Subject

Effective scheduled date applicable to amended ClassNK Rules and Guidance related to tests of diesel engines

ClassNK

Technical Information

No. TEC-1066
Date 11 April 2016

To whom it may concern

IACS has adopted Unified Requirements M51(Rev.4), M71, M72(Corr.1), M73 and Z26 related to tests of diesel engines. Accordingly, relevant ClassNK Rules and Guidance are being amended based upon these Unified Requirements. Please note that the effective scheduled date of the amended Rules and Guidance is as follows:

1. The amended Rules and Guidance will be applied to engines whose applications for approval are submitted to ClassNK on or after 1 July 2016.
2. Requirements related to shipboard trials of diesel engines (IACS UR M51.4), however, only apply to the following engines:
   i) engines whose applications for approval are submitted to ClassNK on or after 1 July 2016; or
   ii) engines installed on new ships whose contracts for construction are dated on or after 1 July 2016

In this regard, an outline of the amendments made to the Rules and Guidance is as follows:

(1) Procedures for the shop tests of diesel engines
(2) Procedures for the shipboard trials of diesel engines (sea trials and torsional vibration measurements tests)
(3) Procedures for the approval of use of diesel engines
(4) Requirements related to material tests, non-destructive tests and hydrostatic tests for the components of diesel engines
(5) Procedures for the shop tests and type approval tests of turbochargers
(6) Procedures for the approval of mass produced diesel engines and turbochargers

(To be continued)

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Attachment:

1. IACS URs M51(Rev.4), UR M71, UR M72(Corr.1), UR M73, and UR Z26

M51 Factory Acceptance Test and Shipboard Trials of I.C. Engines

(1987) (Rev.1 1990) (Corr. 1997) (Rev.2 July 2003) (Rev.3 Jan 2008) (Rev.4 Feb 2015 Complete revision)

1. Safety precautions

1.1 Before any test run is carried out, all relevant equipment for the safety of attending personnel is to be made available by the manufacturer / shipyard and is to be operational.

1.2 This applies especially to crankcase explosive conditions protection, but also to over-speed protection and any other shut down function.

1.3 The overspeed protective device is to be set to a value, which is not higher than the overspeed value that was demonstrated during the type test for that engine. This set point shall be verified by the surveyor.

2. General

2.1 Before any official testing, the engines shall be run-in as prescribed by the engine manufacturer.

2.2 Adequate test bed facilities for loads as required in UR M51.3.3 shall be provided. All fluids used for testing purposes such as fuel, lubrication oil and cooling water are to be suitable for the purpose intended, e.g. they are to be clean, preheated if necessary and cause no harm to engine parts. This applies to all fluids used temporarily or repeatedly for testing purposes only.

2.3 The testing consists of workshop and shipboard (quay and sea trial) testing.

Notes:

1. The requirements in M51 Rev.3 are to be uniformly implemented by IACS Societies for engines; when an application for certification for an engine is dated on or after 1 January 2009.

2. The “date of application for certification of the engine” is the date of whatever document the Classification Society requires/accepts as an application or request for certification of an individual engine.

3. The requirements of UR M51 Rev. 4 – except for UR M51.4 – are to be uniformly implemented by IACS Societies to engines with an application for certification dated on or after 1 July 2016.

   The requirement of UR M51.4 are to be uniformly implemented by IACS Societies to engines:
   - i) with an application for certification dated on or after 1 July 2016; or
   - ii) installed on ships contracted for construction on or after 1 July 2016.

4. The “contracted for construction” date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of “contract for construction”, refer to IACS Procedural Requirement (PR) No.29.

M51 (cont)

2.4 Engines are to be inspected for:

- Jacketing of high-pressure fuel oil lines including the system used for the detection of leakage.

- Screening of pipe connections in piping containing flammable liquids.

- Insulation of hot surfaces by taking random temperature readings that are to be compared with corresponding readings obtained during the type test. This shall be done while running at the rated power of engine. Use of contact thermometers may be accepted at the discretion of the attending Surveyor. If the insulation is modified subsequently to the Type Approval Test, the Society may request temperature measurements as required by UR M71.8.9.

2.5 These inspections are normally to be made during the works trials by the manufacturer and the attending surveyor, but at the discretion of the Society parts of these inspections may be postponed to the shipboard testing.

3. Works trials (Factory Acceptance Test)

3.1 Objectives

The purpose of the works trials is to verify design premises such as power, safety against fire, adherence to approved limits (e.g. maximum pressure), and functionality and to establish reference values or base lines for later reference in the operational phase.

3.2 Records

3.2.1 The following environmental test conditions are to be recorded:

- Ambient air temperature

- Ambient air pressure

- Atmospheric humidity

3.2.2 For each required load point, the following parameters are normally to be recorded:

- Power and speed

- Fuel index (or equivalent reading)

- Maximum combustion pressures (only when the cylinder heads installed are designed for such measurement).

- Exhaust gas temperature before turbine and from each cylinder (to the extent that monitoring is required in M73 and M35/36)

- Charge air temperature

- Charge air pressure

- Turbocharger speed (to the extent that monitoring is required in M73)

M51 (cont)

3.2.3 Calibration records for the instrumentation are, upon request, to be presented to the attending Surveyor.

3.2.4 For all stages at which the engine is to be tested, the pertaining operational values are to be measured and recorded by the engine manufacturer. All results are to be compiled in an acceptance protocol to be issued by the engine manufacturer. This also includes crankshaft deflections if considered necessary by the engine designer.

3.2.5 In each case, all measurements conducted at the various load points are to be carried out at steady state operating conditions. However, for all load points provision should be made for time needed by the Surveyor to carry out visual inspections. The readings for MCR, i.e. 100% power (rated maximum continuous power at corresponding rpm) are to be taken at least twice at an interval of normally 30 minutes.

3.3 Test loads

3.3.1 Test loads for various engine applications are given below. In addition, the scope of the trials may be expanded depending on the engine application, service experience, or other relevant reasons.

Note:
Alternatives to the detailed tests may be agreed between the manufacturer and the Society when the overall scope of tests is found to be equivalent.

3.3.2 Propulsion engines driving propeller or impeller only.

A)	100% power (MCR) at corresponding speed n_0:	at least 60 min.
B)	110% power at engine speed $1.032n_0$:	Records to be taken after 15 minutes or after steady conditions have been reached, whichever is shorter.

Note:
Only required once for each different engine/turbocharger configuration.

C)	Approved intermittent overload (if applicable):	testing for duration as agreed with the manufacturer.

D) 90% (or normal continuous cruise power), 75%, 50% and 25% power in accordance with the nominal propeller curve, the sequence to be selected by the engine manufacturer.

E) Reversing manoeuvres (if applicable).

Note:
After running on the test bed, the fuel delivery system is to be so adjusted that overload power cannot be given in service, unless intermittent overload power is approved by the Society. In that case, the fuel delivery system is to be blocked to that power.

3.3.3 Engines driving generators for electric propulsion.

A)	100% power (MCR) at corresponding speed n_0:	at least 60 min.

M51 (cont)

B) 110% power at engine speed n_0: 15 min. - after having reached steady conditions.

C) Governor tests for compliance with UR M3.1 and M3.2 are to be carried out.

D) 75%, 50% and 25% power and idle, the sequence to be selected by the engine manufacturer.

Note:
After running on the test bed, the fuel delivery system is to be adjusted so that full power plus a 10% margin for transient regulation can be given in service after installation onboard. The transient overload capability is required so that the required transient governing characteristics are achieved also at 100% loading of the engine, and also so that the protection system utilised in the electric distribution system can be activated before the engine stalls.

3.3.4 Engines driving generators for auxiliary purposes.

Tests to be performed as in UR M51.3.3.2.

3.3.5 Propulsion engines also driving power take off (PTO) generator.

A) 100% power (MCR) at corresponding speed n_0: at least 60 min.

B) 110% power at engine speed n_0: 15 min. - after having reached steady conditions.

C) Approved intermittent overload (if applicable): testing for duration as agreed with the manufacturer.

D) 90% (or normal continuous cruise power), 75%, 50% and 25% power in accordance with the nominal propeller curve or at constant speed n_0, the sequence to be selected by the engine manufacturer.

Note:
After running on the test bed, the fuel delivery system is to be adjusted so that full power plus a margin for transient regulation can be given in service after installation onboard. The transient overload capability is required so that the electrical protection of downstream system components is activated before the engine stalls. This margin may be 10% of the engine power but at least 10% of the PTO power.

3.3.6 Engines driving auxiliaries.

A) 100% power (MCR) at corresponding speed n_0: at least 30 min.

B) 110% power at engine speed n_0: 15 min. - after having reached steady conditions.

C) Approved intermittent overload (if applicable): testing for duration as agreed with the manufacturer.

D) For variable speed engines, 75%, 50% and 25% power in accordance with the nominal power consumption curve, the sequence to be selected by the engine manufacturer.

M51 (cont)

Note:
After running on the test bed, the fuel delivery system is normally to be so adjusted that overload power cannot be delivered in service, unless intermittent overload power is approved. In that case, the fuel delivery system is to be blocked to that power.

3.4 Turbocharger matching with engine

3.4.1 Compressor chart

Turbochargers shall have a compressor characteristic that allows the engine, for which it is intended, to operate without surging during all operating conditions and also after extended periods in operation.
For abnormal, but permissible, operation conditions, such as misfiring and sudden load reduction, no continuous surging shall occur.
In this section, *surging* and *continuous surging* are defined as follows:
Surging means the phenomenon, which results in a high pitch vibration of an audible level or explosion-like noise from the scavenger area of the engine.
Continuous surging means that surging happens repeatedly and not only once.

3.4.2 Surge margin verification

Category C turbochargers used on propulsion engines are to be checked for surge margins during the engine workshop testing as specified below. These tests may be waived if successfully tested earlier on an identical configuration of engine and turbocharger (including same nozzle rings).

For 4-stroke engines:

The following shall be performed without indication of surging:

- With maximum continuous power and speed (=100%), the speed shall be reduced with constant torque (fuel index) down to 90% power.

- With 50% power at 80% speed (= propeller characteristic for fixed pitch), the speed shall be reduced to 72% while keeping constant torque (fuel index).

For 2-stroke engines:

The surge margin shall be demonstrated by at least one of the following methods:

1. The engine working characteristic established at workshop testing of the engine shall be plotted into the compressor chart of the turbocharger (established in a test rig). There shall be at least 10% surge margin in the full load range, i.e. working flow shall be 10% above the theoretical (mass) flow at surge limit (at no pressure fluctuations).

2. Sudden fuel cut-off to at least one cylinder shall not result in continuous surging and the turbocharger shall be stabilised at the new load within 20 seconds. For applications with more than one turbocharger the fuel shall be cut-off to the cylinders closest upstream to each turbocharger.

   This test shall be performed at two different engine loads:

   - The maximum power permitted for one cylinder misfiring.

M51 (cont)

- The engine load corresponding to a charge air pressure of about 0.6 bar (but without auxiliary blowers running).

3. No continuous surging and the turbocharger shall be stabilised at the new load within 20 seconds when the power is abruptly reduced from 100% to 50% of the maximum continuous power.

3.5 Integration tests

For electronically controlled engines, integration tests are to be made to verify that the response of the complete mechanical, hydraulic and electronic system is as predicted for all intended operational modes and the tests considered as a system are to be carried out at the works. If such tests are technically unfeasible at the works, however, these tests may be conducted during sea trial. The scope of these tests is to be agreed with the Society for selected cases based on the FMEA required in UR M44.

3.6 Component inspections

Random checks of components to be presented for inspection after works trials are left to the discretion of each Society.

4. Shipboard trials

4.1 Objectives

The purpose of the shipboard testing is to verify compatibility with power transmission and driven machinery in the system, control systems and auxiliary systems necessary for the engine and integration of engine / shipboard control systems, as well as other items that had not been dealt with in the FAT (Factory Acceptance Testing).

4.2 Starting capacity

Starting manoeuvres are to be carried out in order to verify that the capacity of the starting media satisfies the required number of start attempts.

4.3 Monitoring and alarm system

The monitoring and alarm systems are to be checked to the full extent for all engines, except items already verified during the works trials.

4.4 Test loads

4.4.1 Test loads for various engine applications are given below. In addition, the scope of the trials may be expanded depending on the engine application, service experience, or other relevant reasons.

4.4.2 The suitability of the engine to operate on fuels intended for use is to be demonstrated.

Note:
Tests other than those listed below may be required by statutory instruments (e.g. EEDI verification).

M51 (cont)

4.4.3 Propulsion engines driving fixed pitch propeller or impeller.

A) At rated engine speed n_0: at least 4 hours.

B) At engine speed $1.032n_0$ (if engine adjustment permits, see 3.3.1): 30 min.

C) At approved intermittent overload (if applicable): testing for duration as agreed with the manufacturer.

D) Minimum engine speed to be determined.

E) The ability of reversible engines to be operated in reverse direction is to be demonstrated.

Note:
During stopping tests according to Resolution MSC.137 (76), see 4.5.1 for additional requirements in the case of a barred speed range.

4.4.4 Propulsion engines driving controllable pitch propellers.

A) At rated engine speed n_0 with a propeller pitch leading to rated engine power (or to the maximum achievable power if 100% cannot be reached): at least 4 hours.

B) At approved intermittent overload (if applicable): testing for duration as agreed with the manufacturer.

C) With reverse pitch suitable for manoeuvring, see UR M51.4.5.1 for additional requirements in the case of a barred speed range.

4.4.5 Engine(s) driving generator(s) for electrical propulsion and/or main power supply

A) At 100% power (rated electrical power of generator): at least 60 min.

B) At 110% power (rated electrical power of generator): at least 10 min.

Note:
Each engine is to be tested 100% electrical power for at least 60 min and 110% of rated electrical power of the generator for at least 10 min. This may, if possible, be done during the electrical propulsion plant test, which is required to be tested with 100% propulsion power (i.e. total electric motor capacity for propulsion) by distributing the power on as few generators as possible. The duration of this test is to be sufficient to reach stable operating temperatures of all rotating machines or for at least 4 hours. When some of the gen. set(s) cannot be tested due to insufficient time during the propulsion system test mentioned above, those required tests are to be carried out separately.

C) Demonstration of the generator prime movers' and governors' ability to handle load steps as described in UR M3.2.

4.4.6 Propulsion engines also driving power take off (PTO) generator.

A) 100% engine power (MCR) at corresponding speed n_0: at least 4 hours.

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B) 100% propeller branch power at engine speed n_0 (unless already covered in A): 2 hours.

C) 100% PTO branch power at engine speed n_0: at least 1 hour.

4.4.7 Engines driving auxiliaries.

A) 100% power (MCR) at corresponding speed n_0: at least 30 min.

B) Approved intermittent overload: testing for duration as approved.

4.5 Torsional vibrations

4.5.1 Barred speed range

Where a barred speed range (bsr) is required, passages through this bsr, both accelerating and decelerating, are to be demonstrated. The times taken are to be recorded and are to be equal to or below those times stipulated in the approved documentation, if any. This also includes when passing through the bsr in reverse rotational direction, especially during the stopping test.

Note:
Applies both for manual and automatic passing-through systems.

The ship's draft and speed during all these demonstrations is to be recorded. In the case of a controllable pitch propeller, the pitch is also to be recorded.

The engine is to be checked for stable running (steady fuel index) at both upper and lower borders of the bsr. Steady fuel index means an oscillation range less than 5% of the effective stroke (idle to full index).

End of Document

M71 Type Testing of I.C. Engines

(Feb 2015)

1. General

1.1 Type approval of I.C. engine types consists of drawing approval, specification approval, conformity of production, approval of type testing programme, type testing of engines, review of the obtained results, and the issuance of the Type Approval Certificate. The maximum period of validity of a Type Approval Certificate is 5 years. The requirements for drawing approval and specification approval of engines and components are specified in separate URs.

1.2 For the purpose of this UR, the following definitions apply:

Low-Speed Engines means diesel engines having a rated speed of less than 300 rpm.

Medium-Speed Engines means diesel engines having a rated speed of 300 rpm and above, but less than 1400 rpm.

High-Speed Engines means diesel engines having a rated speed of 1400 rpm or above.

2. Objectives

2.1 The type testing, documented in this UR, is to be arranged to represent typical foreseen service load profiles, as specified by the engine builder, as well as to cover for required margins due to fatigue scatter and reasonably foreseen in-service deterioration.

2.2 This applies to:

- Parts subjected to high cycle fatigue (HCF) such as connecting rods, cams, rollers and spring tuned dampers where higher stresses may be provided by means of elevated injection pressure, cylinder maximum pressure, etc.

- Parts subjected to low cycle fatigue (LCF) such as “hot” parts when load profiles such as idle - full load - idle (with steep ramps) are frequently used.

- Operation of the engine at limits as defined by its specified alarm system, such as running at maximum permissible power with the lowest permissible oil pressure and/or highest permissible oil inlet temperature.

3. Validity

3.1 Type testing is required for every new engine type intended for installation onboard ships subject to classification.

3.2 A type test carried out for a particular type of engine at any place of manufacture will be accepted for all engines of the same type built by licensees or the licensor, subject to each place of manufacture being found to be acceptable to the Society.

Notes:

1. The requirement of UR M71 are to be uniformly implemented by IACS Societies to engines with an application for certification dated on or after 1 July 2016.

M71 (cont)

3.3 A type of engine is defined by:

- bore and stroke
- injection method (direct or indirect)
- valve and injection operation (by cams or electronically controlled)
- kind of fuel (liquid, dual-fuel, gaseous)
- working cycle (4-stroke, 2-stroke)
- turbo-charging system (pulsating or constant pressure)
- the charging air cooling system (e.g. with or without intercooler)
- cylinder arrangement (in-line or V) [1)]
- cylinder power, speed and cylinder pressures [2)]

Notes:

[1)] One type test will be considered adequate to cover a range of different numbers of cylinders. However, a type test of an in-line engine may not always cover the V-version. Subject to the individual Societies' discretion, separate type tests may be required for the V-version. On the other hand, a type test of a V-engine covers the in-line engines, unless the bmep is higher.

Items such as axial crankshaft vibration, torsional vibration in camshaft drives, and crankshafts, etc. may vary considerably with the number of cylinders and may influence the choice of engine to be selected for type testing.

[2)] The engine is type approved up to the tested ratings and pressures (100% corresponding to MCR).

Provided documentary evidence of successful service experience with the classified rating of 100% is submitted, an increase (if design approved*) may be permitted without a new type test if the increase from the type tested engine is within:

- 5% of the maximum combustion pressure, or
- 5% of the mean effective pressure, or
- 5% of the rpm

Providing maximum power is not increased by more than 10%, an increase of maximum approved power may be permitted without a new type test provided engineering analysis and evidence of successful service experience in similar field applications (even if the application is not classified) or documentation of internal testing are submitted if the increase from the type tested engine is within:

- 10% of the maximum combustion pressure, or
- 10% of the mean effective pressure, or
- 10% of the rpm

* Only crankshaft calculation and crankshaft drawings, if modified.

M71
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De-rated engine

If an engine has been design approved, and internal testing per Stage A is documented to a rating higher than the one type tested, the Type Approval may be extended to the increased power/mep/rpm upon submission of an Extended Delivery Test Report at:

- Test at over speed (only if nominal speed has increased)
- Rated power, i.e. 100% output at 100% torque and 100% speed corresponding to load point 1., 2 measurements with one running hour in between
- Maximum permissible torque (normally 110%) at 100% speed corresponding to load point 3 or maximum permissible power (normally 110%) and speed according to nominal propeller curve corresponding to load point 3a., ½ hour
- 100% power at maximum permissible speed corresponding to load point 2, ½ hour

Integration Test

An integration test demonstrating that the response of the complete mechanical, hydraulic and electronic system is as predicted maybe carried out for acceptance of sub-systems (Turbo Charger, Engine Control System, Dual Fuel, Exhaust Gas treatment…) separately approved. The scope of these tests shall be proposed by the designer/licensor taking into account of impact on engine.

4. Safety precautions

4.1 Before any test run is carried out, all relevant equipment for the safety of attending personnel is to be made available by the manufacturer/shipyard and is to be operational, and its correct functioning is to be verified.

4.2 This applies especially to crankcase explosive conditions protection, but also over-speed protection and any other shut down function.

4.3 The inspection for jacketing of high-pressure fuel oil lines and proper screening of pipe connections (as required in M71.8.9 fire measures) is also to be carried out before the test runs.

4.4 Interlock test of turning gear is to be performed when installed.

5. Test programme

5.1 The type testing is divided into 3 stages:

1. Stage A - internal tests.
   This includes some of the testing made during the engine development, function testing, and collection of measured parameters and records of testing hours. The results of testing required by the Society or stipulated by the designer are to be presented to the Society before starting stage B.

2. Stage B - witnessed tests.
   This is the testing made in the presence of Classification Society personnel.

3. Stage C - component inspection.
   This is the inspection of engine parts to the extent as required by the Society.

M71 (cont)

5.2 The complete type testing program is subject to approval by the Society. The extent the Surveyor's attendance is to be agreed in each case, but at least during stage B and C.

5.3 Testing prior to the witnessed type testing (stage B and C), is also considered as a part of the complete type testing program.

5.4 Upon completion of complete type testing (stage A through C), a type test report is to be submitted to the Society for review. The type test report is to contain:

- overall description of tests performed during stage A. Records are to be kept by the builders QA management for presentation to the Classification Society.

- detailed description of the load and functional tests conducted during stage B.

- inspection results from stage C.

5.5 As required in M71.2 the type testing is to substantiate the capability of the design and its suitability for the intended operation. Special testing such as LCF and endurance testing will normally be conducted during stage A.

5.6 High speed engines for marine use are normally to be subjected to an endurance test of 100 hours at full load. Omission or simplification of the type test may be considered for the type approval of engines with long service experience from non-marine fields or for the extension of type approval of engines of a well-known type, in excess of the limits given in M71.3.

Propulsion engines for high speed vessels that may be used for frequent load changes from idle to full are normally to be tested with at least 500 cycles (idle - full load - idle) using the steepest load ramp that the control system (or operation manual if not automatically controlled) permits. The duration at each end is to be sufficient for reaching stable temperatures of the hot parts.

6. Measurements and recordings

6.1 During all testing the ambient conditions (air temperature, air pressure and humidity) are to be recorded.

6.2 As a minimum, the following engine data are to be measured and recorded:

- Engine r.p.m.

- Torque

- Maximum combustion pressure for each cylinder [1)]

- Mean indicated pressure for each cylinder [1)]

- Charging air pressure and temperature

- Exhaust gas temperature

- Fuel rack position or similar parameter related to engine load

- Turbocharger speed

M71 (cont)

- All engine parameters that are required for control and monitoring for the intended use (propulsion, auxiliary, emergency).

Notes:

1) For engines where the standard production cylinder heads are not designed for such measurements, a special cylinder head made for this purpose may be used. In such a case, the measurements may be carried out as part of Stage A and are to be properly documented. Where deemed necessary e.g. for dual fuel engines, the measurement of maximum combustion pressure and mean indicated pressure may be carried out by indirect means, provided the reliability of the method is documented.

Calibration records for the instrumentation used to collect data as listed above are to be presented to - and reviewed by the attending Surveyor.

Additional measurements may be required in connection with the design assessment.

7. Stage A - internal tests

7.1 During the internal tests, the engine is to be operated at the load points important for the engine designer and the pertaining operating values are to be recorded. The load conditions to be tested are also to include the testing specified in the applicable type approval programme.

7.2 At least the following conditions are to be tested:

- Normal case:

  The load points 25%, 50%, 75%, 100% and 110% of the maximum rated power for continuous operation, to be made along the normal (theoretical) propeller curve and at constant speed for propulsion engines (if applicable mode of operation i.e. driving controllable pitch propellers), and at constant speed for engines intended for generator sets including a test at no load and rated speed.

- The limit points of the permissible operating range. These limit points are to be defined by the engine manufacturer.

- For high speed engines, the 100 hr full load test and the low cycle fatigue test apply as required in connection with the design assessment.

- Specific tests of parts of the engine, required by the Society or stipulated by the designer.

8. Stage B - witnessed tests

8.1 The tests listed below are to be carried out in the presence of a Surveyor. The achieved results are to be recorded and signed by the attending Surveyor after the type test is completed.

8.2 The over-speed test is to be carried out and is to demonstrate that the engine is not damaged by an actual engine overspeed within the overspeed shutdown system set-point. This test may be carried out at the manufacturer’s choice either with or without load during the speed overshoot.

M71
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8.3 Load points

The engine is to be operated according to the power and speed diagram (see Figure 1). The data to be measured and recorded when testing the engine at the various load points have to include all engine parameters listed in M71.6. The operating time per load point depends on the engine size (achievement of steady state condition) and on the time for collection of the operating values. Normally, an operating time of 0.5 hour can be assumed per load point, however sufficient time should be allowed for visual inspection by the Surveyor.

8.4 The load points are:

- Rated power (MCR), i.e. 100% output at 100% torque and 100% speed corresponding to load point 1, normally for 2 hours with data collection with an interval of 1 hour. If operation of the engine at limits as defined by its specified alarm system (e.g. at alarm levels of lub oil pressure and inlet temperature) is required, the test should be made here.

- 100% power at maximum permissible speed corresponding to load point 2.

- Maximum permissible torque (at least and normally 110%) at 100% speed corresponding to load at point 3, or maximum permissible power (at least and normally 110%) and 103.2% speed according to the nominal propeller curve corresponding to load point 3a. Load point 3a applies to engines only driving fixed pitch propellers or water jets. Load point 3 applies to all other purposes.
  Load point 3 (or 3a as applicable) is to be replaced with a load that corresponds to the specified overload and duration approved for intermittent use. This applies where such overload rating exceeds 110% of MCR. Where the approved intermittent overload rating is less than 110% of MCR, subject overload rating has to replace the load point at 100% of MCR. In such case the load point at 110% of MCR remains.

- Minimum permissible speed at 100% torque, corresponding to load point 4.

- Minimum permissible speed at 90% torque corresponding to load point 5. (Applicable to propulsion engines only).

- Part loads e.g. 75%, 50% and 25% of rated power and speed according to nominal propeller curve (i.e. 90.8%, 79.3% and 62.9% speed) corresponding to points 6, 7 and 8 or at constant rated speed setting corresponding to points 9, 10 and 11, depending on the intended application of the engine.

- Crosshead engines not restricted for use with C.P. propellers are to be tested with no load at the associated maximum permissible engine speed.

8.5 During all these load points, engine parameters are to be within the specified and approved values.

M71
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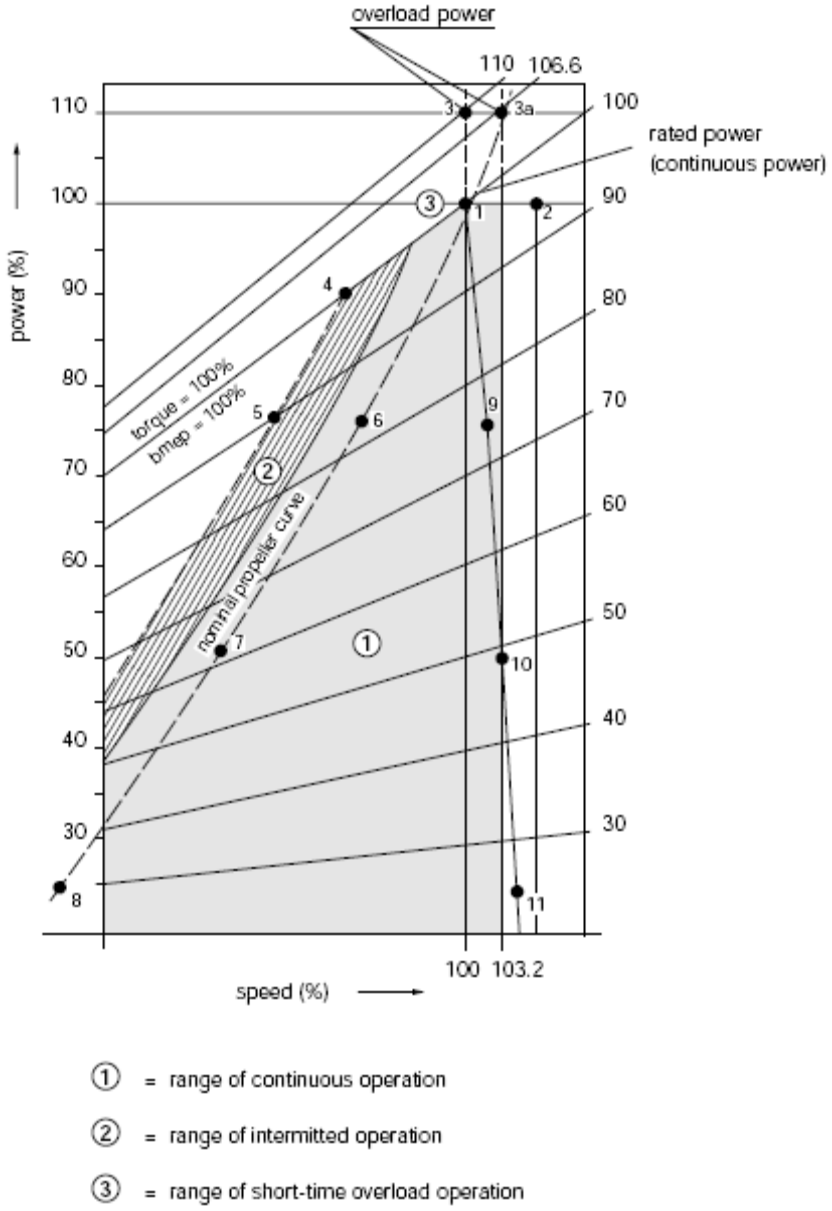

Figure 1 Load points

8.6 Operation with damaged turbocharger

For 2-stroke propulsion engines, the achievable continuous output is to be determined in the case of turbocharger damage.

Engines intended for single propulsion with a fixed pitch propeller are to be able to run continuously at a speed (r.p.m.) of 40% of full speed along the theoretical propeller curve when one turbocharger is out of operation. (The test can be performed by either by-passing the turbocharger, fixing the turbocharger rotor shaft or removing the rotor.)

M71 (cont)

8.7 Functional tests

- Verification of the lowest specified propulsion engine speed according to the nominal propeller curve as specified by the engine designer (even though it works on a water-brake). During this operation, no alarm shall occur.
- Starting tests, for non-reversible engines and/or starting and reversing tests, for reversible engines, for the purpose of determining the minimum air pressure and the consumption for a start.

- Governor tests: tests for compliance with UR M3.1 and M3.2 are to be carried out.

8.8 Integration test

For electronically controlled diesel engines, integration tests are to verify that the response of the complete mechanical, hydraulic and electronic system is as predicted for all intended operational modes. The scope of these tests is to be agreed with the Society for selected cases based on the FMEA required in UR M44.

8.9 Fire protection measures

Verification of compliance with requirements for jacketing of high-pressure fuel oil lines, screening of pipe connections in piping containing flammable liquids and insulation of hot surfaces:

- The engine is to be inspected for jacketing of high-pressure fuel oil lines, including the system for the detection of leakage, and proper screening of pipe connections in piping containing flammable liquids.

- Proper insulation of hot surfaces is to be verified while running the engine at 100% load, alternatively at the overload approved for intermittent use. Readings of surface temperatures are to be done by use of Infrared Thermoscanning Equipment. Equivalent measurement equipment may be used when so approved by the Society. Readings obtained are to be randomly verified by use of contact thermometers.

9. Stage C - Opening up for Inspections

9.1 The crankshaft deflections are to be measured in the specified (by designer) condition (except for engines where no specification exists).

9.2 High speed engines for marine use are normally to be stripped down for a complete inspection after the type test.

9.3 For all the other engines, after the test run the components of one cylinder for in-line engines and two cylinders for V-engines are to be presented for inspection as follows (engines with long service experience from non-marine fields can have a reduced extent of opening):

- piston removed and dismantled

- crosshead bearing dismantled

- guide planes

- connecting rod bearings (big and small end) dismantled (special attention to serrations and fretting on contact surfaces with the bearing backsides)

M71
(cont)

- main bearing dismantled
- cylinder liner in the installed condition
- cylinder head, valves disassembled
- cam drive gear or chain, camshaft and crankcase with opened covers. (The engine must be turnable by turning gear for this inspection.)

9.4 For V-engines, the cylinder units are to be selected from both cylinder banks and different crank throws.

9.5 If deemed necessary by the surveyor, further dismantling of the engine may be required.

End of Document

M72 Certification of Engine Components

(Feb 2015) (Corr.1 Aug 2015)

1. General

1.1 The engine manufacturer is to have a quality control system that is suitable for the actual engine types to be certified by the Society. The quality control system is also to apply to any sub-suppliers. The Society reserves the right to review the system or parts thereof. Materials and components are to be produced in compliance with all the applicable production and quality instructions specified by the engine manufacturer. The Society requires that certain parts are verified and documented by means of Society Certificate (SC), Work Certificate (W) or Test Report (TR).

1.2 Society Certificate (SC)

This is a document issued by the Society stating:

- conformity with Rule requirements.
- that the tests and inspections have been carried out on the certified product itself, or on samples taken from the certified product itself.
- that the inspection and tests were performed in the presence of the Surveyor or in accordance with special agreements, i.e. ACS.

1.3 Work's Certificate (W)

This is a document signed by the manufacturer stating:

- conformity with requirements.
- that the tests and inspections have been carried out on the certified product itself, or on samples taken from the raw material, used for the product to be certified.
- that the tests were witnessed and signed by a qualified representative of the applicable department of the manufacturer.

A Work's Certificate may be considered equivalent to a Society Certificate and endorsed by the Society under the following cases:

- the test was witnessed by the Society Surveyor; or
- an Alternative Certification Scheme (ACS) agreement is in place between the Class Society and the manufacturer or material supplier; or
- the Work's certificate is supported by tests carried out by an accredited third party that is accepted by the Society and independent from the manufacturer and/or material supplier.

Notes:

1. The requirements of UR M72 are to be uniformly implemented by IACS Societies to engines with an application for certification dated on or after 1 July 2016.

M72 (cont)

1.4 Test Report (TR)

This is a document signed by the manufacturer stating:

- conformity with requirements.
- that the tests and inspections have been carried out on samples from the current production.

1.5 The documents above are used for product documentation as well as for documentation of single inspections such as crack detection, dimensional check, etc. If agreed to by the Society, the documentation of single tests and inspections may also be arranged by filling in results on a control sheet following the component through the production.

1.6 The Surveyor is to review the TR and W for compliance with the agreed or approved specifications. SC means that the Surveyor also witnesses the testing, batch or individual, unless an ACS provides other arrangements.

1.7 The manufacturer is not exempted from responsibility for any relevant tests and inspections of those parts for which documentation is not explicitly requested by the Society. Manufacturing works is to be equipped in such a way that all materials and components can be consistently produced to the required standard. This includes production and assembly lines, machining units, special tools and devices, assembly and testing rigs as well as all lifting and transportation devices.

2. Parts to be documented

2.1 The extent of parts to be documented depends on the type of engine, engine size and criticality of the part.

2.2 Symbols used are listed in Table M72.1. A summary of the required documentation for the engine components is listed in Table M72.2.

M72.1 Symbols used in Table M72.2

Symbol	Description
C	chemical composition
CD	crack detection by MPI or DP
CH	crosshead engines
D	cylinder bore diameter (mm)
GJL	gray cast iron
GJS	spheroidal graphite cast iron
GS	cast steel
M	mechanical properties
SC	society certificate
TR	test report
UT	ultrasonic testing
W	work certificate
X	visual examination of accessible surfaces by the Surveyor

2.3 For components and materials not specified in Table M72.2, consideration will be given by the Society upon full details being submitted and reviewed.

M72 (cont)

M72.2 Summary of required documentation for engine components

Part [4), 5), 6), 7)]	Material properties [1)]	Non-destructive examination [2)]	Hydraulic testing [3)]	Dimensional inspection, including surface condition	Visual inspection (surveyor)	Applicable to engines:	Component certificate
Welded bedplate	W(C+M)	W(UT+CD)			fit-up + post-welding	All	SC
Bearing transverse girders GS	W(C+M)	W(UT+CD)			X	All	SC
Welded frame box	W(C+M)	W(UT+CD)			fit-up + post-welding	All	SC
Cylinder block GJL			W[9)]			CH	
Cylinder block GJS			W[9)]			CH	
Welded cylinder frames	W(C+M)	W(UT+CD)			fit-up + post-welding	CH	SC
Engine block GJL			W[9)]			>400 kW/cyl	
Engine block GJS	W(M)		W[9)]			>400 kW/cyl	
Cylinder liner	W(C+M)		W[9)]			D>300mm	
Cylinder head GJL			W			D>300mm	
Cylinder head GJS			W			D>300mm	
Cylinder head GS	W(C+M)	W(UT+CD)	W		X	D>300mm	SC
Forged cylinder head	W(C+M)	W(UT+CD)	W		X	D>300mm	SC
Piston crown GS	W(C+M)	W(UT+CD)			X	D>400mm	SC
Forged piston crown	W(C+M)	W(UT+CD)			X	D>400mm	SC
Crankshaft: made in one piece	SC(C+M)	W(UT+CD)		W	Random, of fillets and oil bores	All	SC
Semi-built crankshaft	See below	See below		See below	See below	All	SC
Crank throw	SC(C+M)	W(UT+CD)		W	Random, of fillets and shrink fittings	All	
Forged main journal and journals with flange	SC(C+M)	W(UT+CD)		W	Random, of shrink fittings	All	

M72 (cont)

M72.2 Summary of required documentation for engine components (continued)

Part [4), 5), 6), 7)]	Material properties [1)]	Non-destructive examination [2)]	Hydraulic testing [3)]	Dimensional inspection, including surface condition	Visual inspection (surveyor)	Applicable to engines:	Component certificate
Exhaust gas valve cage			W			CH	
Piston rod, if applicable	SC(C+M)	W(UT+CD) CD again after final machining (grinding)			Random	D>400mm	SC
Cross head	SC(C+M)	W(UT+CD) CD again after final machining (grinding and polishing)			Random	CH	SC
Connecting rod with cap	SC(C+M)	W(UT+CD)		W	Random, of all surfaces, in particular those shot peened	All	SC
Coupling bolts for crankshaft	SC(C+M)	W(UT+CD)		W	Random, of interference fit	All	SC
Bolts and studs for main bearings	W(C+M)	W(UT+CD)				D>300mm	
Bolts and studs for cylinder heads	W(C+M)	W(UT+CD)				D>300mm	
Bolts and studs for connecting rods	W(C+M)	W(UT+CD)		TR of thread making		D>300mm	
Tie rod	W(C+M)	W(UT+CD)		TR of thread making	Random	CH	SC
High pressure fuel injection pump body			W TR			D>300mm	
High pressure fuel injection valves (only for not autofretted)			W TR			D>300mm	

M72 (cont)

M72.2 Summary of required documentation for engine components (continued)

Part [4), 5), 6), 7)]	Material properties [1)]	Non-destructive examination [2)]	Hydraulic testing [3)]	Dimensional inspection, including surface condition	Visual inspection (surveyor)	Applicable to engines:	Component certificate
High pressure fuel injection pipes including common fuel rail	W(C+M)		W for those that are not autofretted			D>300mm	
High pressure common servo oil system	W(C+M)		W			D>300mm	
Cooler, both sides [8)]	W(C+M)		W			D>300mm	
Accumulator of common rail fuel or servo oil system	W(C+M)		W			All engines with accumulators with a capacity of >0,5 l	
Piping, pumps, actuators, etc. for hydraulic drive of valves, if applicable	W(C+M)		W			>800 kW/cyl	
Engine driven pumps (oil, water, fuel, bilge)			W			>800 kW/cyl	
Bearings for main, crosshead, and crankpin	TR(C)	TR (UT for full contact between basic material and bearing metal)		W		>800 kW/cyl	

M72 (cont)

FOOTNOTES:

1. Material properties include chemical composition and mechanical properties, and also surface treatment such as surface hardening (hardness, depth and extent), peening and rolling (extent and applied force).

2. Non-destructive examination means e.g. ultrasonic testing, crack detection by MPI or DP.

3. Hydraulic testing is applied on the water/oil side of the component. Items are to be tested by hydraulic pressure at the pressure equal to 1.5 times the maximum working pressure. High pressure parts of the fuel injection system are to be tested by hydraulic pressure at the pressure equal to 1.5 maximum working pressure or maximum working pressure plus 300 bar, whichever is the less. Where design or testing features may require modification of these test requirements, special consideration may be given.

4. For turbochargers, see M73.

5. Crankcase safety valves are to be type tested in accordance with M66 and documented according to M9.

6. Oil mist detection systems are to be type tested in accordance with M67 and documented according to M10.

7. For Speed governor and overspeed protective devices, see M3.

8. Charge air coolers need only be tested on the water side.

9. Hydraulic testing is also required for those parts filled with cooling water and having the function of containing the water which is in contact with the cylinder or cylinder liner.

End of Document

M73 Turbochargers

(Feb 2015)

1. Scope

1.1 These requirements are applicable for turbochargers with regard to design approval, type testing and certification and their matching on engines.
Turbochargers are to be type approved, either separately or as a part of an engine. The requirements are written for exhaust gas driven turbochargers, but apply in principle also for engine driven chargers.

1.2 The requirements escalate with the size of the turbochargers. The parameter for size is the engine power (at MCR) supplied by a group of cylinders served by the actual turbocharger, (e.g. for a V-engine with one turbocharger for each bank the size is half of the total engine power).

1.3 Turbochargers are categorised in three groups depending on served power by cylinder groups with:

- Category A: ≤ 1000 kW
- Category B: > 1000 kW and ≤ 2500 kW
- Category C: > 2500 kW

2. Documentation to be submitted

2.1 Category A:

On request

- Containment test report.
- Cross sectional drawing with principal dimensions and names of components.
- Test program.

2.2 Category B and C:

- Cross sectional drawing with principal dimensions and materials of housing components for containment evaluation.
- Documentation of containment in the event of disc fracture, see M73.3.2.
- Operational data and limitations as:
- Maximum permissible operating speed (rpm)

Notes:

1. The requirement of UR M73 are to be uniformly implemented by IACS Societies to turbochargers with an application for certification dated on or after 1 July 2016.

M73
(cont)

- Alarm level for over-speed
- Maximum permissible exhaust gas temperature before turbine
- Alarm level for exhaust gas temperature before turbine
- Minimum lubrication oil inlet pressure
- Lubrication oil inlet pressure low alarm set point
- Maximum lubrication oil outlet temperature
- Lubrication oil outlet temperature high alarm set point
- Maximum permissible vibration levels, i.e. self- and externally generated vibration

(Alarm levels may be equal to permissible limits but shall not be reached when operating the engine at 110% power or at any approved intermittent overload beyond the 110%.)

- Arrangement of lubrication system, all variants within a range.
- Type test reports.
- Test program.

2.3 Category C:

- Drawings of the housing and rotating parts including details of blade fixing.
- Material specifications (chemical composition and mechanical properties) of all parts mentioned above.
- Welding details and welding procedure of above mentioned parts, if applicable.
- Documentation[*)] of safe torque transmission when the disc is connected to the shaft by an interference fit, see M73.3.3.
- Information on expected lifespan, considering creep, low cycle fatigue and high cycle fatigue.
- Operation and maintenance manuals[*)].

[*)] Applicable to two sizes in a generic range of turbochargers.

3. Design requirements and corresponding type testing

3.1 General

3.1.1 The turbochargers shall be designed to operate under conditions given in M46 and M28. The component lifetime and the alarm level for speed shall be based on 45°C air inlet temperature.

3.1.2 The air inlet of turbochargers shall be fitted with a filter.

M73
(cont)

3.2 Containment

3.2.1 Turbochargers shall fulfil containment in the event of a rotor burst. This means that at a rotor burst no part may penetrate the casing of the turbocharger or escape through the air intake. For documentation purposes (test/calculation), it shall be assumed that the discs disintegrate in the worst possible way.

3.2.2 For category B and C, containment shall be documented by testing. Fulfilment of this requirement can be awarded to a generic range of turbochargers based on testing of one specific unit. Testing of a large unit is preferred as this is considered conservative for all smaller units in the generic range. In any case, it must be documented (e.g. by calculation) that the selected test unit really is representative for the whole generic range.

3.3.3 The minimum test speeds, relative to the maximum permissible operating speed, are:

- For the compressor: 120%.
- For the turbine: 140% or the natural burst speed, whichever is lower.

3.2.4 Containment tests shall be performed at working temperature.

3.2.5 A numerical analysis (simulation) of sufficient containment integrity of the casing based on calculations by means of a simulation model may be accepted in lieu of the practical containment test, provided that:

- The numerical simulation model has been tested and its suitability/accuracy has been proven by direct comparison between calculation results and the practical containment test for a reference application (reference containment test). This test shall be performed at least once by the manufacturer for acceptance of the numerical simulation method in lieu of tests.

- The corresponding numerical simulation for the containment is performed for the same speeds as specified for the containment test.

- Material properties for high-speed deformations are to be applied in the numeric simulation. The correlation between normal properties and the properties at the pertinent deformation speed are to be substantiated.

- The design of the turbocharger regarding geometry and kinematics is similar to the turbocharger that was used for the reference containment test. In general, totally new designs will call for a new reference containment test.

3.3 Disc-shaft shrinkage fit

3.3.1 Applicable to Category C

3.3.2 In cases where the disc is connected to the shaft with interference fit, calculations shall substantiate safe torque transmission during all relevant operating conditions such as maximum speed, maximum torque and maximum temperature gradient combined with minimum shrinkage amount.

3.4 Type testing

3.4.1 Applicable to Categories B and C

M73 (cont)

3.4.2 The type test for a generic range of turbochargers may be carried out either on an engine (for which the turbocharger is foreseen) or in a test rig.

3.4.3 Turbochargers are to be subjected to at least 500 load cycles at the limits of operation. This test may be waived if the turbocharger together with the engine is subjected to this kind of low cycle testing, see M71.

3.4.4 The suitability of the turbocharger for such kind of operation is to be preliminarily stated by the manufacturer.

3.4.5 The rotor vibration characteristics shall be measured and recorded in order to identify possible sub-synchronous vibrations and resonances.

3.4.6 The type test shall be completed by a hot running test at maximum permissible speed combined with maximum permissible temperature for at least one hour. After this test, the turbocharger shall be opened for examination, with focus on possible rubbing and the bearing conditions.

3.4.7 The extent of the surveyor's presence during the various parts of the type tests is left to the discretion of each Society.

4. Certification

4.1 The manufacturer shall adhere to a quality system designed to ensure that the designer's specifications are met, and that manufacturing is in accordance with the approved drawings.

4.2 For category C, this shall be verified by means of periodic product audits of an Alternative Certification Scheme (ACS) by the Society.

4.3 These audits shall focus on:

- Chemical composition of material for the rotating parts.
- Mechanical properties of the material of a representative specimen for the rotating parts and the casing.
- UT and crack detection of rotating parts.
- Dimensional inspection of rotating parts.
- Rotor balancing.
- Hydraulic testing of cooling spaces to 4 bars or 1.5 times maximum working pressure, whichever is higher.
- Overspeed test of all compressor wheels for a duration of 3 minutes at either 20% above alarm level speed at room temperature or 10% above alarm level speed at 45°C inlet temperature when tested in the actual housing with the corresponding pressure ratio. The overspeed test may be waived for forged wheels that are individually controlled by an approved non-destructive method.

4.4 Turbochargers shall be delivered with:

M73 (cont)

- For category C, a society certificate, which at a minimum cites the applicable type approval and the ACS, when ACS applies.
- For category B, a work's certificate, which at a minimum cites the applicable type approval, which includes production assessment.

4.5 The same applies to replacement of rotating parts and casing.

4.6 Alternatively to the above periodic product audits, individual certification of a turbocharger and its parts may be made at the discretion of the Society. However, such individual certification of category C turbocharger and its parts shall also be based on test requirements specified in the above mentioned bullet points.

5. Alarms & Monitoring

5.1 For all turbochargers of Categories B and C, indications and alarms as listed in the table are required.

5.2 Indications may be provided at either local or remote locations.

Pos.	Monitored Parameters	Category of Turbochargers				Notes
		B		C		
		Alarm	Indication	Alarm	Indication	
1	Speed	High (4)	X (4)	High (4)	X (4)	
2	Exhaust gas at each turbocharger inlet, temperature	high (1)	X (1)	high	X	High temp. alarms for each cylinder at engine is acceptable (2)
3	Lub. oil at turbocharger outlet, temperature			high	X	If not forced system, oil temperature near bearings
4	Lub. oil at turbocharger inlet, pressure	low	X	low	X	Only for forced lubrication systems (3)

(1) For Category B turbochargers, the exhaust gas temperature may be alternatively monitored at the turbocharger outlet, provided that the alarm level is set to a safe level for the turbine and that correlation between inlet and outlet temperatures is substantiated.

(2) Alarm and indication of the exhaust gas temperature at turbocharger inlet may be waived if alarm and indication for individual exhaust gas temperature is provided for each cylinder and the alarm level is set to a value safe for the turbocharger.

(3) Separate sensors are to be provided if the lubrication oil system of the turbocharger is not integrated with the lubrication oil system of the diesel engine or if it is separated by a throttle or pressure reduction valve from the diesel engine lubrication oil system.

(4) On turbocharging systems where turbochargers are activated sequentially, speed monitoring is not required for the turbocharger(s) being activated last in the sequence, provided all turbochargers share the same intake air filter and they are not fitted with waste gates.

End of Document

Z26 Alternative Certification Scheme (ACS)

(Feb 2015)

1. Definitions

1.1 ACS is a certification scheme involving a manufacturer (and associated sub-suppliers, if needed) in the inspection, testing and certification of the manufacturer's products.

1.2 An ACS will clarify:

- The extent of the required inspection and testing.

- To which extent and under which conditions the manufacturer may perform all or parts of the required inspection and testing without the presence of a Surveyor from the Society when a Society Certificate is required.

1.3 The extent to which the manufacturer is given permission to carry out inspections and testing without the presence of a Surveyor is to be agreed on a case by case basis, e.g. for a specific product production line or for specific parts.

2. Scope

2.1 An ACS may be arranged with product manufacturers and/or sub-suppliers.

2.2 An ACS with a manufacturer must define the handling of subcontracted parts (those that require Society or work certificates or in any other way are addressed in the Society's Rules).
The sub-supplier may be included in the ACS of the manufacturer or have his own ACS or deliver parts that are inspected and certified by the Society.

2.3 An ACS that permits the manufacturer to carry out all or parts of required inspection and testing without the presence of a Surveyor may be arranged in two versions with regard to traceability:

- The ACS describes inspection, testing and certification additional to the manufacturer's standard quality control in order to meet the Rules. The components are to be stamped with a special stamp supplied by the Society or identified as required by the Society.

- The manufacturer has a standard quality control that covers all required inspection, testing and certification in compliance with the Rules. Traceability and the required type of product document for components or products will be defined in the ACS.

Notes:

1. The requirements of UR Z26 is to be uniformly implemented by IACS Societies on or after 1 July 2016.

Z26 (cont)

3. Conditions

3.1 The conditions for the manufacturer to be granted the permission to carry out inspection and testing without the presence of a Surveyor are that:

- The manufacturer has an implemented Quality System according to a national or international standard approved by an accredited certification body or recognised by the Society.

- The manufacturer has a quality control system, current drawings, and Rules and standards that cover the product to be certified.

- The inspection and testing required by the Rules are either standard procedures in the Quality System and recognized by the Society or specified in detail in the ACS.

- The Society initially ascertains the manufacturer's compliance with the ACS-requirements by verifying the required product and process approvals and performing an initial audit. Follow-up and renewal audits are conducted by the Society on a regular basis to verify that conditions of the ACS are continuously maintained by the manufacturer.

- If work certificates (W) or test reports (TR) are found not to fulfil the standards agreed with the Society, the component may not be accepted.

- The agreed ACS may be suspended or cancelled when / if found justified by the Society.

- The Society may carry out unscheduled inspections at the manufacturer and/or subcontractor at its own discretion.

- The manufacturers (and designers, if producing under license) commit themselves to involve the Society when changes to the design, manufacturing process or testing are made as well as when any major production problems or any major product delivery problems have occurred.

- The validity of an ACS is to be a maximum of 5 years. The ACS may be renewed subject to an audit. The scope of the renewal audit shall:

    - verify the conditions of the ACS are still met

    - verify that the current products and processes are appropriately controlled

4. Information to be submitted

4.1 For admission to an alternative certification scheme for a product, the manufacturer is to submit an application enclosing the following documentation:

- Product details.

- Existing class approvals of the manufacturer's products as far as required.

- The procedures relevant to the manufacturing process.

- A list of material suppliers with an indication of their class approval (as far as required by the Rules) and the type of material certification in each case.

Z26 (cont)

- Quality control plans relevant to the products and relevant components to be certified through the alternative certification scheme. Said plans are to detail the inspections and tests required by the Rules with an indication of which inspections and tests are delegated to the manufacturer and which are to be done in the presence of a Society representative.

- The procedures relevant to the quality control and inspections, their methods, frequency and certification.

- The list of suppliers of materials and main components of the product, including certificates.

- The quality system details.

- List of nominated personnel for:

    - Marking/stamping of products

    - Tests and Inspection (responsible)

    - Provision of data and information (e.g. declaration of conformity, test reports etc.)

- Any other additional documents that the Society may require in order to evaluate the manufacturing processes and product quality control.

5. Audit procedure

5.1 Upon satisfactory examination of the complete documentation for application an initial audit shall be carried out at the manufacturer's works. This audit is to verify that the manufacture of the product and the relevant controls are performed in accordance with the documents submitted and are in compliance with the requirements laid down in the ACS documentation and the Society Rules.

5.2 Upon satisfactory outcome of the audits, the extent, duration and conditions of the ACS are documented.

5.3 At least one intermediate audit during the period of validity of the ACS is to be carried out. Additional audits may be required at the discretion of the Society.

End of Document