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(R)

Selection Criteria for Internal Combustion Engines Used in Ground Support Equipment

FOREWORD

The purpose of this Draft Technical Report is to give the technical community the opportunity to review, comment on and use its context prior to approval by SAE. Comments on this draft are welcome and should be submitted in writing to Secretary, Technical Standards Board, SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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1. SCOPE:

This SAE Aerospace Recommended Practice (ARP) is intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances.

1.1 Purpose:

The purpose of this document is to establish a guideline for the selection of prime movers for use in aircraft ground support equipment. This document is recommended for use by those engaged in the design, selection, or purchase of ground support equipment.

1.2 Field of Application:

This document is applicable to both four-stroke and two-stroke spark ignition and compression ignition engines.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1995 Engine Power Test Code - Spark Ignited and Compression Ignition - Gross Power Rating

2.1.2 ISO Publications: Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 3046/1 Reciprocating internal combustion engines - Performance - Part 1: Standard reference conditions and declarations of power, fuel consumption and lubrication oil consumption

2.2 Terminology:

GROSS BRAKE POWER: The power of an engine when configured as a “basic” engine as defined in SAE J1995.

RATED GROSS POWER: Engine gross power as declared by the manufacturer at “rated speed”.

RATED SPEED: The speed determined by the manufacturer at which the engine power is rated.

BASIC ENGINE: A basic engine is an engine configured with only the built in equipment required for self-sustained operation. A basic engine does not include accessories that are necessary only to perform its intended service or that power auxiliary systems. Common “basic engine” accessory examples are listed in SAE J1995.

3. ENGINE PERFORMANCE RATING:

All reciprocating prime movers proposed for use shall have been rated according to SAE J1995. A performance curve of the type exemplified by Figure 1 shall be available from the engine manufacturer and include the following:

a. Power and torque rating for intermittent operation
b. Power and torque rating for continuous operation
c. Specific fuel consumption
d. Type of fuel used

4. OPERATING CONDITIONS:

The proper selection of an engine depends on analysis and recognition of the equipment load requirements, ambient conditions, accessories, and duty cycle.

4.1 Ambient Conditions:

Unless more severe conditions are known to be required, the following conditions can be assumed:

a. Ambient temperatures of up to 45 °C
b. Altitudes of up to 1500 m above sea level
c. Stationary operation

4.2 Duty Cycle Classification:

a. Intermittent duty cycle: The engine operates at varying loads and speeds.
b. Continuous duty cycle: The engine operates at a governed speed under relatively constant load.

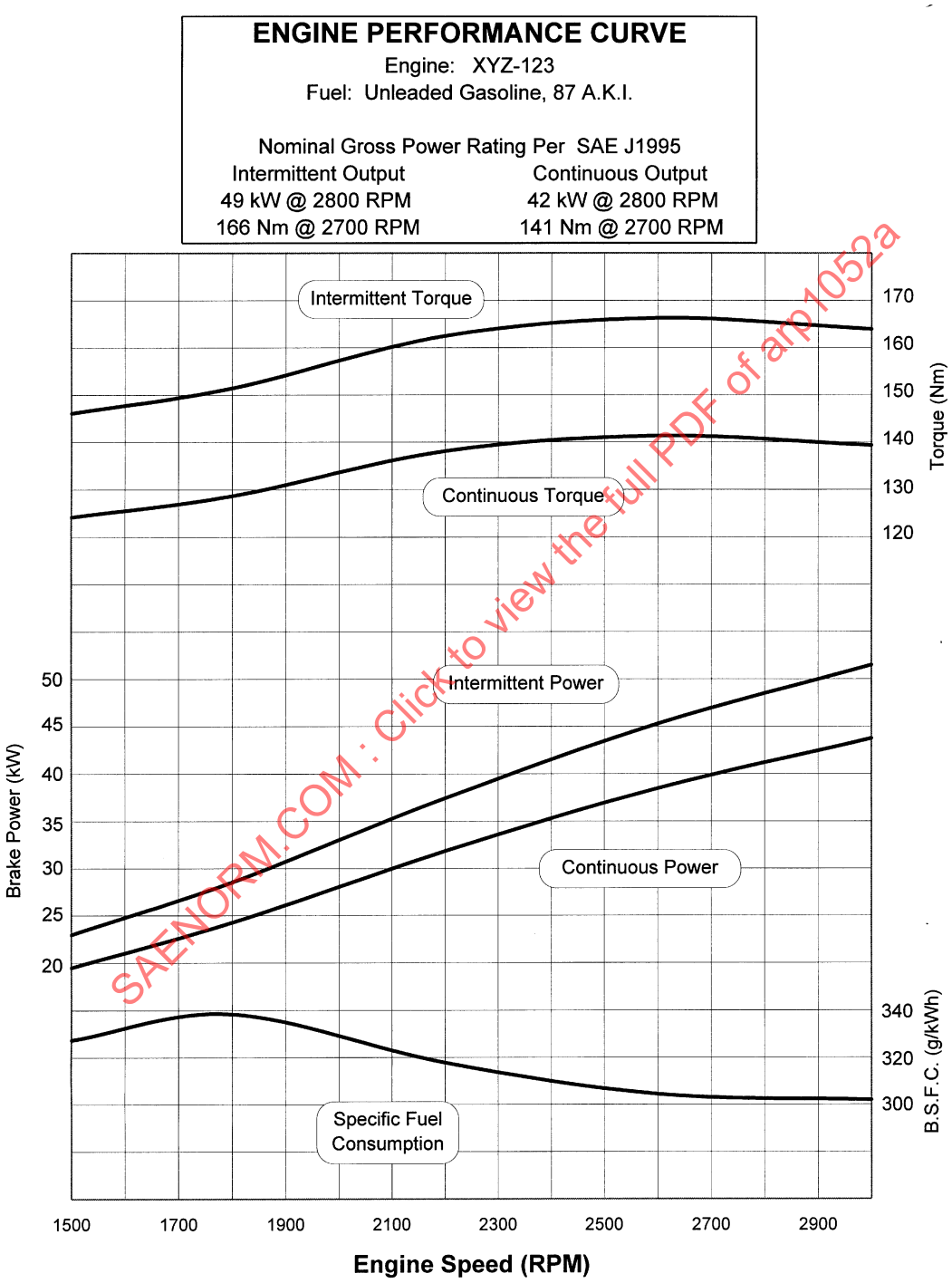

FIGURE 1 - Engine Performance Curve

5. POWER RATING REDUCTIONS:

The adjusted power rating of the engine is derived from the basic engine rating, and allowances for the following:

a. Manufacturing tolerances
b. Accessory requirements
c. Ambient conditions

5.1 Manufacturing Tolerances:

This allowance is made to account for variances in production that may accumulate in a way that reduces engine performance.

a. Value supplied by the manufacturer
b. If unknown, use 7.5%, or $f_{tol} = 0.925$

5.2 Accessory Requirements:

SAE J1995 is a gross power rating and does not account for the power required to operate items such as a cooling fan, alternator, mechanical governor, power steering pump, etc. See SAE J1995 for a detailed explanation of how engines are equipped for a gross power rating. The manufacturer of a specific accessory can provide information regarding power requirements of the item.

5.3 Ambient Conditions:

The power requirement of the engine must account for the most extreme ambient conditions that will prevail during operation. For conditions mentioned in 4.2, use 22%, or $f_{amb} = 0.78$. For conditions beyond the limits mentioned in 4.2, see below.

a. Deduct 1.5% per 5 °C for ambient temperatures above 25 °C. For turbocharged applications, deduct 3%.
b. Deduct 4% per 300 m for altitudes over 150 m above sea level.

NOTE: If the air inlet is located inside the engine compartment, it will be necessary to consider the temperature at the inlet for the reductions mentioned above. Also, f_{amb} is the sum of the separate deductions for temperature and altitude, i.e., a 5% temperature deduction and 4% altitude deduction add for 9% deduction, or $f_{amb} = 0.91$.