SAE INTERNATIONAL

SURFACE VEHICLE STANDARD

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Self-Propelled Sweepers and Scrubbers Fuel Consumption of Non-Propulsion Auxiliary Engines

RATIONALE

The document has been revised to update the referenced documents.

1. SCOPE

This SAE Standard applies to the fuel consumption of non-propulsion engines used to drive exclusively the sweeping and cleaning functions of multi-engine sweepers and scrubbers as defined in SAE J2130-1 and SAE J2130-2.

1.1 Purpose

The purpose of this document is to derive a uniform expression of fuel consumption from a simulated test cycle. The derived expression is based on various work situations encountered during a typical daily eight-hour period of operation. The derived fuel consumption may be used to assess the sizing of fuel tanks.

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 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J2130-1 Identification of Self-Propelled Sweepers and Cleaning Equipment Part 1 – Machines with a Gross Vehicle Mass Greater than 5000 kg

SAE J2130-2 Identification of Self-Propelled Sweepers and Cleaning Equipment Part 2 – Machines with a Gross Vehicle Mass up to 5000 kg

SAE J1702 Self-Propelled Sweepers Sweep-Ability Performance

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3. DEFINITIONS

3.1 AUXILIARY ENGINE

An engine used to power a secondary function of the vehicle, usually to power exclusively the sweeping and or scrubbing systems.

3.2 NORMAL DAY

A time-based operational period where the auxiliary engine operates under variable conditions of power and speed over an eight-hour period representing a normal day's operation.

3.3 SIMULATED TEST CYCLE

A reduced time based operational period of sufficient duration, during which fuel consumption test measurements shall be obtained in order to compute the fuel consumption for the normal day's operational period.

3.4 FUEL CONSUMPTION

The quantity of fuel consumed by an engine over a period of time under set duty cycle conditions.

3.5 FUEL

Fuel shall be of the liquid variety and of the quality recommended for the machine under test. Gaseous fuels are not considered within the scope of this standard.

3.6 FUEL CONSUMPTION MEASURING DEVICE

Accuracy requirement shall be ±3% of the measured value.

4. SYMBOLS

The symbols used in this standard are given in Table 1.

TABLE 1 - SYMBOL

Symbol	Definition	Unit
h	Time – hours	h
min	Time – minutes	min
kW	Power	kW
V	Volume of fuel consumed (normal day)	liter
V_1	Volume of fuel consumed (during test STC_a)	liter
V_2	Volume of fuel consumed (during test STC_b)	liter
V_3	Volume of fuel consumed (during test STC_c)	liter

5. NORMAL DAY AND TEST CYCLES

The normal day cycle is typically composed of periods of activity with differing modes of operation.

Running the engine at idle speed is permitted during the work periods, during the machine preparation and when performing clean-down tasks in the normal day cycle., There are other times when the engine is dormant, for example; during a pre-work inspection or prior to preparing for work.

In the operational periods when the engine is running, it may be running at preset speeds during which the engine load will vary according to power requirement. It could be difficult to mathematically compute the duty under these varying conditions. To assist with the calculation, the empirical analysis, given in Table 2 has been found to be typical of an average eight-hour operational period.

Table 3 presents a 30 minute simulated test cycle of the normal day that is used for tests in order to compute the uniform expression of fuel consumption.

Machines may be equipped with variable or fixed engine speed control devices.

TABLE 2 - NORMAL DAY (EIGHT HOUR) DUTY CYCLE

	Duty Cycle	Time
1	Machine preparation for work (engine dormant)	0.5 h
2	Transit periods (engine dormant)	1.5 h
3	Work period (engine - ‘idle’)	0.5 h
4	Work period (low power - sweeping/scrubbing)	2.0 h
5	Work period (high power - sweeping/scrubbing)	3.0 h
6	Clean-down (engine dormant)	0.5 h
	Total	8.0 h

TABLE 3 - SIMULATED TEST CYCLE (STC)

Test	Test Cycle Condition	Time
STC_a	Work period - (engine - ‘idle”)	10 min
STC_b	Work period - (low power - sweeping/scrubbing)	10 min
STC_c	Work period - (high power - sweeping/scrubbing)	10 min
	Total	30 min

6. TEST PROCEDURE

The engine shall be equipped for tests with a fuel measuring device. A graduated reservoir type, it should be of adequate volume to perform the test. Prior to tests, the machine shall be inspected to make sure that the engine is operational according to the manufacturer’s advertised requirements. Settings for the machine shall be according to the normal set-up declared in the instruction manuals.

The machine and engine shall be at normal operating temperature prior to tests. Tests shall also be conducted in weather conditions in the range 15 °C to 27 °C ambient.

The simulated test cycle is of 30 minutes duration and is comprised of three periods of operation of 10 minutes each. The first test period, STC_a, is with the engine running at normal idle speed. The second test period, STC_b, is at the recommended lowest speed or set condition for the sweeping/scrubbing operation, and the third test period, STC_c, is the highest engine speed or set condition.

The volume of fuel used (V_1, V_2 and V_3) in each test shall be measured in liters.

During the test STC_a, the sweeping/scrubbing functions shall be inert. In tests STC_b and STC_c, all sweeping/scrubbing functions shall be active and working in normal conditions except for optional equipment. If optional equipment is functional, then details shall be recorded in the fuel consumption declaration. Fuel consumption tests may be simultaneously conducted during the course of sweepability trials as described in SAE J1702 in order to substantiate normal sweeping conditions.

An estimation of engine power output may also be recorded during each of the three tests and recorded in the declaration.

7. CALCULATION

In order to formulate the predicted fuel consumption for the normal day duty cycle, Equation 1 shall be employed to calculate the value from the data collated in the simulated test cycle

Normal daily fuel consumption;

$$V = (V_1 \times 3) + (V_2 \times 12) + (V_3 \times 18) \quad \text{(Eq. 1)}$$

where

V_1 = Volume of fuel consumed during test STC_a
V_2 = Volume of fuel consumed during test STC_b
V_3 = Volume of fuel consumed during test STC_c

8. FUEL CONSUMPTION DECLARATION

The derived fuel consumption may be presented in the format shown in Figure 1.