



Certificate No:
TAM00001A6

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Turbocharger

with type designation(s)
TCXxx

Issued to

MAN Energy Solutions SE
Augsburg, Germany

is found to comply with

Application :

Products approved by this certificate is/are accepted for installation on all vessels classed by DNV.

Issued at **Hamburg** on **2023-04-14**

This Certificate is valid until **2028-04-13**.

DNV local unit: **Essen**

for **DNV**

Approval Engineer: **Andreas Wolf**

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.

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to 300,000 USD.



Form code: TA 251

Revision: 2022-09

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Product description

Exhaust driven turbochargers served by cylinder groups with combined maximum power up to 16,000 kW.

Alternative place of production

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

Application/Limitation

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

Turbocharger type	Compressor wheel tip diameter mm	Max. operating speed N_{max} rpm	Max. temperature before turbine °C	Max. engine output kW	Category
TCX17		35,880	650	5,800	C
TCX19		28,490	650	8,100	C
TCX21		23,910	650	11,400	C
TCX23		20,110	650	16,000	C

Compressor ratio:

The compressor ratio of the complete 2-stage system is up to 10,5bar.

The compressor ratio of the TCX turbocharger is max. 3bar

ALARM LEVELS:

Overspeed, maximum alarm level: $0.97 n_{max}$.

High exhaust temperature at turbine entry, maximum alarm level: T_{max}

Lubrication oil inlet temperature: 40 - 75 °C

Maximum oil outlet temperature: 115°C

Alarm oil outlet temperature (Δ inlet temperature/outlet temperature): ≤ 30 °C

Lubrication oil inlet pressure (normal operation): 1.3-2.2 bar

Alarm actuates at: < 1.0 bar

Reduction to engine half load: < 0.8 bar

Engine shut down: < 0.6 bar

Application constraints:

Vibration level

Measurement on the highest point of the compressor casing in all three dimensions.

Turbocharger Type	Max. vibration velocity [mm/s] Max. vibration acceleration [g]
TCX17	$v_{max} = 45$ mm/s $a_{max} = 2,5$ g
TCX19	$v_{max} = 45$ mm/s $a_{max} = 2,5$ g
TCX21	$v_{max} = 50$ mm/s $a_{max} = 2$ g
TCX23	$v_{max} = 55$ mm/s $a_{max} = 1,5$ g

Allowable inclination of turbocharger that may occur during operation:

Permissible Angle of inclination static: $\pm 15^\circ$

Permissible Angle of inclination dynamic: $0^\circ \pm 22.5$

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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.

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 TCXxx turbochargers. For TCXxx 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.

END OF CERTIFICATE