

## Shipbuilding – Shop test code for steam turbines for propelling use

**1. Scope** This Japanese Industrial Standard specifies test code of no load steam running for marine main steam turbine at the manufacturer's shop upon the completion. When it is impracticable to conform to this code, the test in a similar manner as required by this code shall be made upon agreement between parties concerned (purchaser, manufacturer, inspector and others).

**Remark:** This standard makes reference to the following standards:

**JIS F 0401** – Terminology and definition of output of propulsion machinery installed in ships

**2. Test and test record** The test shall be made in accordance with the program prepared in advance. The test results should be entered into the test recording sheet of such form as shown in **Annex**.

### 3. Test method

**3.1 Test program** Prior to the test, the manufacturer shall prepare concrete program showing kind of tests, schedule, method and other essential details of tests, which shall be approved by the parties concerned.

**3.2 Kind and object of test** The engine should, be subjected to all of the following test items in accordance with the table. However, the measurements marked with \* shall be made only when specially needed.

- (1) Ahead running test
- (2) Astern running test
- (3) Emergency shut down device test
- (4) Maneuvering valve test
- (5) Turning gear test
- (6) Vibration measurement
- (7) Noise measurement
- (8) Turbine casing expansion measurement
- (9) Lubricating oil flow measurement

Table 1

| No. | Kind of test                         | Test time                                                                | No. of recording | Remarks                                                         |
|-----|--------------------------------------|--------------------------------------------------------------------------|------------------|-----------------------------------------------------------------|
| 1   | 1/4 max. continuous output           | 10 to 15 min.                                                            | 1                |                                                                 |
|     | 2/4 max. continuous output           | 10 to 15 min.                                                            | 1                |                                                                 |
|     | Normal output                        | 60 min.                                                                  | 4                |                                                                 |
|     | Max. continuous output               | 60 min.                                                                  | 4                | Test time may be varied if necessary.                           |
|     | * Over load output                   | 15 min.                                                                  | 1                |                                                                 |
| 2   | Astern running test                  | 15 min.                                                                  | 1                |                                                                 |
| 3   | Emergency shut down device test      | As required                                                              | 2                | The test for the device proper also shall be done.              |
| 4   | Manoeuvring valve test               | During test                                                              |                  | The test for the valve proper shall be carried out as required. |
| 5   | Turning gear test                    | As required                                                              |                  | For confirmation only                                           |
| * 6 | Vibration measurement                | As required                                                              |                  |                                                                 |
| * 7 | Noise measurement                    | As required                                                              |                  |                                                                 |
| * 8 | Turbine casing expansion measurement | During warming up and ahead and astern running test                      |                  |                                                                 |
| * 9 | Lubricating oil flow measurement     | Twice each for during normal, max. continuous and over load output tests |                  |                                                                 |

Remark: The definition of outputs in the table shall conform to JIS F 0401.

**3.2.1 Ahead running test** The engine should be tested, on continuous no load steam running, for specified time to ascertain the performance at the rotational speed corresponding to each load of 1/4 and 2/4 of maximum continuous output, normal output, maximum continuous output and over load output.

**3.2.2 Astern running test** The engine shall be tested on continuous running at the rotational speed corresponding to the astern running output for specified time in the same manner as the ahead running test.

**3.2.3 Emergency shut down device test** The test shall be carried out as follows:

(1) **Emergency shut down by overspeed**

The test shall be carried out to ascertain that the emergency valve in the main steam line is closed automatically by the emergency shut down device at the specified rotational speed not exceeding 115% of the rotational speed corresponding to the maximum continuous output.

The activating point of the emergency shut down device shall be within  $+0_{-3}$  % of the specified rotational speed, and maximum difference of activating point between each test shall be within 2%. The test shall be carried out at least twice in succession.

(2) **Emergency shut down by oil pressure drop**

The test shall be carried out to ascertain that the emergency valve is closed automatically by emergency shut down device at the specified oil pressure.

**3.2.4 Manoeuvring valve test** The manoeuvring valve shall be tested to ascertain the manoeuvrability of the valve by using the valve which should be provided to the engine.

**3.2.5 Turning gear test** The engine shall be turned by the turning gear equipped therewith to ascertain its starting and other operations.

**3.2.6 Vibration measurement** The amplitude of vibration shall be measured at suitable position by a vibrometer of dial type or self-recording type, etc.

**3.2.7 Noise measurement** The noise originated from the reduction gear shall be measured by an audiometer at suitable positions of the gear casing. The designation of the instrument used, and the distance of microphone from the gear casing shall be clearly stated on the recording sheets.

**3.2.8 Turbine casing expansion measurement** The thermal expansion of turbine casing shall be measured using a dial gauge.

**3.2.9 Lubricating oil flow measurement** The flow quantity of circulating lubricating oil shall be measured using a flowmeter or a measuring tank during the test.

**3.2.10 Independent test for emergency valve and manoeuvring valve** Both emergency and manoeuvring valves should be subjected independently to the test against leakage through valve seats after the valves have been kept under the designed steam condition for several hours and also shall be ascertained that they can be opened and closed without any difficulties.

**4. Other measurement** Other measurement shall be as follows:

(1) **Measuring instruments** The measuring instrument used shall be the one which has been examined correctly.

(2) **Pressure measurement** The pressure gauge, compound gauge or vacuum gauge, etc. shall be used. The gauges shall be mounted correctly in the respective positions.

(3) **Rotational speed measurement** The rotational speed shall be measured by a tachometer at the end of main shaft.

(4) **Temperature measurement** The temperature shall be measured either by a ber thermometer or thermo-couple, etc.

**5. Precaution on testing** Precaution for testing shall be as follows:

(1) As far as possible, the test shall be made under the design steam condition.

(2) The rotational speed shall be increased or decreased gradually while paying attention to the vibration and noise of the engine. When any operational defect is found, the condition and cause shall be thoroughly investigated before resuming the further test.

(3) Lubrication oil temperature should be maintained at the temperature specified in the instruction book.

(4) When the bearing temperature increases abnormally, the engine shall be stopped immediately and the cause shall be investigated.

(5) An extreme precaution shall be taken during the test against the possible danger arising from the steam drain.

(6) The engine shall be tested after cleaning out the lubrication oil pipe lines with particular care.

(7) After the test, the engine and reduction gear shall be overhauled and all of the parts shall be inspected carefully. The following data should be recorded before the turbine is re-assembled.

(a) Balancing test of rotor (dynamic)

(b) Deflection of rotor (eccentricity of shaft center), only when needed.

For the reduction gear, it is recommended the tooth contact is inspected and recorded.

| Turbine             |      | Reduction gear      |      | Shaft               |      | Bearing             |      | Coupling            |      | Foundation          |      |
|---------------------|------|---------------------|------|---------------------|------|---------------------|------|---------------------|------|---------------------|------|
| Item                | Unit | Item                | Unit | Item                | Unit | Item                | Unit | Item                | Unit | Item                | Unit |
| 1. Rotational speed | rpm  | 1. Rotational speed | rpm  | 1. Rotational speed | rpm  | 1. Rotational speed | rpm  | 1. Rotational speed | rpm  | 1. Rotational speed | rpm  |
| 2. Vibration        | mm/s | 2. Vibration        | mm/s | 2. Vibration        | mm/s | 2. Vibration        | mm/s | 2. Vibration        | mm/s | 2. Vibration        | mm/s |
| 3. Noise            | dB   | 3. Noise            | dB   | 3. Noise            | dB   | 3. Noise            | dB   | 3. Noise            | dB   | 3. Noise            | dB   |
| 4. Temperature      | °C   | 4. Temperature      | °C   | 4. Temperature      | °C   | 4. Temperature      | °C   | 4. Temperature      | °C   | 4. Temperature      | °C   |
| 5. Pressure         | MPa  | 5. Pressure         | MPa  | 5. Pressure         | MPa  | 5. Pressure         | MPa  | 5. Pressure         | MPa  | 5. Pressure         | MPa  |
| 6. Flow             | m³/h | 6. Flow             | m³/h | 6. Flow             | m³/h | 6. Flow             | m³/h | 6. Flow             | m³/h | 6. Flow             | m³/h |
| 7. Deflection       | mm   | 7. Deflection       | mm   | 7. Deflection       | mm   | 7. Deflection       | mm   | 7. Deflection       | mm   | 7. Deflection       | mm   |
| 8. Balancing        | g    | 8. Balancing        | g    | 8. Balancing        | g    | 8. Balancing        | g    | 8. Balancing        | g    | 8. Balancing        | g    |
| 9. Tooth contact    |      | 9. Tooth contact    |      | 9. Tooth contact    |      | 9. Tooth contact    |      | 9. Tooth contact    |      | 9. Tooth contact    |      |
| 10. Others          |      | 10. Others          |      | 10. Others          |      | 10. Others          |      | 10. Others          |      | 10. Others          |      |