SURFACE VEHICLE STANDARD

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Small Craft - Marine Propulsion Engine and Systems - Power Measurements and Declarations

RATIONALE

Revise standard to make it clear that this standard applies to electric propulsion as well as internal combustion engines.

1. SCOPE

This SAE Standard specifies the test requirements in addition to those given in ISO 3046-1 for determining the power, at a single point or as a power curve, of marine propulsion engines or systems for recreational craft and other small craft using similar propulsion equipment of less than 24 m length of the hull.

It also provides the means for documenting and checking the declared (rated) power published by the manufacturer.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 ISO Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ISO 3046-1 Reciprocating internal combustion engines - Performance - Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods - Additional requirements for engines for general use

ISO 3046-3 Reciprocating internal combustion engines - Performance - Part 3: Test measurements

ISO 3675 Crude petroleum and liquid petroleum products - Laboratory determination of density - Hydrometer method

ISO 5163 Petroleum products - Determination of knock characteristics of motor and aviation fuels - Motor method

ISO 5164 Petroleum products - Determination of knock characteristics of motor fuels - Research method

ISO 5165 Petroleum products - Determination of the ignition quality of diesel fuels - Cetane engine method

ISO 8217 Petroleum products - Fuels (Class F) - Specifications of marine fuels

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3. DEFINITIONS

3.1 POWER

Rate of energy per time unit expressed in kilowatts (kW).

3.2 NET TORQUE

Torque transmitted on a test bed at the end of the crankshaft or motor at the corresponding motor speed.

3.3 DECLARED PROPELLER SHAFT POWER

Value of the power, declared by the manufacturer, expressed in kilowatts (kW) at the propeller shaft of an electric propulsion system sold with complete propulsion units or at the coupling to the propeller shaft of a motor sold with reduction and/or reversing gears.

3.4 DECLARED ENGINE SPEED (CRANKSHAFT SPEED)

3.4.1 In the case of spark-ignition engines without speed governors, the declared engine speed shall be the midpoint of the full throttle speed range recommended by the manufacturer for propeller selection.

3.4.2 In the case of engines with speed governors, the declared engine speed shall be the governed speed chosen by the manufacturer.

3.5 DECLARED POWER

The corrected net brake power declared for a given engine or propulsion system at its final output shaft when all the auxiliaries that affect the power output are fitted. The declared power shall be determined and corrected according to ISO 3046-1.The declared power shall be “propeller shaft power” and so named at the propeller shaft of engines sold with attached propulsion units, such as outboard engines, and at the coupling to the propeller shaft of engines sold with reduction or reversing gears. The declared power shall be “crankshaft power” and so named when measured at the engine output shaft of the engines. When using crankshaft power, the power declaration shall be accompanied by a statement that propeller shaft power will be reduced by gear losses.

4. INTERNAL COMBUSTION ENGINE TEST

4.1 Engine or Propulsion System

4.1.1 The test engine or propulsion system shall be representative of the manufacturer’s production units. It shall be run-in according to the manufacturer’s recommendations and shall be fitted with an exhaust system. All auxiliaries fitted shall be listed and described.

4.1.2 Fuel system components that may be sensitive to orientation may be reoriented to accommodate engine test positions that are different than normal operating orientations.

4.1.3 If the exhaust system as delivered is not complete, the back-pressure at the declared engine speed shall be within ±0.75 kPa of the maximum back-pressure specified by the manufacturer at which the declared power can be achieved.

If the exhaust system as delivered is complete, the laboratory exhaust system shall maintain the exhaust pressure at the unit outlet within ±0.75 kPa of the barometric pressure at the test bed.

NOTE: The maximum permissible back-pressure declaration is required by ISO 3046-1.

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4.1.4 If the engine air inlet is connected to a laboratory air system, the system shall supply air to the engine within ±0.75 kPa of the barometric pressure at the test bed.

4.1.5 For liquid-cooled engines, the temperature of the coolant at the raw-water inlet shall be maintained at 298 K ± 15 K (25 °C ± 15 °C), except that for engines with charge air cooler the temperature shall be maintained at 298 K ± 5 K (25 °C ± 5 °C).

The coolant pressure shall not exceed 50 kPa. The coolant outlet temperature shall be within the range specified by the manufacturer if such a range is specified.

4.1.6 Fuel temperature at the inlet of the compression-ignition engine fuel-injection pump shall be maintained at 313 K ± 3 K (40 °C ± 3 °C).

NOTE: These requirements are not applicable for compression-ignition engines running on intermediate or heavy fuels.

4.2 Fuels and Lubricants

4.2.1 Fuels used shall conform to the manufacturer's specifications.

4.2.2 For spark-ignition engines, record the test fuel and the octane number determined in accordance with ISO 5163 (motor method) and ISO 5164 (research method) and density determined in accordance with ISO 3675.

4.2.3 For compression-ignition (diesel) engines, record the cetane number determined in accordance with ISO 5165, the density determined in accordance with ISO 3675 or API gravity, and lower calorific value. Use ISO-F-DMX (refer to ISO 8217) or equivalent fuel if compatible with the engine.

4.2.4 Lubricating oil used shall conform to the manufacturer's recommendations. Record lubricating oil type, grade, and, if applicable, viscosity of the lubricant.

5. INTERNAL COMBUSTION ENGINE TEST CONDITIONS

5.1 Test conditions should be maintained as near to standard reference conditions as possible (see 3.5) in order to minimize the magnitude of the correction factor. Adjustments shall be made before the test in accordance with the manufacturer's instructions. No changes or adjustments shall be made during the test, except as indicated in the test procedure.

5.2 Generator and Hydraulic Systems

The generator or alternator, hydraulic systems, and similar systems intended for intermittent load only shall be operated under no-load conditions.

5.3 Engine Stabilization

No data shall be taken until the engine has reached stable operating conditions maintained for at least 2 minutes within the permissible deviations prescribed in ISO 3046-3 clause 4.2.

5.4 Engine Speed

During a run or reading, the engine speed shall not deviate from the nominal speed by more than ±1% or ±10 r/min, whichever is greater.

5.5 Fluid Levels

All fluid levels shall be within the range specified by the manufacturer.

5.6 Wet Exhaust System

Wet exhaust systems shall be operated with the water flow necessary for normal installations.

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6. INTERNAL COMBUSTION ENGINE DATA ACQUISITION AND REPORTING

6.1 Accuracy

Test measurements and their degree of accuracy shall be as specified in ISO 3046-3.

6.2 Air Temperature

The temperature of the inlet air to the engine (ambient air) shall be measured so as to obtain a mass average temperature. The temperature shall be taken in the engine inlet airstream or within 150 mm of the air inlet to the air cleaner, silencer, or flame arrester.

On outboard engines, the cowl, if supplied, shall be regarded as a part of the air inlet system.

6.3 Temperature of Coolant

The temperature of the coolant medium shall be measured not further than 150 mm from the raw-water inlet. Water jacket temperatures in liquid-cooled engines and engine temperatures in air-cooled engines shall be measured at point(s) specified by the manufacturer.

6.4 Lubricating Oil Temperature

Lubricating oil temperatures shall be measured at point(s) specified by the manufacturer.

6.5 Readings

Observed dynamometer load, engine speed, ambient air pressure, wet and dry bulb readings, and fuel consumption data (if recorded) shall be taken simultaneously and shall be the average of at least two stabilized sustained values that do not vary more than the permissible deviations prescribed in ISO 3046-3 clause 4.2, except that engine speed shall not vary more than ±1% or ±10 r/min, whichever is greater.

A measuring interval of not less than 30 seconds shall be used when measuring engine speed and fuel consumption.

6.6 Recording of Results

Power test data given in 6.6.1 to 6.6.3 should be recorded.

6.6.1 The following data shall be recorded simultaneously within 1 minute:

a. Engine speed

b. Torque or beam load

c. Intake air temperature and pressure at the point located and specified in 6.2

d. Fuel temperature (for compression-ignition [diesel] engines only)

e. Ambient air temperature of the atmosphere

f. Barometric pressure at the test bed

g. Wet and dry bulb temperature

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6.6.2 The following data shall also be recorded:

a. Laboratory exhaust system pressure (see 4.1.3)

b. Lubricating oil temperature (see 6.4)

c. Coolant temperature at raw-water inlet and engine outlet (see 4.1.5 and 6.3)

d. Coolant supply pressure (see 4.1.5)

e. Fuel delivery per injection cycle (for compression-ignition [diesel] engines only and if the engine has no acceptance test)

f. Exhaust back-pressure (see 4.1.3)

g. Fuel and lubricants used (see 4.2)

6.6.3 The following optional data should be recorded where applicable or for safety of operation:

a. Lubricating oil pressure

b. Intake air temperature and pressure inside the air intake manifold

c. Exhaust gas temperature

d. Ignition or injection timing

e. Fuel supply pressure at supply-pump outlet

f. Fuel consumption per unit of time

7. PRESENTATION OF DATA

7.1 Declaration of Power and Speed

A single value of the declared power shall be accompanied by a statement of the declared engine speed.

Power and engine speed may alternatively be presented as a power curve. Declarations shall indicate whether the power is propeller shaft power (see 3.3) or crankshaft power (see 3.5).

7.2 Engine Speed Range and Declared Power

It is recommended to choose the full throttle engine speed range quoted in 3.4.1 so that the highest power within this range does not exceed the declared power by more than 6%. If the highest power exceeds declared power by more than 6%, both powers shall be stated.

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