DNV·GL

Certificate No:
TAM00000Z6

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Turbocharger

with type designation(s)
TCRxx

Issued to
MAN Energy Solutions SE
Augsburg, Germany

is found to comply with
DNV GL rules for classification – Ships Pt.4 Ch.3 Sec.1 Reciprocating internal combustion engines

Application :

The turbochargers are approved for use on internal combustion engines with application data as given in the certificate.
Product approved by this certificate is accepted for installation on all vessels classed by DNV GL.

Issued at **Hamburg** on **2020-06-10**
This Certificate is valid until **2025-06-09**.
DNV GL local station: **Augsburg**

Approval Engineer: **Andreas Wolf**

for **DNV GL**

Olaf Drews
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.

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Product description

Exhaust driven turbochargers served by cylinder groups with combined maximum power up to 7500 kW.

Alternative place of production

PBS Turbo s.r.o.
Vikovska 279
595 01 Velká Bites
Czech Republic

MAN Energy Solutions China Production., Ltd.
Fengming Road 9, Wujin High-Tech Industrial Zone
213164 Changzhou
P.R. China

Application/Limitation

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

Turbocharger type		Continuous operation N_{max} (rpm)	Short time operation (rpm)	T_{max} (°C)	P_{max} (kW)
TCR 10		85000	86500	700	1100
TCR 12		70900	72100	650	1600
TCR 12 with compressor wheel 175D		70000	70000	720	1600
TCR 14		59100	59700	650	2400
TCR 16		49100	49600	650	2499
TCR 18		40500	40900	650	2700
TCR 20		33600	34000	650	5000
TCR 22		25800	26000	650	7500

N_{Cmax} :Max allowable continuous operating speed
N_{Smax} :Max allowable short time operating speed

Maximum compressor ratio for all TCRxx types: 5.4

ALARM LEVELS:

Overspeed, maximum alarm level: 0.97 n_{max}.
High exhaust temperature at turbine entry, maximum alarm level: T_{max}
Low lubrication oil pressure at turbocharger inlet, minimum alarm level (gauge pressure):

Normal operation: 1.3 bar < P_{Oil} < 2.2 bar
Alarm: P_{Oil} ≤ 1.0 bar
Engine slow down: P_{Oil} ≤ 0.8 bar
Engine shut down: P_{Oil} < 0.6 bar

High temperature increase from oil inlet to oil outlet, maximum alarm level[1)]: 40°C

[1)] Alarm only required for turbochargers served by cylinder groups with combined power > 2500 kW

Application constraints:

Measurement on the silencer front plate

Frequency range 3-300 Hz	
Type:	Vibration acceleration
TCR10	2.9 effective
TCR12	2.6 effective
TCR14	2.0 effective
TCR 16	1.7 g effective
TCR18	1.4 effective
TCR20	1.2 g effective
TCR22	0.9 g efffective

Measurement on the flange of the compressor casing / silencer

Frequency range 3-300 Hz	
Type:	Vibration acceleration
TCR10	2.2 g effective
TCR12	2.0 effective
TCR14	1.6 effective
TCR16	1.4 g effective
TCR18	1.1 effective
TCR20	0.9 g effective
TCR22	0.7 g effective

Measurement on the bearing casing:

0-peak, single value measuring point	
Type:	Vibration acceleration
TCR10-22	0.8 g

Allowable inclination of turbocharger that may occur during operation:

Direction of turbocharger	Maximum allowable angle of inclination, static (continous)	Maximum allowable angle of inclination, dynamic (short time)
List (athwartships)	25°	
Trim (fore and aft)	25°	
Rolling (athwartships)		0° ± 30°
Pitching (fore and aft)		0° ± 30°

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

Periodical assessment
Periodical assessment is to be performed after 2 years and after 3.5 years. A renewal assessment will be performed at renewal of the certificate.

The objective of the Periodical Assessment is to verify that the conditions for the Type Approval are not altered since the Type Approval certificate was issued.The main scope of the Periodical Assessment will normally include:

- Verification of the Type Approval applicant's production and quality system w.r.t. ensuring continued consistent production of the Type Approved products at the Type Approval applicant's own premises and at other companies that are given the responsibility for manufacturing of the products.
- Review of the Type Approval documentation and that this is still used as basis for the production
- Review of possible changes to the design, the material and the performance of the product
- Verification of the product marking.

In cases where the Type Approved product is manufactured at other companies, the Periodical Assessment shall verify that the Type Approval applicant has a quality control system for consistent production at their licensees/subcontractors. Furthermore Periodical Assessment shall be carried out randomly at these companies.

When a Type Approved product is manufactured at other companies, the Type Approval applicant takes the sole responsibility for the conformity of the product to the applicable requirements.

Other conditions
This Type Approval covers the mechanical parts of the TCRxx turbochargers. For TCRxx turbochargers with electronically controlled VTA (Variable Turbine Nozzle Ring) system, the Type Approval shall be used together with the corresponding and valid DNV Type Approval Certificate for the control system of the VTA system, or a separate approval of this control system on a case-by-case basis.

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) or by the class society (category C). For turbochargers of category A an certificate is not mandatory.

This Type Approval Certificate replaces DNV TAC M-12414 and GL TAC 24 319-04 HH.

END OF CERTIFICATE