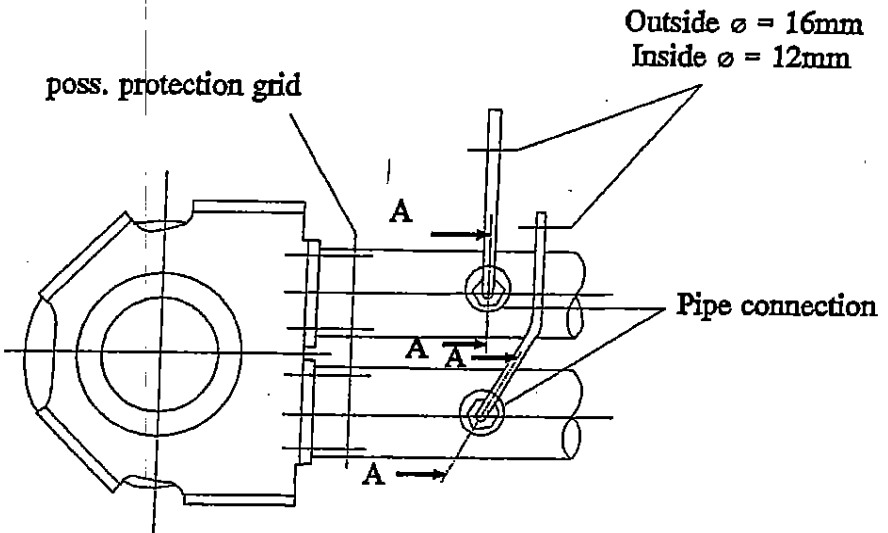



1 Gasinlet  
1 pipe connection

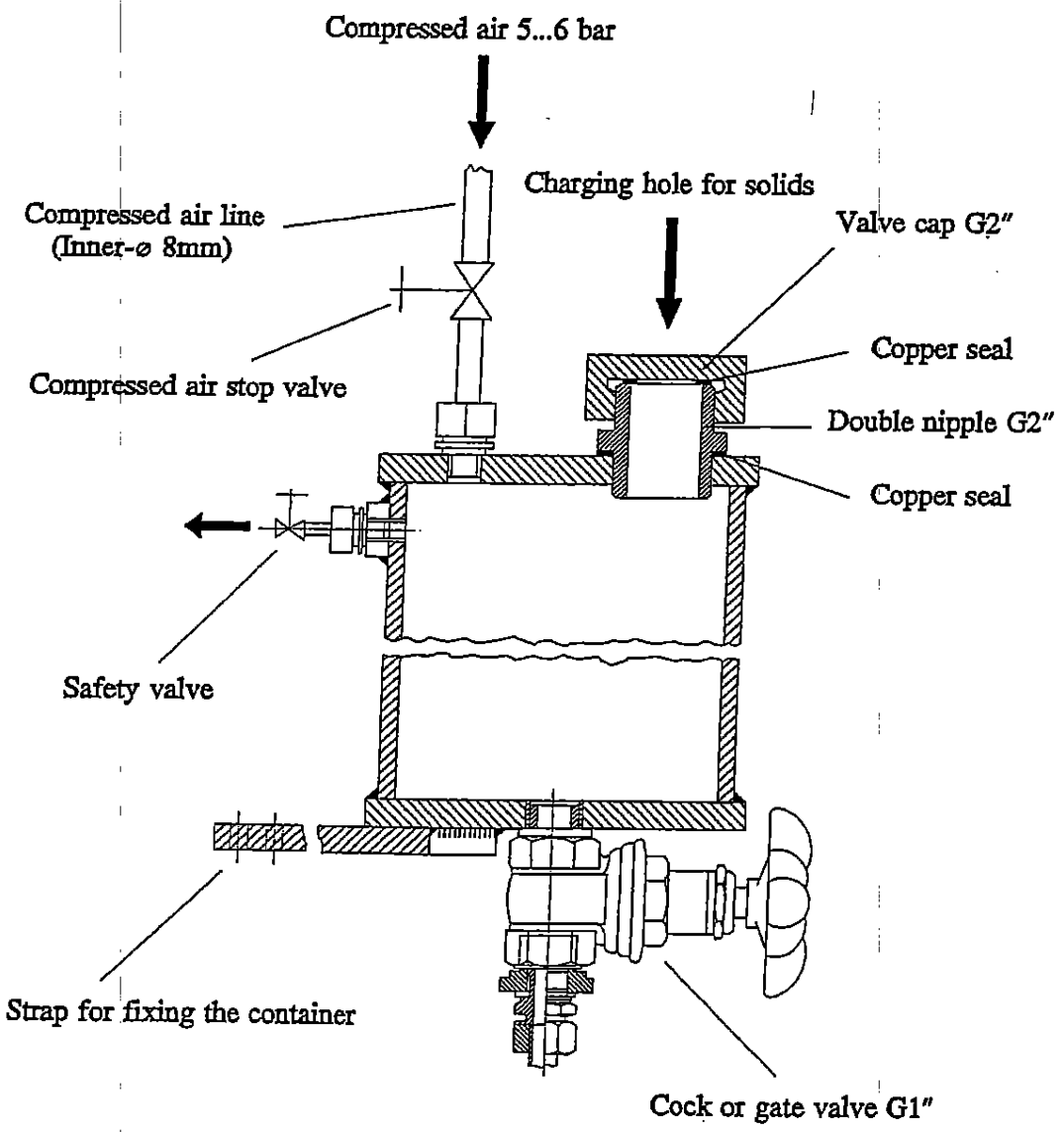


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2 and more gas inlets  
1 pipe connection per exhaust gas line



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Container

| Size | Volume                |
|------|-----------------------|
| I    | ca. 1 dm <sup>3</sup> |
| II   | ca. 3 dm <sup>3</sup> |
| III  | ca. 5 dm <sup>3</sup> |


**QUANTITY OF SOLID BODIES (in dm<sup>3</sup>) PER TURBOCHARGER AND THE SIZE OF CONTAINERS REQUIRED IN EACH CASE.**

I Gas inlet.

| T/C<br>VTR          | Quantity<br>1*) [dm <sup>3</sup> ] | I gas inlet<br>Size | Number | Solids<br>[dm <sup>3</sup> ] |
|---------------------|------------------------------------|---------------------|--------|------------------------------|
| 184<br>160/1        | 0,2 ... 0,3                        | I                   | 1      | 1x0,3                        |
| 214<br>200/1        | 0,3 ... 0,4                        | I                   | 1      | 1x0,4                        |
| 254<br>250/1        | 0,4 ... 0,6                        | I                   | 1      | 1x0,6                        |
| 304<br>320/1        | 0,6 ... 1,0                        | II                  | 1      | 1x1,0                        |
| 354<br>400/1        | 1,0 ... 1,6                        | II                  | 1      | 1x1,6                        |
| 454<br>500/1        | 1,6 ... 2,0                        | II                  | 1      | 1x2,0                        |
| 564<br>630/1        | 2,0 ... 2,4                        | II                  | 1      | 1x2,4                        |
| 714<br>750/1<br>900 | 2,4 ... 2,8                        | III                 | 1      | 1x2,8                        |

1\*) Quantity of solids in (dm<sup>3</sup>) per turbocharger and cleaning.

Remark: If the solid bodies are blown in before the protection grid, the quantity of solids can be increased by 10 to 20%.


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2 Gas inlets.

| T/C<br>VTR          | Quantity<br>1*) [dm <sup>3</sup> ] | 2 gas inlets<br>Size | Number | Solids<br>[dm <sup>3</sup> ] |
|---------------------|------------------------------------|----------------------|--------|------------------------------|
| 184<br>160/1        | 0,2 ... 0,3                        | I                    | 2      | each 1x0,15                  |
| 214<br>200/1        | 0,3 ... 0,4                        | I                    | 2      | each 1x0,2                   |
| 254<br>250/1        | 0,4 ... 0,6                        | I                    | 2      | each 1x0,3                   |
| 304<br>320/1        | 0,6 ... 1,0                        | I                    | 2      | each 1x0,5                   |
| 354<br>400/1        | 1,0 ... 1,6                        | II                   | 2      | each 1x0,8                   |
| 454<br>500/1        | 1,6 ... 2,0                        | II                   | 2      | each 1x1,0                   |
| 564<br>630/1        | 2,0 ... 2,4                        | II                   | 2      | each 1x1,2                   |
| 714<br>750/1<br>900 | 2,4 ... 2,8                        | II                   | 2      | each 1x1,4                   |

1\*) Quantity of solids in (dm<sup>3</sup>) per turbocharger and cleaning.

Remark: If the solid bodies are blown in before the protection grid, the quantity of solids can be increased by 10 to 20%.


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**3 Gas inlets.**

| T/C<br>VTR          | Quantity<br>1*) [dm <sup>3</sup> ] | 3 gas inlets<br>Size | Number | Solids<br>[dm <sup>3</sup> ] |
|---------------------|------------------------------------|----------------------|--------|------------------------------|
| 184<br>160/1        | 0,2 ... 0,3                        | I                    | 3      | each 1x0,15                  |
| 214<br>200/1        | 0,3 ... 0,4                        | I                    | 3      | each 1x0,15                  |
| 254<br>250/1        | 0,4 ... 0,6                        | I                    | 3      | each 1x0,2                   |
| 304<br>320/1        | 0,6 ... 1,0                        | I                    | 3      | each 1x0,35                  |
| 354<br>400/1        | 1,0 ... 1,6                        | II                   | 3      | each 1x0,55                  |
| 454<br>500/1        | 1,6 ... 2,0                        | II                   | 3      | each 1x0,7                   |
| 564<br>630/1        | 2,0 ... 2,4                        | II                   | 3      | each 1x0,8                   |
| 714<br>750/1<br>900 | 2,4 ... 2,8                        | II                   | 3      | each 1x0,9                   |

1\*) Quantity of solids in (dm<sup>3</sup>) per turbocharger and cleaning.

Remark: If the solid bodies are blown in before the protection grid, the quantity of solids can be increased by 10 to 20%.

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**4 Gas inlets.**

| T/C<br>VTR          | Quantity<br>1*) [dm <sup>3</sup> ] | 4 gas inlets<br>Size | Number | Solids<br>[dm <sup>3</sup> ] |
|---------------------|------------------------------------|----------------------|--------|------------------------------|
| 184<br>160/1        | 0,2 ... 0,3                        | I                    | 4      | each 1x0,1                   |
| 214<br>200/1        | 0,3 ... 0,4                        | I                    | 4      | each 1x0,1                   |
| 254<br>250/1        | 0,4 ... 0,6                        | I                    | 4      | each 1x0,15                  |
| 304<br>320/1        | 0,6 ... 1,0                        | I                    | 4      | each 1x0,25                  |
| 354<br>400/1        | 1,0 ... 1,6                        | I                    | 4      | each 1x0,4                   |
| 454<br>500/1        | 1,6 ... 2,0                        | I                    | 4      | each 1x0,5                   |
| 564<br>630/1        | 2,0 ... 2,4                        | I                    | 4      | each 1x0,6                   |
| 714<br>750/1<br>900 | 2,4 ... 2,8                        | I                    | 4      | each 1x0,7                   |

1\*) Quantity of solids in (dm<sup>3</sup>) per turbocharger and cleaning.

Remark: If the solid bodies are blown in before the protection grid, the quantity of solids can be increased by 10 to 20%.