

# TYPE APPROVAL CERTIFICATE

## This is to certify:

**That the Turbocharger**

with type designation(s)  
**METxxMB**

Issued to

**Mitsubishi Heavy Ind., Ltd. Nagasaki SY & Mach. Works  
(Saiwai)  
Nagasaki Nagasaki, Japan**

is found to comply with

**Det Norske Veritas' Rules for Classification of Ships/High Speed and Light Craft**

## Application :

**The turbochargers are approved for use on diesel engines with application data as given in the certificate**

This Certificate is valid until **2015-12-31**.

Issued at **Høvik** on **2015-06-29**

DNV GL local station: **Hiroshima**

for **DNV GL**

Approval Engineer: **Tage Olav Alexander Strøm**

-----  
**Oddvar Deinboll**  
**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 combined power in the range of 2000 – 27 700 kW

## Application/Limitation

| Type                  | MET33MB |       |       |       |       |       |
|-----------------------|---------|-------|-------|-------|-------|-------|
| Impeller type         | V (W)   |       | U     |       |       |       |
|                       |         |       | H     |       | S     |       |
|                       | 2       | 3     | 2     | 3     | 2     | 3     |
| Max rated speed (RPM) | 27000   | 25440 | 27000 | 27000 | 26060 | 26060 |
| Max temperature (°C)  | 580     |       |       |       |       |       |
| Max compressor ratio  | 4.2     |       | 5.0   |       | 4.6   |       |

| Type                  | MET42MB |       |       |       |       |       |
|-----------------------|---------|-------|-------|-------|-------|-------|
| Impeller type         | V (W)   |       | U     |       |       |       |
|                       |         |       | H     |       | S     |       |
|                       | 2       | 3     | 2     | 3     | 2     | 3     |
| Max rated speed (RPM) | 21800   | 20540 | 21800 | 21800 | 21040 | 21040 |
| Max temperature (°C)  | 580     |       |       |       |       |       |
| Max compressor ratio  | 4.2     |       | 5.0   |       | 4.6   |       |

| Type                  | MET48MB |      |       |       |       |       |
|-----------------------|---------|------|-------|-------|-------|-------|
| Impeller type         | V (W)   |      | U     |       |       |       |
|                       |         |      | H     |       | S     |       |
|                       | 2       | 3    | 2     | 3     | 2     | 3     |
| Max rated speed (RPM) | 19200   | 1810 | 19220 | 19220 | 18550 | 18550 |
| Max temperature (°C)  | 580     |      |       |       |       |       |
| Max compressor ratio  | 4.2     |      | 5.0   |       | 4.6   |       |

| Type                  | MET53MB |       |       |       |       |       |
|-----------------------|---------|-------|-------|-------|-------|-------|
| Impeller type         | V (W)   |       | U     |       |       |       |
|                       |         |       | H     |       | S     |       |
|                       | 2       | 3     | 2     | 3     | 2     | 3     |
| Max rated speed (RPM) | 17180   | 16190 | 17180 | 17180 | 16590 | 16590 |
| Max temperature (°C)  | 580     |       |       |       |       |       |
| Max compressor ratio  | 4.2     |       | 5.0   |       | 4.6   |       |

| Type                  | MET60MB |       |       |       |       |       |
|-----------------------|---------|-------|-------|-------|-------|-------|
| Impeller type         | V (W)   |       | U     |       |       |       |
|                       |         |       | H     |       | S     |       |
|                       | 2       | 3     | 2     | 3     | 2     | 3     |
| Max rated speed (RPM) | 15450   | 14550 | 15450 | 15450 | 14900 | 14900 |
| Max temperature (°C)  | 580     |       |       |       |       |       |
| Max compressor ratio  | 4.2     |       | 5.0   |       | 4.6   |       |

| Type                  | MET66MB |       |       |       |       |       |
|-----------------------|---------|-------|-------|-------|-------|-------|
| Impeller type         | V (W)   |       | U     |       |       |       |
|                       |         |       | H     |       | S     |       |
|                       | 2       | 3     | 2     | 3     | 2     | 3     |
| Max rated speed (RPM) | 13790   | 13000 | 13790 | 13790 | 13310 | 13310 |
| Max temperature (°C)  | 580     |       |       |       |       |       |
| Max compressor ratio  | 4.2     |       | 5.0   |       | 4.6   |       |

Job Id: **262.1-011061-6**  
Certificate No: **TAM000000S**

| Type                  | MET71MB |       |       |       |       |       |
|-----------------------|---------|-------|-------|-------|-------|-------|
| Impeller type         | V (W)   |       | U     |       |       |       |
|                       |         |       | H     |       | S     |       |
|                       | 2       | 3     | 2     | 3     | 2     | 3     |
| Max rated speed (RPM) | 12750   | 12010 | 12750 | 12750 | 12300 | 12300 |
| Max temperature (°C)  | 580     |       |       |       |       |       |
| Max compressor ratio  | 4.2     |       | 5.0   |       | 4.6   |       |

| Type                  | MET83MB |       |       |       |       |       |
|-----------------------|---------|-------|-------|-------|-------|-------|
| Impeller type         | V (W)   |       | U     |       |       |       |
|                       |         |       | H     |       | S     |       |
|                       | 2       | 3     | 2     | 3     | 2     | 3     |
| Max rated speed (RPM) | 10900   | 10270 | 10900 | 10900 | 10510 | 10510 |
| Max temperature (°C)  | 580     |       |       |       |       |       |
| Max compressor ratio  | 4.2     |       | 5.0   |       | 4.6   |       |

| Type                  | MET90MB |      |      |      |      |      |
|-----------------------|---------|------|------|------|------|------|
| Impeller type         | V (W)   |      | U    |      |      |      |
|                       |         |      | H    |      | S    |      |
|                       | 2       | 3    | 2    | 3    | 2    | 3    |
| Max rated speed (RPM) | 9870    | 9300 | 9870 | 9870 | 9530 | 9530 |
| Max temperature (°C)  | 580     |      |      |      |      |      |
| Max compressor ratio  | 4.2     |      | 5.0  |      | 4.6  |      |

#### **ALARM LEVELS:**

Overspeed, maximum alarm level: 105% of maximum rated speed

High exhaust temperature at turbine entry, maximum alarm level: 550 °C.

Low lubrication oil pressure at turbocharger inlet, minimum alarm level: 0.6 bar (gauge pressure)

Maximum lubrication oil outlet temperature (alarm level): 85 °C

#### **Application constraints:**

Maximum allowed inclinations for MET-MB turbochargers:

Static: ± 15°

Dynamic (momentary): ± 22.5°

Engine and rotor vibrations to be within Mitsubishi's specifications for MET-MB turbochargers (ref. Tz-E002-3925).

#### **Tests carried out**

Type Approval test of MET66MB August 2011.

#### **Marking of product**

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

#### **Periodical assessment**

Job Id: **262.1-011061-6**  
Certificate No: **TAM000000S**

For retention of the Type Approval, a DNV surveyor 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.

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.

END OF CERTIFICATE