



**GUIDANCE FOR THE CLASSIFICATION AND
CONSTRUCTION**

PART 1. SEAGOING SHIPS

**VOLUME K
GUIDANCE FOR
MASS PRODUCED ENGINES
2016 EDITION**

BIRO KLASIFIKASI INDONESIA



GUIDANCE FOR THE CLASSIFICATION AND CONSTRUCTION

PART 1. SEAGOING SHIPS

VOLUME K GUIDANCE FOR MASS PRODUCED ENGINES 2016 EDITION

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Foreword

Guidance for Mass Produced Engines 2016 edition amends Regulations for Mass Produced Engines 1996 edition. This new edition has new format including major changes to numbering of entire Section as well as new requirements related to testing of outboard engine which has been set out in Section 4. This Guidance also provide information from the latest Industrial Standard such as ISO 15550 and ISO 8665. The amendment is also developed in consideration with other BKI Manufacture and Component approval standard.

The core of each section presented on this Guidance are as follow:

- Section 1 - General
Providing General Terms and Condition to apply this Guidance
- Section 2 – Approval as Supplier of Mass Produced Engine
Stated the requirement needs to be fulfilled in order to gain approval as Supplier of Mass Produced Engine
- Section 3 – Testing of Mass Produced Engine at Manufacturer’s Work
Providing requirement and item for Type Test and Bench Test of Mass Produced Engine
- Section 4 – Additional Requirements of Mass Produced Outboard Engine
New additional requirement related to certification of Mass Produced Outboard Engine

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Table of Contents

Foreword	iii
Table of Contents.....	v
Amendment Notice	vii
Section 1 General	1-1/2
A. Scope	1-1/2
B. Mass production	1-1/2
Section 2 Approval as Supplier of Mass Produced Engines	2-1/6
A. Application for approval.....	2-1/6
B. Document for approval.....	2-1/6
C. Mass product processes/quality assurance	2-1/6
D. Type-testing.....	2-2/6
E. Continuous checks on manufacture.....	2-5/6
F. Period of validity	2-5/6
Section 3 Testing of Mass Produced Engines in Manufacturer's Work	3-1/4
A. Component test.....	3-1/4
B. Bench tests.....	3-1/4
C. Engine documents to be submitted.....	3-2/4
D. Engine stamping	3-3/4
Section 4 Additional requirements for Mass Produced Outboard Engines	4-1/2
A. Type-Testing	4-1/2
B. Type Test Programme	4-1/2
C. Bench Test.....	4-2/2

Amendment Notice

These pages contain amendments within the following section of the Guidance for Mass Produced Engines Edition 2016

These amendments are effective from February 1st 2016

Paragraph	Title/Subject	Status/Remark
Section 1 – General		
A	Scope	
1	No Title	The compliance for manufacturer
3	No Title	To add new scope fo application of outboard propulsion engine
4	No Title	
Section 2 – Approval as Supplier of Mass Produced Engines		
A	Application for approval	
	No Title	Form required for approval
B	Document for approval	
	No Title	Reference rules and standard
	No Title	Additional requirement of drawing and document for outboard engine
D	Type-testing	
3	Type-test programme and duration	
	No Title	Procedure for type test of outboard propulsion engine
5.3	No Title	To add new requirement of operating parameters specific for outboard engine
Section 3 – Testing of Mass Produced Engines in Manufacturer's Work		
A	Component test	
1	No Title	Requirement related to stamping of individual components
2	No Title	Requirement related to stamping of individual components
3	No Title	Requirement related to acceptance test certificate for mass produced outboard engines
B	Bench tests	
1	No Title	Requirement for supervision of bench test
5	No Title	Requirement for work trials for outboard engines
C	Engine documents to be submitted	
	No Title	Requirement for test certificate
D	Engine stamping	
	No Title	Provision for engine stamping of mass produced engine
Section 4 – Additional requirements for Mass Produced Outboard Engines		
	No Title	Additional requirements for mass produced outboard engines inculed type testing, type test programme and bench test

Section 1

General

A. Scope

1. This Guidance apply to internal combustion engines which are produced in accordance with the Rules of Biro Klasifikasi Indonesia (BKI) and in mass in accordance with B of this Section - hereafter referred to as mass produced engines - and for which the manufacturer has received an approval as a supplier of mass produced engines from BKI.
2. The scope of this Guidance is limited to engines with cylinder bores of ≤ 300 mm.
3. This Guidance also apply to marine outboard propulsion engines used for small craft up to 24 m hull length.
4. BKI Head Office will decide which engine types / engine series meet the requirements for the application of this Guidance.

B. Mass production

1. For the purpose of this Guidance, the mass production of internal combustion engines meets the following criteria:
 - The engines are produced in considerable numbers
 - The materials and components used are manufactured in compliance with all the production and quality controls specified by the engine manufacturer and recognized by BKI.
 - The components of mass produced engines must be manufactured on machining units which have been specially adjusted for that purpose and which are subjected to the inspection necessary to quality assurance.
 - The engine components must completely satisfy the engine manufacturer's quality requirements, must be interchangeable and must be able to be fitted without reworking of adaption.
2. Components supplied by subcontractors and castings and forgings which are used in the manufacture of, or as spare for, mass produced engines are to be manufactured in the same way in para B.1. The inspections necessary to quality assurance are to comply with Section 2.C.2.

Section 2

Approval as Supplier of Mass Produced Engines

Approval of an engine manufacturer as a supplier of mass produced engines relates in every case to a particular engine type/engine series, and application for approval is to be made by the engine manufacturer to BKI Head Office.

Engine manufacturers who meet the requirements of Section 1. B. can be approved by BKI as suppliers of mass produced engines. When such approval has been awarded, engines to be classified by BKI may be supplied after testing in accordance with Section 3 or 4.

Approval requires that the internal quality assurance procedures and manufacturing plant and processes of the engine manufacturer concerned have been approved by BKI and that the manufacture of each individual engine conforms to the maker's quality requirements recognized by BKI and also that all the tests stipulated in BKI's Rules can be performed by the engine manufacturer himself.

The testing of the complete engine to be classified is to be performed in the presence of BKI Surveyor.

A. Application for approval

Application for approval in respect of an engine type/engine series shall be submitted to BKI Head Office prior to approval process by the engine manufacturer on BKI forms:

F12.3.01 Application for Approval of Manufacturer

F12.3.03 Annex 1 Application of Approval Engine Type : List of Document for Approval

F12.3.04 Annex 2 Application of Approval Engine Type : Datasheet for Crankshaft Calculation

B. Document for approval

Approval requires that each engine type/engine series comply with BKI's Rules and International Industrial Standard has been approved. For this purpose, all drawings and documents subject to compulsory examination are to be submitted to BKI in accordance with the Rules for Machinery Installations (Pt.1, Vol. III) Sect. 2.

For outboard engines, in addition to drawing and documents specified above, the following drawings are to be submitted:

- Power transmission
- Propeller

C. Mass product processes/quality assurance

1. Engine manufacturers

The manufacture of mass produced engines is not individually supervised by BKI but is monitored by the engine manufacturer's quality assurance system. Recognition by BKI of the quality assurance system requires that:

- the duties, structure and organization of quality controls of quality assurance procedures are clearly defined, described and available,
- proof can be supplied of the professional expertise and independence of the personnel employed in quality assurance,
- the results of quality controls are placed on record and can, on request, be produced for examination at any time,
- the manufacturing, laboratory and testing equipment is kept under continuous supervision by the quality assurance department,
- as part of the internal quality assurance procedure, engines are selected at regular intervals from the production flow and are subjected, after the trial run or an extended trial run in the works, to a thorough inspection in a partially or fully dismantled condition.

The engine manufacturer is to supply BKI with full details of the above and of any changes introduced.

BKI performs works visits at regular intervals to verify that the conditions for approval continue to be fully fulfilled (checking manufacturing processes and methods and the quality assurance procedures)

2. Subcontractors

Works test certificates are acceptable for components subject to compulsory inspection manufactured by subcontractors. This is subject to the condition that manufacture is performed strictly in compliance with the quality controls stipulated by the engine manufacturer and that these are regularly checked by the engine manufacturer's quality assurance department.

Where components subject to compulsory inspection manufactured by subcontractors undergo no further testing by the engine manufacturer, the quality control arrangements of the subcontractor are checked by BKI as required. The engine manufacturer is responsible for ensuring agreements with subcontractors which enable BKI to carry out checks.

D. Type-testing

Approval of an engine type/engine series as a mass produced engine requires previous type-testing in the presence of BKI's representative.

The type-testing of mass produced engines is subject to the following requirements. Any exceptions require BKI's agreement.

1. Selection of engine for type-testing

The engine for type-testing is to be chosen from current mass production by agreement with the responsible BKI Surveyor.

2. Equipment for engines to be type-tested

The type-test is to be performed on an engine corresponding to BKI's Rules and fitted with all the prescribed equipment items. If testing with complete equipment according to the Rules is not possible on the test bed, the missing equipment is to be presented and / or tested on another engine from the series.

3. Type-test programme and duration

Type test for outboard propulsion engine shall be carried out in accordance with Section 4.

Unless otherwise agreed between the engine manufacturer and BKI, the type-test for inboard engine is to be performed according to the following programme and for the times indicated.

The performance points are required to conform to the power - speed diagram in Fig. 1.

3.1. Rated power (continuous power)

i.e. 100% power at 100% torque and 100% speed (rated speed) corresponding to performance point 1. for 80 hours

3.2. 100% power

at maximum permissible speed corresponding to performance point 2. for 1 hour

3.3. Maximum permissible torque

i.e. normally 110% at 100% speed corresponding to point 3 or maximum permissible power (normally 110%) at a speed according to nominal propeller curve corresponding to point 3.a., both for 8 hours

3.4. Minimum permissible speed for intermitted operation

- at 100% torque corresponding to performance point 4 for 0.5 hours
- at 90% torque corresponding to performance point 5. for 0.5 hours

3.5. Partial load operation

Partial load operation i.e. 75% , 50% and 25% of rated power at speeds according to nominal propeller curve corresponding to points 6, 7 and 8 and started from rated speed with constant governor setting corresponding to points 9, 10 and 11 (see Figure 2.1) for 8 hours.

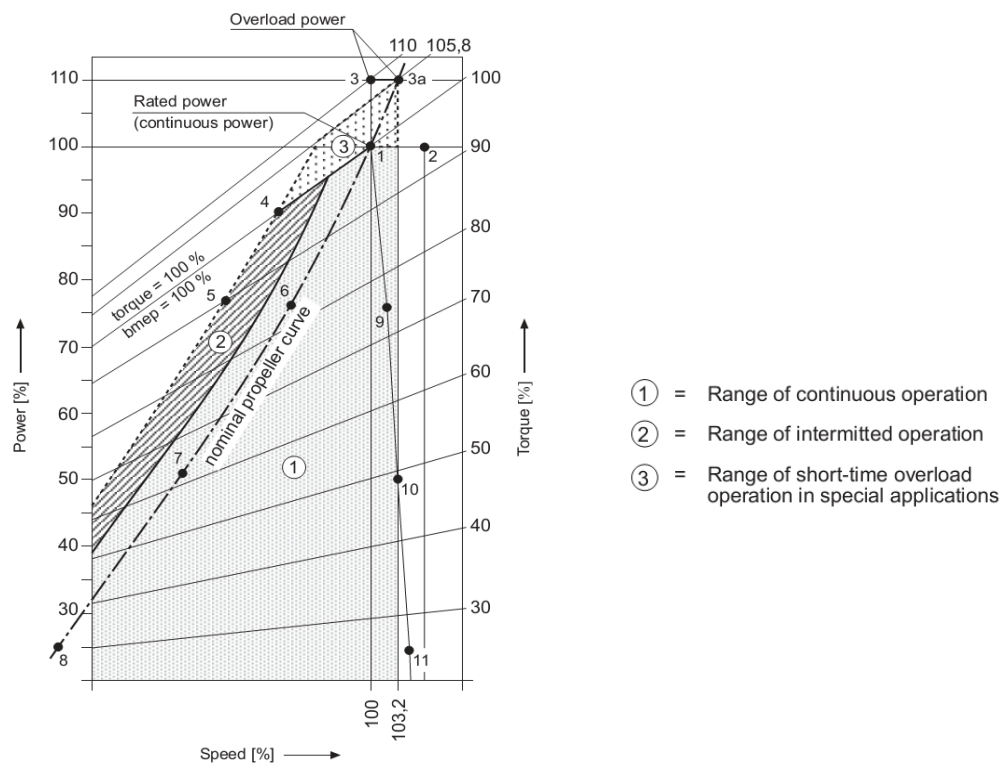


Fig. 2.1. Power - Speed Diagram

3.6. Intermittent load

(100 % power → no load) for 2 hours

3.7. Functional test

- Starting test and, where applicable, reversing manoeuvres
- Speed governor test
- Test of safety system (over speed device, failure of lubricating oil system)
- Test of engine with turbocharger out of action (where applicable)
- Test of minimum on-load speed for main propulsion engines and of idling speed for auxiliary engines

4. The testing conditions stated in 4.3.1. - 4.3.6. are to be combined into test cycles, which are to be repeated consistently over the entire specified period.

Notes:

For engines intended for various applications involving differing power and speed condition the type-test programme and the testing periods are to be increased to cover the entire output and speed range of the engine type.

For heavy-fuel engines, suitable proof is required of heavy - fuel operation capacity.

The testing programme is to be agreed with BKI.

5. Test report

5.1 A report on the result of testings is to be compiled which shall be submitted to BKI on completion of the type-test.

The report is to contain the following details:

- technical engine data
- test conditions in accordance with 5.2.
- operating parameters in accordance with 5.3.
- result of follow-up inspection in accordance with 5.4.

5.2. Test conditions

- Ambient temperature
- Barometric pressure
- Relative humidity of air
- External cooling water temperature at inlet
- Characteristic of fuel and lubricating oil

5.3. Operating parameters

During the type-test, at least the operating parameters listed below for the various loading points are to be measured and recorded at regular intervals:

- Torque or brake load
- Engine speed

- Engine power
- Maximum combustion pressure (indicator diagrams if possible), not needed for outboard engine
- Exhaust smoke (blackening index)
- Lubricating oil pressure and temperature
- Cooling water pressure and temperature
- Exhaust gas temperature in exhaust manifold and, if possible, at each cylinder outlet
- Exhaust back pressure (for outboard engine only)

Additional information for turbocharged engines:

- Turbocharger speed
- Air temperature and pressure at turbocharger and charge air cooler inlet and outlet
- Exhaust gas temperature and pressure at exhaust-gas turbine inlet and outlet
- Inlet temperature of charge air cooling water

5.4. Component inspection

After the type-test all major parts of the inboard engine are to be dismantled for inspection

The results of the component inspections are to be placed on record. Important parts are to be photographed.

E. Continuous checks on manufacture

Every approval as supplier of mass produced engines is subject to the condition that BKI has the right to check manufacture and quality assurance at any time and to have random rechecks carried out to ensure that the requirements stated in Section 2.C are being observed. BKI is to be allowed access to all necessary documents.

F. Period of validity

1. BKI issues a Certificate with an approval number attesting approval as a supplier of mass produced engines. The approval is valid for 5 years from date of issue and is based on the manufacturing and quality assurance procedures existing at the time of the approval test.

Validity may be renewed on application by the engine manufacturer.

2. The engine manufacturer is obliged to notify BKI of any significant design or functional changes as well as of all changes in operating characteristic. BKI will decide whether any supplementary tests additional to the type-test need to be performed for maintenance or the awarded approval.

3. BKI reserves the right to restrict or withdraw approval and to demand an inspection of individual components under its supervision should the conditions necessary to approval be infringed by deficiencies in the manufacturer's quality assurance procedures or by defects affecting the engines.

Section 3

Testing of Mass Produced Engines in Manufacturer's Work

Engines for which a mass production approval has been issued and which are to be supplied with BKI class are subject to the following requirements:

A. Component test

1. All components subject to compulsory inspection under BKI's Rules are tested by the manufacturer and marked with evidence of the tests applied. Stamping of individual components by BKI is not required unless for components subject to BKI certificate according to Table 2.3 of Rules for Machinery Installation (Pt.1, Vol.III)¹⁾.

2. The engine manufacturer is required to guarantee that the spares and reserve parts subject to compulsory inspection under BKI's Rules conform to the current Rules. The manufacturer has to mark the parts so that they can be recognized as original spares. Stamping of individual components by BKI is not required unless for components subject to BKI certificate according to Table 2.3. of Rules for Machinery Installation (Pt.1, Vol.III)¹⁾.

3. For mass produced outboard engines, Acceptance Test Certificates (according to EN 10204-3.1) completed by the works are to be presented to the BKI Surveyor and these shall indicate the requirements and the actual values of the mechanical characteristic and chemical composition of the material. It must be possible to identify the components by reference to the works certificates.

B. Bench tests

1. Each engine to be supplied with BKI class is to be subjected to a bench test of the following scope under supervision of manufacturer quality representative.

2. Scope of works trials

For all stages, the engine is going to be tested, the pertaining operation values are to be measured and recorded by the engine manufacturer. All results are to be in an acceptance protocol to be issued by the engine manufacturer.

The measurements shall in every case only be performed when steady state operation has been achieved. The readings for 100% power (rated power at rated speed) are to be taken twice at an interval of at least 30 minutes.

2.1 Main engines for direct propeller drive

- a) 100% power (rated power)
at 100% speed (rated speed) : 60 minutes
- b) 110% power
at 103,2% of the rated speed : 45 minutes

¹⁾ Applicable to mass produced engine applications made after 1 July 2016

Note:

After running on test bed, the power is normally limited to the rated power (100% power), so that overload power cannot be given in service.

- c) 90%, 75%, 50%, 25% power according to the nominal propeller curve
- d) Determination of minimum on-load speed
- e) Starting and reserving maneuvers, governor test, testing of over speed protection device.

2.2 Main engines for electrical propeller drive:

The test is to be performed at rated speed with a constant governor setting under the following conditions:

- a) 100% power (rated power) 60 minutes
- b) 110% power 45 minutes

Note:

After running on test bed the power of diesel engines driving generators must be adjusted such that overload power (110% power) can be given in service after installation on board, so that the governing characteristics including the activation of generator protective devices can be fulfilled at all times.

- c) 75%, 50% and 25% power and idling
- d) Starting tests and governor test, testing of over speed protection device

2.3 For auxiliary driving engines and the prime movers of electric generators the scope of the tests is as specified in 2.2.2.

3. BKI reserves the right to demand a special test programme according to the character of the installation.

4. For main engines and the prime movers of electric generators the rated power is to be verified as minimum power.

5. The requirements of work trials for outboard engines are stipulated in Section 4.

C. Engine documents to be submitted

The engine manufacturer shall submit the following documents to BKI Head Office after the bench test :

- The engine manufacturer's confirmation that the engine presented for classification meets the engine manufacturer's quality requirements on which the BKI approval as supplier of mass produced engines is based.
- Test certificates for material of components in accordance with A
- Important attachments where demanded by BKI Head Office.
- Result of bench test.

D. Engine stamping

On completion of the tests, a BKI Test Certificate indicating the mass produced engine approval number is issued for each mass produced engine. Each engine is stamped with the BKI Test Certificate number, KI stamp, mass product identification and test date (month and year).

Example of stamping on a mass produced engine:

230-TP KI 0116 MP

Section 4

Additional requirements for Mass Produced Outboard Engines

This section apply to type test and individual certification of outboard engine in addition to the requirements stipulated in Section 1, 2 and 3

A. Type-Testing

The type-testing of mass produced outboard engines is subject to the following requirements. Any exceptions require BKI's agreement.

- 1.** The following parameters shall be measured while conducting type test programme according to B :
 - Barometric pressure, humidity and ambient temperature
 - Engine speed or cycle frequency
 - Engine brake torque
 - Fuel consumption
 - Lubricating oil pressure
 - Temperature and pressure of exhaust gas leaving the engine

Engine manufacturer shall present brake power and specific fuel consumption calculations to BKI Surveyor with regards to above measurements

- 2.** The following Functional tests are to be verified subsequent to Type test programme :
 - The correct functioning of the reversing mechanism, built-in reverse reduction gear and couplings
 - The ability of the starting system
 - The ability of all malfunction protection and warning devices to respond correctly to the fault conditions in which they should operate (e.g., low lubricating oil pressure, high lubricating oil temperatures, high coolant temperatures, etc.)

B. Type Test Programme

Power measurement shall be taken at a sufficient number of engine speeds to completely define the power and torque curve between the lowest and the highest engine speeds recommended by the manufacturer (see see example in Figure 4.1.). The speed range shall include the point at which the engine produces its maximum power and torque.

The measurements shall in every case only be performed when steady state operation has been achieved.

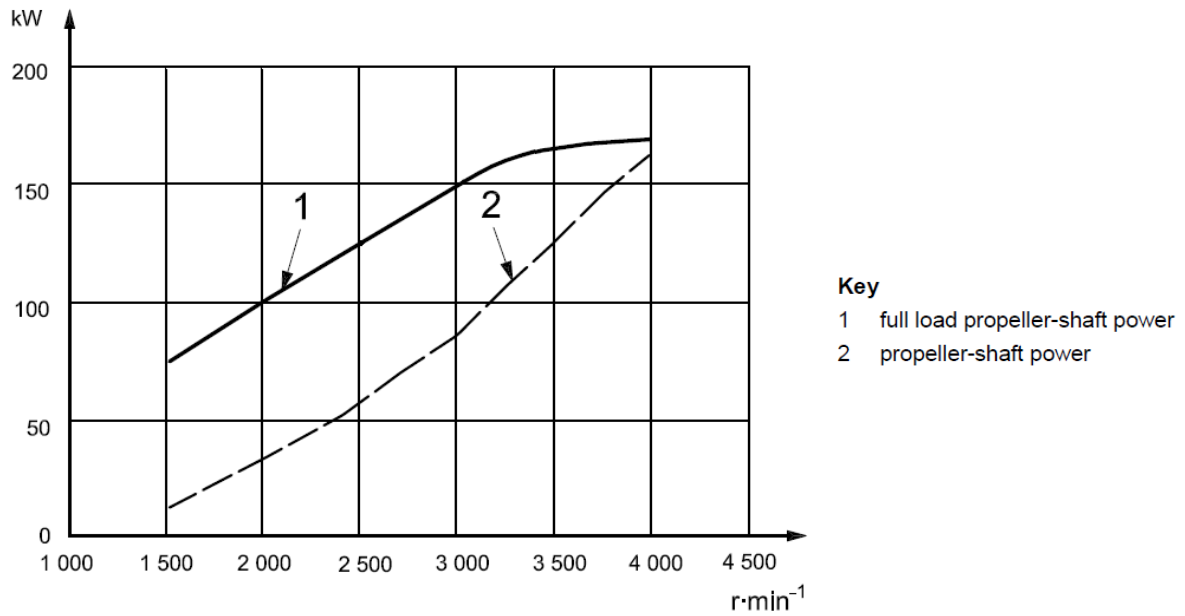


Fig. 4.1. Power – Speed Curve with Complete Propulsion Unit (ISO 8665)

C. Bench Test

In addition to the requirements set out in Section 3.B, work trials for bench test are to be carried out according to B of this section.