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**The technical specifications of turbochargers used for marine
diesel engines
(English Translation)**

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1 Scope

This standard specifies the technical requirements, test, inspection rules, marking, packaging, transportation, storage of turbochargers used for marine diesel engines.

This standard applies to the design, manufacture, acceptance of turbochargers (hereinafter referred to as "turbochargers"), which is matched with marine diesel engines, used as main propulsion or power generation auxiliary engines of ship.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document;

for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB 727 Turbocharger nomenclature and code

GB/T 1147 Reciprocating internal combustion engines - General technical specifications

GB/T 9239.1-2006 Mechanical vibration - Balance quality requirements for rotors in a constant (rigid) state - Part 1.Specification and verification of balance tolerances

CB/T 3253 Technical conditions for marine diesel engine

3.1 Nomenclature and designation

The nomenclature and designation of the turbocharger shall comply with the provisions of GB 727.

3.2 Classification

The turbocharger is divided into the following, according to turbine type.

the turbocharger, the air temperature and pressure at the outlet of the compressor, the temperature and pressure of the exhaust gas at the inlet of the turbine.

3.5.4 The casing design of the turbocharger shall ensure that it has sufficient containment, to ensure that any part of the rotor will fly away without penetrating the casing, when the turbocharger is abnormal.

3.5.5 The main rotating parts and rotor assembly of the turbocharger, such as the air guide wheel, the compressor impeller, the main shaft with blades, shall be subjected to a dynamic balance test. The balance accuracy shall reach the balance quality grade G2.5 of GB/T 9239.1-2006.

3.5.6 The air guide wheel and compressor impeller of the turbocharger shall be subjected to an overspeed test. The overspeed speed shall not be lower than 110% of the maximum speed of the turbocharger.

3.5.7 The turbocharger shall be provided with an air intake muffler filter. The air intake muffler filter shall have the functions of filtering dust and impurities AND reducing intake noise.

3.5.8 For the turbocharger, whose lubricating oil is supplied by the lubricating oil system of the diesel engine, when the lubricating oil's filtration accuracy of the diesel engine cannot meet the requirements of the turbocharger, it shall provide a lubricating oil filter, which matches the bearing system, in front of the lubricating oil inlet of the turbocharger; meanwhile it shall be provided with low pressure and high temperature alarming device. The lubricating oil pressure shall be in the range of 150 kPa ~ 600 kPa.

The inlet temperature of lubricating oil is generally not lower than 40 °C; the outlet temperature is not higher than 120 °C.

3.5.9 For a turbocharger, which has a water-cooled casing, the inlet temperature of the cooling water shall not be lower than 30 °C; the outlet temperature shall not be higher than 90 °C; the temperature difference between the inlet and outlet of the cooling water in the same casing shall not exceed 12 °C. The cooling water's flow and pressure shall meet the requirements for the temperature difference, between the cooling water inlet and outlet.

3.5.10 The working conditions of pitch and heel of the turbocharger shall meet the relevant provisions in GB/T 1147 and CB/T 3253.

3.5.11 The same type of parts of the same type of turbocharger shall have complete interchangeability.

3.5.12 The turbocharger shall be equipped with a rotor locking device.

3.6.1 Aerodynamic performance

The total efficiency of the turbocharger, flow rate, compressor's pressure ratio, compressor efficiency, turbine efficiency shall reach the design indicators. Under the specified pressure ratio, the maximum deviation of the speed shall not exceed $\pm 2\%$; the maximum deviation of the flow shall not exceed $\pm 3\%$.

3.6.2 Reliability

The turbocharger, that is normally used according to the maintenance and operation instructions, shall be able to operate safely and stably, under its calibrated maximum allowable speed and maximum allowable temperature (referring to the exhaust gas temperature at turbine inlet). This calibration value corresponds to the 110% load condition of the matched diesel engine AND has a certain margin.

3.7 Leaks

The cooling water cavity and oil cavity of the turbocharger shall be subjected to a hydraulic test. The test pressure shall be 500 kPa or 1.5 times the working pressure (whichever is greater), which lasts for 5 minutes. There shall be no leakage. When the turbocharger is running, there shall be no water leakage, oil leakage, air leakage in the casing and each seal.

3.8 Environmental adaptability

The design, test, parameter calculation of the turbocharger are based on the following standard environmental conditions.

- a) Ambient temperature $t_0 = 25\text{ }^{\circ}\text{C}$;
- b) Atmospheric pressure $p_0 = 100\text{ kPa}$;
- c) Relative humidity $\Phi_0 = 60\%$.

3.9 Vibration

When the turbocharger is running stably at each speed, the maximum allowable vibration velocity of the axial-flow turbocharger is 4 mm/s. When the radial-flow and mixed-flow turbochargers use a water-cooled casing, the allowable maximum vibration velocity is 6 mm/s. When using a non-water-cooled casing, the maximum allowable vibration velocity value is 4 mm/s.

3.10 Noise

During the platform test, the average value of the noise of the turbocharger (tested with a muffler filter, sound pressure level) shall meet the requirements of Table 1.

The turbine performance test shall be carried out, on the turbine performance test bench.

When the conditions are not available, the turbocharger can also be operated in the self-circulating condition, on the turbocharger test bench. Based on the measured parameters, use the thermodynamic method to calculate the turbine performance parameters directly.

The specific measurement items are as shown in A.1 in Appendix A. After the test, the expansion ratio-turbine efficiency curve and the expansion ratio-flow capacity curve shall be made, according to the calculation results, as shown in A.3 in Appendix A.

The results of the turbine performance test shall meet the requirements of 3.6.1.

4.1.2.2.3 Performance test of the whole machine

The performance test of the whole machine is carried out on the turbocharger whole machine test bench. During the test, the turbocharger runs to a specified pressure ratio, in a self-circulating mode. After the working conditions are stable, measure and record the various parameters of the turbocharger. The specific measurement items are as shown in Table A.1 in Appendix A. Calculate the compressor pressure ratio, efficiency, total turbocharger efficiency.

The results of the performance test of the whole machine shall meet the requirements of 3.6.1.

4.1.2.3 Reliability test

4.1.2.3.1

Durability test

The durability test is carried out on the test bench of the turbocharger. The running time of the turbocharger, in the durability test, is 50 h ~ 100 h, which shall include at least 1 h operation limit assessment, that is, the turbocharger is in the operating state of the highest allowable speed and the highest allowable temperature (referring to the turbine's inlet exhaust gas temperature). In other time periods of the durability test, the speed of the turbocharger shall be 90% of the maximum allowable speed, the inlet exhaust gas temperature of turbocharger can be lower than the maximum allowable temperature (referring to the turbine's inlet exhaust gas temperature), by 30 °C ~ 50 °C. In the durability test, after the working conditions are stable, it shall measure and record the parameters of the turbocharger every 2 hours. For the specific measurement items, see

A.1 in Appendix A. In the durability test, the turbocharger itself is not allowed to fail.