TABLE I—MECHANICAL EFFICIENCY OF SPARK IGNITION ENGINES, % (CONTINUED)

	daN/cm²																			
	6.9	7.0	7.2	7.3	7.4	7.6	7.7	7.9	8.0	8.1	8.3	8.4	8.5	8.7	8.8	9.0	9.1	9.2	9.4	9.5	9.6
	psi																				
rpm	100	102	104	106	108	110	112	114	116	118	120	122	124	126	128	130	132	134	136	138	140
800	88.4	88.7	89.0	89.3	89.5	89.8	90.0	90.2	90.5	90.7	90.9	91.1	91.3	91.5	91.7	91.9	92.1	92.2	92.4	92.6	92.7
1000	87.9	88.2	88.5	88.8	89.0	89.3	89.5	89.8	90.0	90.2	90.5	90.7	90.9	91.1	91.3	91.5	91.6	91.8	92.0	92.2	92.3
1200	87.4	87.7	88.0	88.3	88.5	88.8	89.1	89.3	89.5	89.8	90.0	90.2	90.4	90.6	90.8	91.0	91.2	91.4	91.6	91.7	91.9
1400	86.9	87.2	87.5	87.8	88.0	88.3	88.6	88.8	89.0	89.3	89.5	89.7	89.9	90.1	90.4	90.5	90.7	90.9	91.1	91.3	91.5
1600	86.3	86.6	86.9	87.2	87.5	87.8	88.0	88.3	88.5	88.8	89.0	89.2	89.4	89.7	89.9	90.1	90.3	90.5	90.6	90.8	91.0
1800	85.8	86.1	86.4	86.7	86.9	87.2	87.5	87.7	88.0	88.2	88.5	88.7	88.9	89.1	89.3	89.6	89.8	89.9	90.1	90.3	90.5
2000	85.2	85.5	85.8	86.1	86.4	86.6	86.9	87.2	87.4	87.7	87.9	88.1	88.4	88.6	88.8	89.0	89.2	89.4	89.6	89.8	90.0
2200	84.5	84.9	85.2	85.5	85.8	86.0	86.3	86.6	86.8	87.1	87.3	87.6	87.8	88.0	88.3	88.5	88.7	88.9	89.1	89.3	89.5
2400	83.9	84.2	84.5	84.8	85.1	85.4	85.7	86.0	86.3	86.5	86.8	87.0	87.2	87.5	87.7	87.9	88.1	88.3	88.5	88.7	88.9
2600	83.2	83.6	83.9	84.2	84.5	84.8	85.1	85.4	85.6	85.9	86.2	86.4	86.6	86.9	87.1	87.3	87.5	87.8	88.0	88.2	88.4
2800	82.6	82.9	83.2	83.6	83.9	84.2	84.5	84.7	85.0	85.3	85.5	85.8	86.0	86.3	86.5	86.7	86.9	87.2	87.4	87.6	87.8
3000	81.9	82.2	82.6	82.9	83.2	83.5	83.8	84.1	84.4	84.6	84.9	85.2	85.4	85.6	85.9	86.1	86.3	86.6	86.8	87.0	87.2
3200	81.2	81.5	81.9	82.2	82.5	82.8	83.1	83.4	83.7	84.0	84.2	84.5	84.8	85.0	85.2	85.5	85.7	85.9	86.2	86.4	86.6
3400	80.5	80.8	81.2	81.5	81.8	82.1	82.5	82.7	83.0	83.3	83.6	83.8	84.1	84.4	84.6	84.8	85.1	85.3	85.5	85.7	85.9
3600	79.8	80.1	80.5	80.8	81.1	81.5	81.8	82.1	82.3	82.6	82.9	83.2	83.4	83.7	83.9	84.2	84.4	84.6	84.9	85.1	85.3
3800	79.0	79.4	79.8	80.1	80.4	80.7	81.1	81.4	81.7	81.9	82.2	82.5	82.8	83.0	83.3	83.5	83.7	84.0	84.2	84.4	84.7
4000	78.3	78.7	79.0	79.4	79.7	80.0	80.3	80.6	80.9	81.2	81.5	81.8	82.1	82.3	82.6	82.8	83.1	83.3	83.5	83.8	84.0
4200	77.5	77.9	78.3	78.6	79.0	79.3	79.6	79.9	80.2	80.5	80.8	81.1	81.4	81.6	81.9	82.1	82.4	82.6	82.9	83.1	83.3
4400	76.8	77.2	77.5	77.9	78.2	78.6	78.9	79.2	79.5	79.8	80.1	80.4	80.6	80.9	81.2	81.4	81.7	81.9	82.2	82.4	82.6
4600	76.0	76.4	76.8	77.1	77.5	77.8	78.1	78.5	78.8	79.1	79.4	79.6	79.9	80.2	80.5	80.7	81.0	81.2	81.5	81.7	81.9
4800	75.3	75.6	76.0	76.4	76.7	77.1	77.4	77.7	78.0	78.3	78.6	78.9	79.2	79.5	79.7	80.0	80.3	80.5	80.8	81.0	81.2
5000	74.5	74.9	75.2	75.6	76.0	76.3	76.6	77.0	77.3	77.6	77.8	78.2	78.5	78.7	79.0	79.3	79.5	79.8	80.0	80.3	80.5
5200	73.7	74.1	74.5	74.8	75.2	75.5	75.9	76.2	76.5	76.8	77.1	77.4	77.7	78.0	78.3	78.5	78.8	79.1	79.3	79.6	79.8
5400	72.9	73.3	73.7	74.1	74.4	74.8	75.1	75.4	75.8	76.1	76.4	76.7	77.0	77.3	77.5	77.8	78.1	78.3	78.6	78.8	79.1
5600	72.1	72.5	72.9	73.3	73.6	74.0	74.3	74.7	75.0	75.3	75.6	75.9	76.2	76.5	76.8	77.1	77.3	77.6	77.8	78.1	78.3
5800	71.3	71.7	72.1	72.5	72.9	73.2	73.6	73.9	74.2	74.5	74.9	75.2	75.5	75.7	76.0	76.3	76.6	76.8	77.1	77.4	77.6
6000	70.5	70.9	71.3	71.7	72.1	72.4	72.8	73.1	73.5	73.8	74.1	74.4	74.7	75.0	75.3	75.6	75.8	76.1	76.4	76.6	76.9

ENGINE RATING CODE DIESEL—SAE J270

SAE Standard

Report of Engine Committee approved September 1971.

Purpose—The purpose of this code is to provide a standard for documenting the rated performance of an engine and a standard procedure for determining this performance in an engine dynamometer laboratory.

Scope—This code specifies the conditions of testing and engine configuration which must be satisfied in order to qualify for the designation "SAE net" horsepower or "SAE gross" horsepower or in any way to indicate power capability conforming to SAE standards or requirements. It is applicable to all 4-stroke cycle and 2-stroke cycle diesel engines, naturally aspirated, mechanically supercharged turbocharged. This code is not intended as a complete laboratory test manual or for the derating of engines for altitude.

This code is composed of the following sections:

1. Definitions of Terminology
2. Test Equipment Requirements
3. Test Procedures
4. Computation
5. Presentation of Results

1. *Definitions of Terminology*

1.1 Power Output—Engine power output shall be expressed in units of "horsepower," equivalent to 550 ft-lb/s or "kilowatts" equivalent to 1000 J/s.[1]

1.1.1 *Observed power* is the power actually developed by an engine under the atmospheric conditions existing during the test.

1.1.2 *Corrected power* is the observed power adjusted to standard atmospheric conditions, using the correction methods specified in paragraph 4.

1.2 Gross and Net Power

1.2.1 *Gross power* is the brake power output of a "basic" engine as defined in paragraph 1.6. (See note in paragraph 3.6.1.1, regarding air-cooled engines.)

1.2.2 *Net power* is the brake power output of a "fully equipped" engine as defined in pa agraph 1.6.

1.3 Brake Power—Brake power is the power available at the flywheel or other output member(s) for doing useful work.

1.3.1 *Maximum brake power* is the highest power developed at a given speed.

1.3.2 *Peak brake power* is the highest power developed within the engine speed range.

1.3.3 *Rated speed* is a speed specified by the manufacturer and is usually either the speed at which peak power occurs or the maximum speed of the engine, whichever is lower.

1.3.4 *Intermittent brake power* is the highest power recommended by the manufacturer for satisfactory operation within the manufacturer's specified conditions of load, speed, and duty cycle. (See paragraph 5.)

1.3.5 *Continuous brake power* is the power recommended by the manufacturer for satisfactory operation under the manufacturer's specified continuous duty conditions. (See paragraph 5.)

1.3.6 *Rated brake power* is the power specified by the manufacturer for a given application at a given (rated) speed. (See paragraph 5.)

1.4 Friction Power—Friction power is the power required to drive the engine as equipped during the power test. Friction power may be approximated by one of the following methods with sufficient accuracy for the purpose of this code.

(a) Hot motoring method (preferred method, see paragraph 3.6.1.2).

(b) Calculated friction using mechanical efficiency equations or table. (See paragraph 4.5.1.2.)

1.5 Indicated Power—Indicated power is the power developed in the cylinders. For the purpose of this code, it is defined as the sum of the brake power and the friction power.

1.6 Engine

1.6.1 *Basic engine* is an engine equipped only with the built-in accessories essential to its operation: intake air system, fuel pump, oil pump, coolant pump for liquid cooled engines, and built-in emission control equipment.

1.6.2 *Fully equipped engine* is an engine equipped with all the ac-

[1]Any specified condition or action preceded by "shall be" is a requirement of this code; i preceded by "should be," it is recommended but not required.

cessories necessary to perform its intended functions unaided. This includes (but is not restricted to) the basic engine of paragraph 1.6.1 plus exhaust system, cooling system, generator, or alternator, starter, and emission control equipment.

2. *Test Equipment Requirements*—The required limits of accuracy concern the instrument precision specified by the manufacturer of the instruments used and do not include human or other probable errors incurred in the reading.

2.1 Torque

2.1.1 Dynamometer and scale capacity shall be compatible with engine size. Dynamometer shall be capable of maintaining load and speed conditions as defined in paragraph 3.

2.1.2 Dynamometer coupling drive between engine and dynamometer shall be suitable for operation through the test engine speed range with minimum power loss or out-of-balance.

2.1.3 Dynamometer Balance, Calibration, and Sensitivity

2.1.3.1 Scales shall be checked for zero scale reading with the dynamometer frame in the neutral position.

2.1.3.2 Calibration of the dynamometer with the engine running at steady-state (beam) load, for example 100 lb or 50 daN, may be checked by the addition of a 100 lb or 50 daN weight to the opposite side which should bring the scale back to zero. This shall be done for several different loads within the range of expected operation and shall be repeated under static conditions. The result thus obtained shall be accurate within ±½% of the observed full load reading.

2.1.3.3 Sensitivity of the dynamometer and scales shall be checked by adding small increments of weight until the pointer moves a readable amount. The magnitude of this weight, which is the sensitivity, shall not exceed ¼% of the observed full load reading. Several points shall be checked within the operating range.

2.2 Speed

2.2.1 Revolution counter shall be accurate within ±¼% of the observed reading or ±10 revolutions, whichever may be less.

2.2.2 Tachometer shall be accurate within ±½% of the observed reading, if used for computations.

2.3 Time—The time measuring instruments shall be accurate within ±¼% of the observed reading.

2.4 Fuel System

2.4.1 The engine fuel system used in the test shall be in accordance with the manufacturer's specifications.

2.4.2 Fuel consumption measurement (mass or volume) instrumentation shall be accurate within ±1% of the observed reading.

2.5 Temperatures

2.5.1 Temperatures shall be measured in degrees Fahrenheit when using English units or degrees Celsius when using SI units.

2.5.2 Accuracy of instrumentation for measuring temperatures of 400 F (204 C) or less should be ±2 F (±1 C) and, at temperatures above 400 F (204 C) should be ±10 F (±5.5 C).

2.5.3 The necessary temperature measurements and corresponding locations are as follows:

2.5.3.1 Temperature of the inlet air to the engine (ambient air) shall be measured in a manner to get a mass average temperature. The temperature shall be taken in the engine inlet air stream or within 6 in (152 mm) of the air inlet horn or air cleaner. Care should be taken to shield the thermometer or thermocouple from radiant heat sources and sufficient number of locations shall be checked to assure a representative average inlet temperature.

2.5.3.2 *Coolant Temperatures*—Temperatures in liquid-cooled engines shall be measured at the inlet and outlet of the engine. Temperatures in air-cooled engines should be measured at point(s) specified by the manufacturer.

2.5.3.3 Oil temperatures shall be measured in the oil gallery.

2.5.3.4 Fuel supply temperature should be measured at the outlet of the primary filter.

2.6 Pressures

2.6.1 Pressures shall be measured in pounds per square inch (daN/cm²), inches (mm) of mercury, or inches (mm) of water either above or below atmospheric pressure.

2.6.2 The necessary pressure measurements, the required instrument accuracies, and corresponding locations are as follows:

2.6.2.1 Air cleaner and piping restriction ±0.1 in (±2.5 mm) water.

2.6.2.2 Exhaust pressure measured within 6 in (152 mm) downstream of the outlet of the engine exhaust system specified for the test, ±0.1 in Hg or ±2.5 mm Hg. (See paragraphs 3.6.1.1 and 3.6.2.1.)

2.7 Atmospheric Conditions

2.7.1 All measurements shall be made in a location representative of the engine's test environment.

2.7.2 Barometric pressure: aneroid or mercury barometer corrected for temperature (accuracy ±0.02 in Hg or ±0.51 mm Hg).

2.7.3 Wet and dry bulb temperatures shall be measured with a sling-psychrometer or equivalent. The thermometers used shall be accurate within ±0.5 F or ±0.28 C.

3. *Test Procedures*—This section contains the required test procedures for determining the following engine performance characteristics: gross power, net power.

3.1 Description of Tests

3.1.1 Gross brake power test consists of a run at full throttle to determine power output versus speed of the basic engine as defined in paragraph 1.6.

3.1.2 Net brake power test consists of a run at full throttle to determine power output versus speed of the fully equipped engine as defined in paragraph 1.6.

3.2 Engine Installation and Adjustments—The test engine shall be a representative unit within the manufacturer's specifications. All auxiliary equipment used on the test engine, such as fan, air cleaner, exhaust system, and pumps, shall be listed and described.

If the engine exhaust is connected to a laboratory exhaust system, that system shall not cause a vacuum of more than 3 in (76 mm) of water or a back pressure exceeding the value specified by the manufacturer. If the engine air inlet is connected to a laboratory air system, the system should neither supply air to the engine above atmospheric pressure nor at a vacuum exceeding that specified by the manufacturer.

The generator or alternator shall not be charging.

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.

3.3 Run-In—The engine shall be run-in according to the manufacturer's recommendations. If no such recommendation is available, the engine shall be run-in until power is repeatable within 1% over a 4 h period.

3.4 Fuels and Lubricants

3.4.1 Fuel used shall conform to the manufacturer's specifications:

Record ASTM or other fuel specification and Cetane number, API gravity, kinematic viscosity in centistokes (m^2/s) at 100 F (37.8 C) and distillation in F (C) at 10%, 50%, 90% and end point.[2]

3.4.2 Lubricating oil used shall conform with the manufacturer's recommendations. Record oil performance level and SAE viscosity number of the lubricant.

3.5 Test Conditions—Performance data shall be obtained under stabilized normal operating conditions, with an adequate fresh air supply to the engine. Test conditions, such as inlet air temperature, should be selected as near to standard as possible (paragraph 4.3) in order to minimize the magnitude of the correction factor.

3.5.1 No data shall be taken until torque, speed, and temperatures have been maintained within 1% for at least 2 min.

3.5.2 Engine speed should be held as nearly constant as possible during a run or reading and shall not deviate from the nominal speed by more than ±1% or ±10 rpm, whichever is greater.

3.5.3 Observed brake load and fuel consumption data shall be taken simultaneously and shall be the average of two stabilized sustained values which do not vary more than 1%. A measuring interval of not less than 30 s shall be used when measuring speed and fuel consumption with an automatically sychronized counter timer combination; for hand operation, the time interval shall be not less than 120 s.

3.5.4 Coolant outlet temperature in liquid-cooled engines shall be controlled at 190 ±10 F (88 ±5.5 C) unless otherwise specified by the manufacturer.

3.5.5 Fuel temperature at the inlet of the fuel pump shall be controlled to 100 ±10 F (37.8 ±5.5 C).

3.6 Procedures

3.6.1 Gross Power Test

3.6.1.1 *Engine Equipment and Settings*—A "basic engine" is used for this test (see paragraph 1.6).

Air Cleaner—on or use system with equivalent restriction

Radiator—off
Fan—off
} Liquid-cooled

Fan or blower on, with air control mechanism operating normally—Air-cooled

Oil pan—Standard production

[2] Kinematic viscosity at standard temperatures other than 37.8 C, such as 20 or 50 C, may be used.

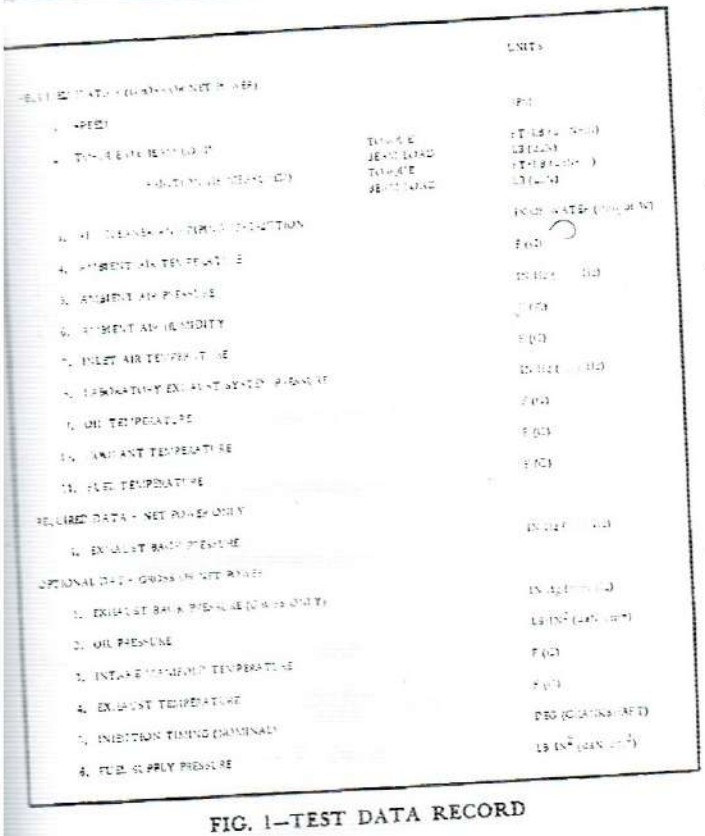


FIG. 1—TEST DATA RECORD

Muffler, exhaust pipe and tail pipe—off
Exhaust manifold—Standard production
Injection timing—normal
Fuel pump setting—normal
Emission controls integral with engine—normal

3.6.1.2 *Procedure*—Record data for at least five (approximately evenly spaced) operating speeds to define completely the power curve between 600 rpm (or the lowest stable speed) and the maximum engine speed recommended by the manufacturer, or 200 rpm past peak power.

Motoring friction shall be taken with coolant inlet and oil gallery temperatures within 5 F (3 C) of those observed during the power test.

3.6.1.3 *Data to be Recorded for Test Documentation and Computation Purposes* (see Fig. 1)

Speed
Torque or beam load (power, friction if measured)
Air cleaner and piping restriction
Fuel consumption
Ambient air temperature, pressure, humidity
Intake air temperature
Laboratory exhaust system pressure (see paragraph 2.6.2.2)
Oil, coolant, and fuel temperature

The following data should also be recorded where applicable and for safety of operation:

Oil pressure
Intake manifold temperature
Exhaust temperature
Exhaust back pressure
Injection timing (nominal)
Fuel supply pressure

3.6.2 NET POWER TEST

3.6.2.1 *Engine Equipment and Settings*—A "fully equipped engine" is used for this test (see paragraph 1.6.2).

Air cleaner—on or use system with equivalent restriction
Radiator—on[3] Liquid-cooled
Fan—on or accounted for
Fan or blower on, air control mechanism operating normally—Air-cooled
Generator (alternator)—driven but not charging
Muffler, exhaust pipe, and tail pipe—on or system providing equivalent restriction
Injection timing—normal
Emission control equipment—normal

3.6.2.2 *Procedure*—Same as Gross Power Test (paragraph 3.6.1.2).

3.6.2.3 *Data to be Recorded for Test Documentation* (see Fig. 1)—Same as Gross Power Test except exhaust back pressure is required data.

4. Computations and Results

4.1 Definition of Symbols

Symbol	Definition	Units English	Units SI
A	Correction for absolute temperature	460 F	273 C
B	Barometric pressure	in Hg	mm Hg
C	Correction factor		
D	Engine displacement	in^3	cm^3
E	Correction for units of work	396,000	600,000
F	Fuel consumption	lb/h	g/h
G	Power constant	5252	955
K	Dynamometer constant	G/R	G/R
L	Dynamometer scale reading	lb	daN
M	Time of fuel measurement	min	min
N	Engine speed	rpm	rpm
R	Dynamometer torque arm	ft	m
T	Torque	lb-ft	daN m
V	Volume of fuel measured (see footnote 3)	cm^3	cm^3
W	Mass of fuel	lb	g
a	Engine revolutions per cycle		
d	Air density	lb/ft^3	kg/m^3
e	Water vapor pressure in atmosphere	in Hg	mm Hg
n	Mechanical efficiency	%	%
t	Ambient temperature	F	C
z	Coefficient in mechanical efficiency equation		
(sp. gr.)	Specific gravity of fuel at tank or burette temperature		
bp	Brake power	hp	kW
fp	Friction power	hp	kW
ip	Indicated power	hp	kW
fan p	Fan power	hp	kW
bmep	Brake mean effective pressure	lb/in^2	daN/cm^2
imep	Indicated mean effective pressure	lb/in^2	daN/cm^2
Subscripts			
c	Corrected to standard conditions		
d	Dry air condition		
m	Moist air condition		
r	Manufacturer's rated value		
t	Observed at test conditions		
Superscript *	To denote standard ambient conditions		

4.2 Useful Equivalents

1 kg = 2.2046 lb mass

1 daN = 2.248 lb force

$$1 \frac{daN}{cm^2} = 14.504 \text{ lb/in}^2$$

1 hp = 33,000 ft lb/min

1 kW = 6,000 daNm/min

1 kW = 1.341 hp

4.3 Standard Ambient Conditions

Barometric pressure	B^*	29.38 in Hg, 746.2 mm Hg
Temperature	t^*	85 F, 29.4 C
Water vapor pressure	e^*	0.38 in Hg, 9.6 mm Hg
Dry barometric pressure	B_d^*	29.00 in Hg, 736.6 mm Hg
Dry air density	d_d^*	0.0705 lb/ft^3, 1.124 kg/m^3

4.4 Computations from Test Data

4.4.1 OBSERVED POWER

$$\text{Brake power, } bp_t = \frac{(N \cdot L)}{K}$$

$$\text{Brake torque, } T_t = (L \cdot R)$$

$$\text{Brake mean effective pressure, } bmep_t = \frac{E \cdot L \cdot R \cdot a}{G \cdot D} = \frac{E \cdot a}{D \cdot N} bp_t$$

$$\text{Friction power, } fp_t = \frac{(N \cdot L)}{K}$$

[3]When the radiator is not an integral part of the engine assembly, an equivalent heat exchanger may be used.

[4]Use of SI units for this SAE Standard is consistent with general practice when measuring fuel volume.

$$fp_t = bp_t \left(\frac{100}{n} - 1\right)$$

$$\text{Indicated power, } \widehat{ip_t} = bp_t + fp_t$$

$$ip_t = bp_t \left(\frac{100}{n}\right)$$

4.4.2 MECHANICAL EFFICIENCY (Friction Power)—Engine friction for purposes of this code may be established by the methods noted in paragraph 1.4 with the hot motoring method preferred. If friction must be approximated by calculation, the method is covered in paragraph 4.5.1.2.

4.4.3 FUEL CONSUMPTION

$$\text{Fuel consumption, } F_t = W_t \cdot \frac{60}{M}$$

$$\text{Brake specific fuel consumption, } bsfc_t = \frac{W_t \cdot 60}{bp_t \cdot M} = \frac{F_t}{bp_t}$$

$$\text{Indicated specific fuel consumption, } isfc_t = \frac{F_t}{bp_t + fp_t} = \frac{F_t}{bp_t \cdot \left(\frac{100}{n}\right)}$$

Fuel mass from volumetric method:

$$W_t = V \cdot \frac{(\text{sp. gr.})}{453.6} \quad \text{(English units)}[4]$$

$$W_t = V \cdot (\text{sp. gr.}) \quad \text{(SI units)}$$

4.4.4 BAROMETRIC PRESSURE

$$\text{Dry barometric pressure, } B_d = B - e$$

4.5 Corrected Power

4.5.1 CORRECTION FACTOR—The performance of diesel engines is affected by barometric pressure, temperature, and humidity of the ambient atmosphere. Therefore, in order to provide a common basis of comparison, it is necessary to apply a correction factor to convert the observed data to specified standard atmospheric conditions.

The method of correction prescribed is based upon the assumption that at constant air-fuel ratio, indicated thermal efficiency remains unaffected by changes in atmospheric pressure, temperature, and humidity, or that the effect is negligible. This assumption is valid only if the range of ambient conditions to be covered is sufficiently small, so that engine combustion characteristics are not affected. This range cannot be accurately defined since it is a function of individual engine design. For this reason, it is recommended that only test data obtained within the range of dry barometric pressure between 28 and 30 in Hg (711 and 762 mm Hg) and inlet air temperature between 60 and 110 F (15.5 and 43.3 C) be used for correction by this standard. If test data obtained outside this range are used as a basis for correction, the atmospheric conditions under which the test was performed shall be shown with the corrected results.

4.5.1.1 *Correction Factor*

$$C_D = \frac{B_d^*}{B_{dt}} \cdot \left(\frac{t_t + A}{t^* + A}\right)^{0.7}$$

4.5.1.2 *Friction*—If the preferred hot motored friction is not used, Table 1 may be used to approximate diesel engine friction for the use in this code. If it is not used, the following equations shall be used to calculate mechanical efficiency and friction power.

When $bmep_t$ is in lb/in²:

$$n = \frac{100}{1 + \frac{z}{bmep_t}}$$

When $bmep_t$ is in DaN/cm²

$$n = \frac{100}{1 + \frac{0.0689z}{bmep_t}}$$

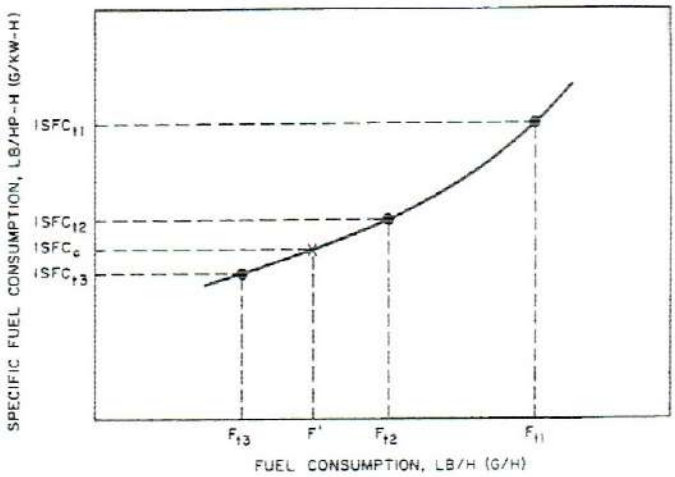


FIG. 2—METHOD OF ESTABLISHING FUEL CONSUMPTION FOR POWER CORRECTION FOR DIESEL ENGINES

In both equations:

$$z = 20.1893 - 3.75948\left(\frac{N}{1000}\right) + 3.33129\left(\frac{N}{1000}\right)^2$$

4.5.1.3 *Correction Calculation*—Since the diesel engine operates at a set fuel rate, the correction factor defined in paragraph 4.5.1.1 shall be applied in conjunction with the following procedure.

At test atmospheric conditions, engine power and fuel rate shall be measured and recorded at three fuel rate settings at the same engine speed. One test point should be at the desired fuel setting. When the test air density is less than standard density, the other two points should be at approximately 5 and 10% lower fuel rates. When the test air density is greater than standard density, the other two points should be at approximately 5 and 10% higher fuel rates for best accuracy. When practical considerations, such as limited pump delivery, prevent use of the higher rates, points at lower fuel rates may be used but some accuracy will be lost due to extrapolation rather than interpolation of data. Engine friction shall be recorded as friction power at the rated fuel setting for naturally aspirated engines and as mechanical efficiency at each fuel setting for turbocharged engines. Calculate isfc, at each test point (see paragraph 4.4.3) and plot versus fuel rate as shown in Fig. 2.

Find corrected indicated specific fuel consumption ($isfc_e$) on Fig. 2 at F'.

$$F' = \frac{F_t}{C_D}$$

Calculate corrected bp for naturally aspirated and mechanically supercharged engines by

$$bp_e = \frac{F_t}{isfc_e} - fp_t$$

or for turbocharged engines by

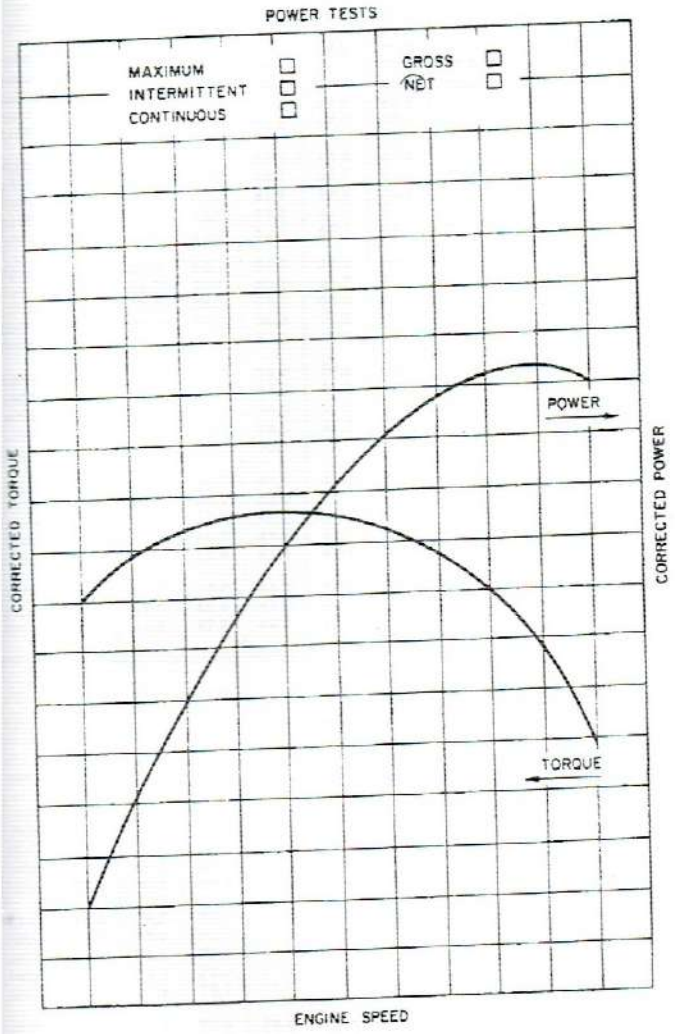
$$bp_e = \frac{F_t}{isfc_e} \cdot \left(\frac{n}{100}\right)$$

where mechanical efficiency (n) may be obtained from hot motored test data or the formula in paragraph 4.5.1.2. Abbreviated correction procedures based upon this method will be considered acceptable if they result in corrected values identical to those obtained by this three-point procedure.

$$\text{Corrected brake torque, } T = \frac{C}{N} \cdot bp_e$$

$$\text{Corrected brake mean effective pressure, } bmep_e = \frac{E \cdot a}{D \cdot N} \cdot bp_e$$

ENGINE RATING CODE—DIESEL ENGINE



DATE OF TEST:

ENGINE:
MANUFACTURER
MODEL SERIAL
NO. OF CYL BORE STROKE
DISPLACEMENT
NOMINAL COMPRESSION RATIO

INJECTION SYSTEM:
FUEL INJECTION PUMP: MFR
MODEL
BASIC TIMING
AUTOMATIC TIMING RANGE
FUEL INJECTORS: MFR

LUBRICATION SYSTEM:
CAPACITY
LUBRICANT
PERFORMANCE LEVEL
SAE VISCOSITY

DATE OF TEST:

ENGINE:
MANUFACTURER
MODEL SERIAL
NO. OF CYL ___ BORE ___ STROKE ___
DISPLACEMENT ___
NOMINAL COMPRESSION RATIO ___

PRODUCTION SYSTEM:
AIR CLEANER: MFR ___ MODEL ___
TURBOCHARGER: MFR ___ MODEL ___
INTERCOOLERS: MFR ___ MODEL ___

EXHAUST SYSTEM:
TYPE: DUAL ___ SINGLE ___
MUFFLER: MFR ___ MODEL ___
TAIL PIPE: MFR ___ MODEL ___

INJECTION SYSTEM:
FUEL INJECTION PUMP: MFR ___
MODEL ___
BASIC TIMING ___
AUTOMATIC TIMING RANGE ___
FUEL INJECTORS: MFR ___
MODEL ___

FUEL:
CETANE NO. ___
API GRAVITY ___
SPECIFICATION ___

LUBRICATION SYSTEM:
CAPACITY ___
LUBRICANT ___
PERFORMANCE LEVEL ___
SAE VISCOSITY ___

COOLING SYSTEM:
FAN: MFR ___ MODEL ___
RADIATOR: MFR ___ MODEL ___

GENERATOR: MFR ___ MODEL ___
OR ALTERNATOR

GOVERNOR: MFR ___ MODEL ___

OTHER ACCESSORIES:

FIG. 8—TYPICAL ENGINE PERFORMANCE CURVES AND DATA REQUIRED

Fuel Consumption—Fuel Consumption at standard conditions is by definition, the same as at test conditions:

$$F_c = F_t$$

$$\text{Brake specific fuel consumption, } bsfc_c = \frac{F_c}{bp_c}$$

5. Presentation of Results—The following computed values shall be presented graphically. If the curves represent "intermittent" or "continuous" brake power, it should be so indicated.

If the curves are indicated to be "intermittent" brake power, the proposed cycle should be identified, possibly in terms of minutes per hour allowable at the intermittent rating. Suggested curves to be plotted and the data required are shown in Fig. 1 and 8. The suggested curves and data shall be presented together.

Data shall be corrected per paragraph 4.5.1. Reported corrected curves shall carry the notation: "Performance obtained and corrected in accordance with SAE J270.

5.1 Graphic Data (Gross or Net Power)—Corrected brake power and corrected brake torque versus engine speed.