

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Turbocharger

with type designation(s)
HSRx

Issued to

Kompressorenbau Bannewitz GmbH
Bannewitz, Germany

is found to comply with
DNV GL rules for classification – Ships

Application :

The turbocharger is approved for use on diesel engines with application data as given in the certificate.

This Certificate is valid until **2021-07-04**.

Issued at **Hamburg** on **2016-07-05**

DNV GL local station: **Hamburg Propulsion & Engines**

Approval Engineer: **Andreas Wolf**

for **DNV GL**

Frank Lutz
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Product description

Exhaust driven turbochargers served by cylinder groups with maximum combined power in the range 1000 kW to 5500 kW

Application/Limitation

Maximum allowed operating speed, exhaust gas temperature at turbine entry and power rating:

Type	Compressor wheel diameter (mm)	Maximum allowable operating speed (min ¹)	Maximum allowable exhaust gas temperature before turbine (°C)	Served power per cylinder group (kW)
HSR4	208	41800	650	1000-3600
HSR6	300	29000	650	5000-5500

Maximum compressor ratio: 3.0

Alarm Levels:

Alarm level for overseed	: $0.97 n_{\max}$
Alarm level for exhaust gas temperature before turbine	: $T_{\max} - 15^{\circ}\text{C}$
Minimum lubrication oil inlet pressure (design level)	: 150 kPa
Alarm level for minimum lubrication oil inlet pressure	: 125 kPa
Limit value for too low oil pressure before turbocharger	
“Oil pressure too low” (emergency stop)	: 50 kPa
Maximum lubrication oil outlet temperature and alarm level	: $\leq 120^{\circ}\text{C}$

Application constraints:

Maximum allowable vibration loads at engine for 10 ...250Hz for HSRx turbochargers

Max. admissible value	At the-exhaust gas turbocharger (measured at bearing housing LG)
Velocity V_{eff} (mm/s)	45
Amplitude S_{eff} (mm)	0.7
Acceleration a_{eff} (m/s ²)	70

Allowable statical inclination of turbocharger that may occur during operation is limited to $\pm 30^\circ$ in longitudinal and $\pm 15^\circ$ for in lateral direction of the turbocharger.

Allowable dynamical inclination of turbocharger that may occur during operation is limited to $\pm 45^\circ$ in longitudinal and $\pm 25^\circ$ for in lateral direction of the turbocharger.

[illegible]

Job Id: **262.1-019120-2**
Certificate No: **TAM00000A2**

Tests carried out

Type Approval test HSR4 carried out at KBB on 2015-02-04
Type Approval test report HSR4 (no.2400008), dated 2015-02-04
Type Approval test HSR6 carried out at KBB on 2015-12-14
Type Approval test report HSR6 (no.26000010), dated 2015-12-14

Marking of product

The product to be marked with manufacturer's name or trademark and type number identification.

Periodical assessment

For retention of the Type Approval, DNV GL shall perform a survey every second year and before the expiry date of this certificate to verify that the conditions of the type approval are complied with.

In cases where the type approved product is manufactured at other companies, periodical assessments shall be carried out randomly at these companies. All companies shall be assessed at least once in the period of validity of the TA certificate.

This will be according to Class Guideline DNVGL-CG-0338, Section 4.

Other conditions

Turbochargers are categorized in three categories depending on power served by each turbocharger:
Category A = ≤ 1000 kW, Category B = > 1000 kW and ≤ 2500 kW, Category C = > 2500 kW.

Turbochargers shall be delivered with a product certificate issued by the manufacturer (category B) and by the class society (category C). For turbochargers of category A a certificate is not mandatory.

END OF CERTIFICATE