The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

SAE J2542

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Submitted for recognition as an American National Standard

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

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.

1.1 **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 Publications—**The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J2130—Self-Propelled Sweepers
SAE J1702—Self-Propelled Sweepers Sweepability Performance

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.

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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—SYMBOLS

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.

During the normal day cycle, the engine may be running at idle speeds during the work periods and during the machine preparation and clean-down tasks. 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. As the duty under these varying conditions may be difficult to mathematically compute, the following 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;

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

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.

SAE J2542
SELF-PROPELLED SWEEPERS AND SCRUBBERS
FUEL CONSUMPTION

Machine Make: .....

Type: .....

Serial No: .....

Engine Type: .....

Fuel Type: .....

.....

Test Cycle Condition	Engine Speed (rpm)	Power (kW)	Consumption (Liter/h)
Engine - idle			
Engine - low power			
Engine - high power			

Variation to Duty Cycle .....

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Remarks: .....

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Normal Daily Fuel Consumption: ..... Liter / 8 hour shift

Certifying Engineer: .....

Date: ..... Certification Reference: .....

FIGURE 1—SELF-PROPELLED SWEEPERS AND SCRUBBERS FUEL CONSUMPTION FORMAT

PREPARED BY THE SAE MACHINERY TECHNICAL COMMITTEE MTC SC2—
SWEEPER, CLEANER, AND MACHINERY