DNV·GL

Certificate No:
**TAM00000VE**

# TYPE APPROVAL CERTIFICATE

## This is to certify:

**That the Turbocharger**

with type designation(s)
**TCAxx**

Issued to
**MAN Diesel & Turbo SE**
**Augsburg, Germany**

is found to comply with
**DNV GL rules for classification – Ships**
**DNV GL rules for classification – High speed and light craft**

## 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 **2018-12-18**
This Certificate is valid until **2023-12-17**.
DNV GL local station: **Augsburg**

for **DNV GL**

Approval Engineer: **Andreas Wolf**

**Burkhard Lilienthal**
**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 power in the range 5000 kW to 29000 kW

## Alternative place of production

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

MAN Diesel & Turbo China Production Co., Ltd.
Fengming Road 9, Wujin High-Tech Industrial Zone
213164 Changzhou
P.R. China

## Application/Limitation:

Maximum allowed compressor ratio, operating speed and exhaust gas temperature at turbine entry:

| Turbocharger type | | Continuous operation $N_{max}$ (rpm) | Short time operation (rpm) | $T_{max}$ (°C) | $P_{max}$ (kW) | Max compressor ratio |
|---|---|---|---|---|---|---|
| | | | | | | |
| TCA 33 | | 27800 | 28300 | 650 | 5400 | 5.3 |
| TCA 33 | | 31100 | 31700 | 650 | 5400 | 5.3 |
| | | | | | | |
| TCA 44 | | 22500 | 22900 | 530 | 7900 | 5.3 |
| | | | | | | |
| TCA 55 | | 20600 | 21000 | 650 | 10400 | 5.4 |
| TCA 55 | | 20100 | 20400 | 650 | 10400 | 5.4 |
| TCA 55 | | 19600 | 19900 | 650 | 10400 | 5.4 |
| TCA 55 | | 20100 | 20400 | 650 | 10400 | 5.4 |
| TCA 55 | | | | 650 | 10400 | 5.4 |
| | | | | | | |
| TCA 66 | | 17300 | 17650 | 650 | 14800 | 5.4 |
| TCA 66 | | 16900 | 17200 | 650 | 14800 | 5.4 |
| TCA 66 | | 16500 | 16800 | 650 | 14800 | 5.4 |
| TCA 66 | | 16900 | 17200 | 650 | 14800 | 5.4 |
| | | | | | | |
| TCA 77 | | 14600 | 14900 | 620 | 21000 | 5.5 |
| TCA 77 | | 14200 | 14500 | 620 | 21000 | 5.5 |
| TCA 77 | | 13900 | 14100 | 620 | 21000 | 5.5 |
| TCA 77 | | 14200 | 14500 | 620 | 21000 | 5.5 |
| | | | | | | |
| TCA 88 | | 12300 | 12500 | 650 | 30000 | 5.5 |
| TCA 88 | | 12000 | 12200 | 650 | 30000 | 5.5 |
| TCA 88 | | 11700 | 11900 | 650 | 30000 | 5.5 |
| TCA 88 | | 11400 | 11600 | 650 | 30000 | 5.5 |
| | | | | | | |
| TCA 88-25xxx | | 10800 | 11000 | 500 | 30000 | 4.2 |

## 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: 1.2 bar < $P_{Oil}$ < 2.2 bar
Alarm: $P_{Oil}$ < 1.2 bar
Engine slow down: $P_{Oil}$ < 1.0 bar
Engine shut down: $P_{Oil}$ < 0.8 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:

A1: Turbocharger vibration limit values: Recommendation

| | Frequency range (Hz) | Silencer front plate, horizontal, vertical and axial (mm/s) | (g) | Flange of the compressor casing, horizontal, vertical and axial (mm/s) | (g) |
|---|---|---|---|---|---|
| TCA 33 | 2 … 200 | 45 | 2.6 | 35 | 2.0 |
| TCA 44 | | | 2.0 | | 1.6 |
| TCA 55 | | | 1.7 | | 1.4 |
| TCA 66 | | | 1.4 | | 1.1 |
| TCA 77 | | | 1.2 | | 0.9 |
| TCA 88 | | | 0.9 | | 0.7 |

A2: Turbocharger vibration limit values: consult Turbochargers@mandieselturbo.com

| | Frequency range (Hz) | Silencer front plate, horizontal, vertical and axial (mm/s) | (g) | Flange of the compressor casing, horizontal, vertical and axial (mm/s) | (g) |
|---|---|---|---|---|---|
| TCA 33 | 2 … 200 | 100 | 5.8 | 50 | 2.9 |
| TCA 44 | | | 4.5 | | 2.2 |
| TCA 55 | | | 3.8 | | 1.9 |
| TCA 66 | | | 3.2 | | 1.6 |
| TCA 77 | | | 2.6 | | 1.3 |
| TCA 88 | | | 1.9 | | 1.0 |

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) | ±15° | |
| Trim (fore and aft) | ±15° | |
| Rolling (athwartships) | | 0° ± 22.5° |
| Pitching (fore and aft) | | 0° ± 22.5° |

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## Tests carried out

| Type | Date |
|---|---|
| TCA 77-40009 | 2002-11-21, Report dated 2002-11-21 |
| TCA 66-40001 | 2003-06-04, Report dated 2003-06-05 |
| TCA 55-20002 | 2004-01-19, Report dated 2004-01-20 |
| TCA 55-40003 | 2004-03-17, Report dated 2004-01-19 |
| TCA 88-25005 | 2008-02-20, Report dated 2008-11-21 |
| TCA 66-20020 | 2010-03-07, Report dated 2010-03-10 |
| TCA 33-42004 | 2013-11-11, Report dated 2013-11-11 |

## 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, 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
This Type Approval covers the mechanical parts of the TCAxx turbochargers. For TCAxx 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-12650 and GL TAC 58 936-08 HH.

END OF CERTIFICATE