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ภาคผนวก

## ภาคผนวก ก

มาตรฐาน ISO 3046 ที่เกี่ยวข้องกับการทดสอบเครื่องยนต์

## มาตรฐาน ISO 3046 ที่เกี่ยวข้องกับการทดสอบเครื่องยนต์ [26]

### International Combustion Engines - Performance

Part 1 - Engines for land, rail-traction and marine use - Standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption

#### ก.1 Scope

This report of ISO 3046 specifies the standard reference conditions and the methods of declaring of power, fuel consumption and lubricating oil consumption for reciprocating internal combustion engines using liquid or gaseous for particular engine applications.

#### ก.2 Field of application

This part of ISO 3046 covers reciprocating internal combustion engines for land, rail-traction and marine use, excluding engines to propel agricultural tractors, road vehicles and aircraft.

This part of ISO 3046 may be applied to engines used to proper road construction and earth-moving machines, industrial trucks and for other applications where no suitable International Standard for these engines exist.

#### ก.3 References

ISO1000, SI units and recommendation for the use of their multiples and of certain other units.

ISO 1204, Reciprocating internal combustion engines - Designation of the direction of rotation.

ISO 1205, Reciprocating internal combustion engines - Designation of the direction of cylinders.

ISO 1585, Road vehicles - Engine test code - Net power.

ISO 2534, Road vehicles - Engine test code - Gross power.

ISO 2710, Reciprocating internal combustion engines - General definitions.

ISO 3046/2, Reciprocating internal combustion engines - Performance - Part 2 : Engine tests.

ISO 3046/4, Reciprocating internal combustion engines - Performance - Part 4 :  
Speed governing.

ISO 3046/6, Reciprocating internal combustion engines - Performance - Part 6 :  
Overspeed protection

#### n.4 Units and terms

n.4.1 The units used are those of the International System of Units (SI Unit) described in ISO 1000.

n.4.2 The general engine terms used are as defined in ISO 2710.

#### n.5 Standard reference conditions

For the purpose of determining the power and fuel consumption of engines, the following standard reference conditions shall be used :

Total barometric pressure :

$$P_r = 100 \text{ kPa}$$

Air temperature :

$$T_r = 300 \text{ K (27 } ^\circ\text{C)}$$

Relative humidity :

$$\phi_r = 60 \%$$

Charge air coolant temperature :

$$T_{cr} = 300 \text{ K (27 } ^\circ\text{C)}$$

If other reference conditions are chosen, these shall be stated.

#### NOTES

1. Relative humidity of 60% corresponds to a water vapor pressure of 2,133 kPa (16 mmHg) at a temperature of 300 K.
2. The air density at the standard reference conditions is equivalent to that at 98 kPa (376 mmHg) and 20 °C and to that at 101 kPa (760 mmHg) and 30 °C
3. For automotive type inboard and outboard marine propulsion engines, the standard reference conditions in ISO 1585 and ISO 2534 may be applied but they shall be stated.



## **n.6. Auxiliaries**

### **n.6.1 Introduction**

In order to show alertly the conditions under which a power is determined, it is necessary to distinguish those auxiliaries which affect the final shaft output of the engine and also those which are necessary for the continuous or repeated use of the engine.

Items of equipment fitted to the engine and without which the engine could not in any circumstance operate at its declared power are considered to be engine components and are not therefore, classed as auxiliaries.

(Such as fuel injection pump, exhaust turbocharger and charge air cooler are in this category of engine components.)

**n.6.2 dependent auxiliary** : Item of equipment, the presence or absence of which affects the final shaft output of the engine.

**n.6.3 independent auxiliary** : Item of equipment which uses power supplied from a source other than the engine.

**n.6.4 essential auxiliary** : Item of equipment which is essential for the continued or repeated operation of the engine.

**n.6.5 non-essential auxiliary** : Item of equipment which is not essential for the continued or repeated operation of the engine.

## **n.7 Declarations of power**

### **n.7.1 Introduction**

#### **n.7.1.1 Purpose of statement of power**

Statements of power are required for two main purposes :

a) the declaration by a manufacturer of the value of the power which his engine will deliver under a given set of circumstances. This declared value is known as the "rated power".

b) the verification by measurement that the engine delivers the power which has been declared in a), under the same set of circumstances or after proper allowance has been made for any difference in circumstance.

To specify the set of circumstances under which the declared value of a power would be achieved, the declaration shall state :

- a) the kind of statement of power (see 7.4) and of necessary, the ambient and operating condition (see 7.4.2).
- b) the kind of power output (see 7.3).
- c) the kind of power (see 7.3).
- d) the corresponding engine speed.

#### **NOTE**

1. The term used in a) to c) may be combined, for example, continuous net brake fuel stop power.
2. Where appropriate to the engine application and the method of manufacture, the power achieved may be subject to a tolerance on the declared power. The existence of and its magnitude shall be stated by the manufacturer.
3. Measurement of the powers referred to in this International Standard shall be determined in accordance with ISO 3046/2.

#### **n.7.1.2 Unit of power**

Power shall be expressed in kilowatts (kW) The addition of the equivalent metric or imperial "horsepower" is permitted for a transitional period.

#### **n.7.1.3 Power and torque**

For engines delivering power by a shaft or shafts, any power in this International Standard is a quantity proportional to the mean torque, calculated on shafts transmitting this torque.

For engines delivering power other than by a shaft or shafts, reference shall be made to the appropriate International Standard for the driven for the driven machine.

#### **n.7.1.4 Engine speed**

The speed of an engine is the mean rotational speed of its crankshaft or crankshatts in revolution per minute, except in the case of "free piston" engines where the speed is the number of cycles per minute of the reciprocating components.

#### **n.7.1.5 Engine with integral gearing**

When stating the power of an engine fined with an integral (built-in) speed increasing or reducing device, the speed of the driving shaft extremist shall also be given at the declared engine speed.

### **n.7.2 Kinds of power**

#### **n.7.2.1 Indicated power**

The total power developed in the working cylinders by the gases on the combustion side of the working pistons.

#### **n.7.2.2 Brake power**

The power of the sum of the powers measured at the extremity of the engine driving shaft or shafts.

n.7.2.2.1 Any statement of brake powers shall be supported by the following list of auxiliaries :

- a) essential dependent auxiliaries as defined in 6.2 and 6.4;
- b) essential independent as define in 6.3 and 6.4;
- c) non-essential dependent auxiliaries as defined in 6.2 and 6.5.

The power absorbed by the independent and the non-essential dependent auxiliaries may be significant, in such cases, their power requirement shall be declared.

Note - Examples of typical auxiliaries are listed in annex A for guidance purposes. These lists are not necessary complete.

#### **n.7.2.3 Net brake power**

The brake power measured when the engine is using only the auxiliaries listed in 7.2.2 a).

### **n.7.3 Kinds of power output**

#### **n.7.3.1 continuous power**

Power which an engine is capable of delivering continuous, between the normal maintenance intervals stated by the manufacturer, at stated speed and under stated ambient conditions, the maintenance prescribed by the manufacturer being carried out.

#### **n.7.3.1 Overload power**

Power which an engine may be permitted to deliver, at stated ambient conditions, immediately after working at the continuous power.

The duration and frequency of use of overload power which is permitted will depend on the service application but adequate allowance shall be made in setting the engine fuel stop permit the overload power shall be expressed as a percentage of the continuous power, together with the duration and frequency permitted and the appropriate engine speed.

Unless otherwise stated an overload power of 110% of the continuous power at a speed corresponding to the engine application is permitted for a period of 12 hours of operation.

### **NOTES**

1. The power of marine main propulsion engines is normally limited to to continuous power, so that the overload power cannot be given in service. However, for special applications, marine main propulsion engines may develop overload power in service.
2. If the engine application is not determined, the engine manufacturer shall specify the overload power and the corresponding engine speed.

#### **n.7,3.2 Fuel stop power**

Power which an engine is capable of delivering during a stated period corresponding to its application, and at stated speed and under stated ambient conditions, with the fuel limit so that the fuel stop power cannot exceeded.

#### **n.7.4 Kinds of statements of power**

##### **n.7.4.1 ISO powers**

###### **n.7.4.1.1 ISO power**

Power determined under the operating conditions of the manufacturer's test bed and adjusted to the standard reference conditions in clause 5.

###### **n.7.4.1.2 ISO standard power**

The name given of the continuous net brake power which the engine manufacturer declares that an engine is capable of delivering continuously, between the normal maintenance intervals stated by the manufacturer, and under the following conditions :

- a) at a stated speed under the operating conditions of the engine manufacturer's test bed;
- b) with the declared power adjusted to the standard reference conditions given in clause 5;
- c) the maintenance prescribed by the engine manufacturer being carried out.

###### **n.7.4.2 Service power**

Power determined under the ambient and operating conditions of an engine application.

To establish service power, the following conditions shall be taken into account :

- a) the ambient conditions, or any nominal ambient conditions according to the special requirements of inspecting and/or legislative authorities and/or classification societies, as specified by the customer (see clause 12);
- b) the normal duty of the engine;
- c) the expected interval between maintenance periods;
- d) the nature and amount of the supervision required;
- e) all information relevant to the operation of the engine in service (see clauses 12 and 13).

## **n.8. Declarations of fuel consumption**

### **n.8.1 Definitions**

#### **n.8.1.1 Fuel consumption**

The quantity of fuel consumed by an engine per unit of time at a state power and under stated conditions.

The quantity of liquid fuels shall be expressed in mass units (kg).

The quantity of gaseous fuels shall be expressed in energy units (J).

#### **n.8.1.2 Specific fuel consumption**

The fuel consumption per unit of power.

#### **n.8.1.3 ISO specific fuel consumption**

The name given in the specific fuel consumption at the ISO standard power.

If not otherwise specified by the manufacturer, a declared specific fuel consumption shall be considered to be the ISO specific fuel consumption.

### **n.8.2 Reference calorific value of fuels**

#### **n.8.2.1 Liquid fuel engines**

The declared specific fuel consumption of a liquid fuel engine shall be related to a reference lower calorific value of 42,000 kJ/kg (10,030 kcal/kg).

#### **n.8.2.2 Gas engines**

The declared specific fuel consumption of a gas engines shall be related to a stated lower calorific value the gas. The type of gas shall be declared.

#### **n.8.2.3 Specific fuel consumption declarations**

The specific fuel consumption of an engine shall be declared at :

- a) the ISO standard power;
- b) (if required by special agreement) at any other declared powers and at specific engine speeds appropriate to the particular engine application.

Unless otherwise states, a deviation of +5% is permitted for the specific fuel consumption for the declared power.

## n.9. Declarations of lubricating oil consumption 1 Lubricating oil consumption

### n.9.1 Lubricating oil consumption

The quantity of lubricating oil consumed by an engine per unit of time. This quantity is used for guidance. It shall be expressed in litres or kilograms per engine operating hour at the declared power and engine speed.

n.9.2 The lubricating oil consumption after a stated period of running-in shall be declared.

n.9.3 The oil discarded during an engine oil change shall be not included in the lubricating oil consumption declaration.

## n.10. Adjustment of net brake power for ambient conditions

n.10.1 When it is required to operate the engine under conditions difference from the standard reference conditions given in clause 5, the net brake power output shall be adjusted to or from the standard reference conditions by the following formulae (see note 1) :

$$P_x = \alpha P_r \quad (n-1)$$

$$\alpha = k - 0.7(1-k) \left( \frac{1}{\eta_m} - 1 \right) \quad (\text{see note 2}) \quad (n-2)$$

$$k = \left( \frac{p_x - a\phi_x p_{sx}}{p_r - a\phi_r p_{sr}} \right)^m \left( \frac{T_r}{T_x} \right)^n \left( \frac{T_{cr}}{T_{cx}} \right)^q \quad (n-3)$$

n.10.2 In the case of turbocharged engines in which the limits of turbocharger speed and turbocharger turbine inlet temperature have not been reached at the declared power under standard reference conditions, the manufacturer may declare substitute reference conditions to or from which power adjustments is to be made.

The following formulae (4) and (5) will then be used instead of formula (3)

$$k = \left( \frac{p_x}{p_r} \right)^m \left( \frac{T_r}{T_x} \right)^n \left( \frac{T_{cr}}{T_{cx}} \right)^q \quad (n-4)$$

$$P_{ra} = P_r \times \left( \frac{\pi_r}{\pi_{\max}} \right) \quad (n-5)$$

Where :

$P_r$  is the brake power;

$p_r$  is the standard reference total barometric pressure;

$p_{sr}$  is the saturation vapour pressure under standard reference conditions;

$\phi_r$  is the standard reference relative humidity;

$T_r$  is the standard reference absolute air temperature;

$T_{cr}$  is the standard reference absolute charge or coolant temperature;

$P_{ra}$  is the substitute reference total barometric pressure given by formula (5);

$T_{ra}$  is the substitute reference absolute air temperature to be stated by the manufacturer;

$\pi_r$  is the boost pressure ratio at declared power under standard reference conditions to be stated by the manufacturer;

$\pi_{max}$  is the maximum available boost pressure ratio to be stated by the manufacturer;

$\alpha$  is the power adjustment factor;

$k$  is the ratio of indicated power;

$\eta_m$  is the mechanical efficiency (see note 4);

$P_x$  is the brake power under the conditions being considered;

$p_x$  is the total barometric pressure condition being considered;

$p_{sx}$  is the saturation vapour pressure under pressure the conditions being considered;

$\phi_x$  is the relative humidity condition being considered;

$T_x$  is the absolute air temperature being considered;

$T_{cr}$  is the absolute charge air coolant temperature at charge air cooler inlet being considered.

The factor  $a$  and exponent  $m$ ,  $n$ , and  $q$  have the numerical value given in table 1 (see note 5).

#### NOTES

1. For the convenience of users of these formulae, reference may be made to tables and nomograms in annexes B to O, which also include numerical examples.



2. When the ambient conditions are more favourable than the standard reference conditions, the declared power under the ambient conditions may be limited by the manufacturer to the declared power at the standard reference conditions.

3. If the relative humidity is not known, a value of 60% should be assumed in formulae references A, E and G in table 1.

For all other formulae references the power adjustment is independent of humidity ( $a = 0$ ).

4. The value of mechanical efficiency shall be stated by the engine manufacturer. In the absence of any such statement, the value of  $\eta_m = 0.80$  will be assumed.

5. When declaring the ISO standard power the engine manufacturer shall state which of the formulae references in table 1 is applicable.

Table n-1 - Numerical values for power adjustment

Engine type	Condition		Formula reference	Factor	Exponents		
				a	m	n	q
Compression ignition oil engine and dual-fuel engines	Non - turbocharged	Power limited by air excess	A	1	1	0.75	0
		Power limited by thermal reason	B	0	1	1	0
	Turbocharged without charge air cooling	Low and medium speed four-stroke engine	C	0	0.7	2	0
				Turbocharged with charge air cooling	D	0	0.7
Spark ignition engines using gaseous fuel	Non - turbocharged		E	1	0.86	0.56	0
	Turbocharged with charge air cooling	Low and medium speed four-speed engine	F	0	0.57	0.55	1.75
Spark ignition engines using liquid fuel	Naturally aspirated		G	1	1	0.5	0

NOTE - The factors and exponents given in table 1 have been established by tests on a number of engines to be generally representative and shall be used in the absence of any other specific information; for example in formula reference D, for an engine with the charge air cooled by engine jacket water, the value for exponent q could be zero. At present, they apply only to the type of engines specified but table 1 will be extended to include other types when sufficient are available.

## n.11 Adjustment of fuel consumption for ambient conditions

n.11.1 When it is required to operate the engine under conditions different from the standard reference conditions given in clause 5, the fuel consumption will differ from that declared for the standard reference conditions and shall be adjusted to or from the standard reference conditions.

The following formulae shall be used if other methods are not declared by the engine manufacturers :

$$b_x = \beta b_r \quad (n-6)$$

where  $\beta = k/\alpha \quad (n-7)$

where :

$b$  is the specific fuel consumption

$\beta$  is the fuel consumption adjustment factor

$\alpha$  is the power adjustment factor (see 10.1)

$k$  is the ratio of indicated power (see 10.1)

Subscript  $r$  corresponds to values under the standard reference conditions.

Subscript  $x$  corresponds to values the conditions being considered.

NOTE - For the convenience of users of these formulae, reference may be made to the tables and nomograms in annexes B to 0, which also include numerical examples.

## n.12 Information to be supplied by the customer

The customer shall supply the following information concerning the required power :

- a) The application and the power required from the engine and details arising therefrom.
- b) The expected frequency and duration of the required powered and the corresponding engine speeds.
- c) Site conditions
  - 1) Site barometric pressure (highest and lowest reading available; if no pressure data are available the altitude above sea level).
  - 2) The monthly mean minimum and maximum air temperatures during the hottest and coldest months of the year.

- 3) The highest and lowest ambient air temperatures around the engine.
  - 4) The relative humidity (or alternatively the water vapour pressure or the wet and dry bulb temperature) ruling at the maximum temperature conditions.
  - 5) The maximum and minimum temperature of the cooling water available.
- d) The specification and lower calorific value of the fuel available.
  - e) Whether the engine is to comply with the requirements of any classification society or with special requirements.
  - f) The probable period for which the engine will be running continuously, and the duration of maximum and minimum load.
  - g) Any other information appropriate to the particular engine application.

#### n.13 Information to supplied by the engine manufacturer

The engine manufacturer shall supply the following information :

- a) The declared powers.
- b) The corresponding crankshaft and output shaft speeds.

**NOTE** - For certain applications of variable engines it is common practice to supply a power/speed diagram covering the ranges of power over which the engine can be used in continuous and in short period operation.

- c) The direction of rotation (see ISO 1204).
- d) The number and arrangement of cylinders (see ISO 1205).
- e) Whether the engine is two-stroke or four-stroke, naturally aspired, mechanically pressure charge or turbocaharged and whether with or without charge air cooler.
- f) The quantity of air required for the operation of the engine for :
  - 1) combustion and scavenging;
  - 2) cooling and ventilation.
- g) The method of starting, apparatus supplied and additional apparatus required.
- h) The type and grade of lubricating oil(s) recommended.

j) The type of governing, with speed droop of required (see ISO 3046/4 and ISO 3046/6).

If for variable speed duties, the working speed range and the idling speed.

If necessary, the critical speed range shall be indicated.

k) The method of cooling and the capacity of the cooling system with the rates of circulation of the cooling fluids.

m) (From air cooled engines only.) Whether hot air discharge ducting can be fitted.

n) A schedule recommended maintenance and overhaul periods.

p) Specifications and lower calorific values of fuels recommended.

q) Maximum permissible back-pressure in the exhaust system and the maximum permissible intake depression.

r) Any other information appropriate to the particular engine application.

ภาคผนวก ข

การวัดอัตราการไหลของอากาศ

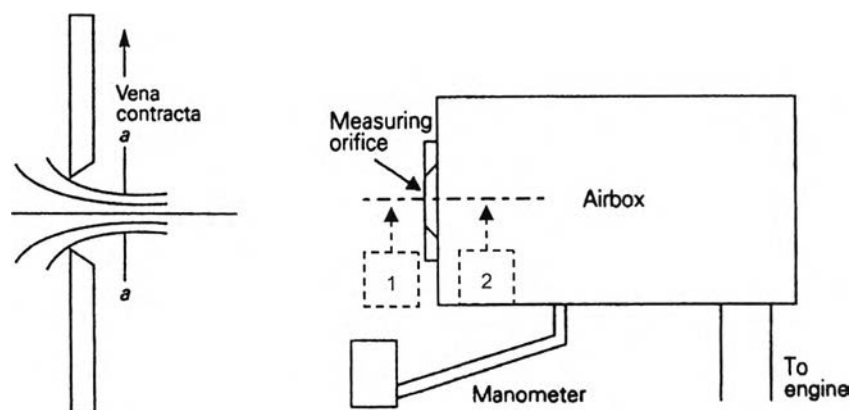
### การวัดอัตราการไหลของอากาศด้วยวิธี Air box method [16], [17]

การวัดอัตราการไหลของอากาศด้วยวิธี Air box method เป็นการวัดโดยใช้แผ่นออริฟิซ ประกอบกับถังพักอากาศ ซึ่งถังพักอากาศจะช่วยลดการกระเพื่อมของอากาศที่ถูกดูดตามจังหวะการทำงานของเครื่องยนต์ ทำให้อากาศที่ไหลผ่านออริฟิซมีอัตราการไหลที่สม่ำเสมอสามารถวัดความดันตกคล่อมได้ถูกต้องมากขึ้น

ขนาดเส้นผ่านศูนย์กลางของแผ่นออริฟิซโดยประมาณ ที่อัตราการไหลต่างๆ แสดงดังตาราง ข-1

ตาราง ข-1 แสดงขนาดเส้นผ่านศูนย์กลางของออริฟิซโดยประมาณที่อัตราการไหลต่างๆ

Orifice diameter (mm.)	Air Flow rate (m <sup>3</sup> /s)	Mass Flow rate (kg/s)
10	0.002	0.002
20	0.008	0.009
50	0.048	0.057
100	0.19	0.23
150	0.43	0.51



รูปที่ ข-1 แสดงภาพการวัดอัตราการไหลของอากาศโดยวิธี Air box method [16]

ภาพซ้ายแสดงการไหลของอากาศผ่านแผ่น orifice plate

ภาพขวาแสดงภาพ Orifice flow meter

ปริมาณของถังที่เล็กที่สุดที่จะทำให้ไม่เกิดการกระเพื่อมของอากาศที่ไหล ได้ถูกวิเคราะห์ โดย Kastner [25] ดังสมการ (ข-1)

$$V_b = \frac{417 \times 10^6 K^4 d^2}{N_c V_s n_{\min}^2} \quad (\text{ข-1})$$

- โดยที่  $V_b$  คือ ปริมาตรถังพักอากาศที่เล็กที่สุด ( $m^3$ )  
 $K$  คือ ค่าคงที่มีค่าเท่ากับ 1 สำหรับเครื่องยนต์ 2 จังหวะ และ  
 มีค่าเท่ากับ 2 สำหรับเครื่องยนต์ 4 จังหวะ  
 $d$  คือ เส้นผ่านศูนย์กลางกลางของ orifice plate (m)  
 $N_c$  คือ จำนวนกระบอกสูบของเครื่องยนต์  
 $V_s$  คือ ปริมาตรช่วงชักลูกสูบ ( $m^3$ )  
 $n_{\min}$  คือ ความเร็วรอบเครื่องยนต์ที่น้อยที่สุด (rev/min)

สมมติให้อากาศที่ไหลผ่าน orifice plate เป็นของไหลอัดตัวไม่ได้ (Incompressible flow) และพิจารณาให้ความหนาแน่นของอากาศคงที่ จากสมการเบอร์นูลลี จะได้ว่า

$$\frac{p_1}{\gamma_{\text{air}}} + \frac{v_1^2}{2g} + Z_1 = \frac{p_2}{\gamma_{\text{air}}} + \frac{v_2^2}{2g} + Z_2 \quad (\text{ข-2})$$

- โดยที่  $p$  คือ ความดัน (kPa)  
 $v$  คือ ความเร็วอากาศ (m/s)  
 $\gamma_{\text{air}}$  คือ น้ำหนักจำเพาะของอากาศ ( $kg/m^2 \cdot s^2$ ) =  $\rho_{\text{air}} g$   
 $\rho_{\text{air}}$  คือ ความหนาแน่นของอากาศ ( $kg/m^3$ ) เท่ากับ  $1.165 kg/m^3$  ที่  $30^\circ C$   
 $Z$  คือ ระดับความสูง (m)  
 $g$  คือ ค่าความเร่งเนื่องจากแรงโน้มถ่วงของโลก ( $m/s^2$ ) เท่ากับ  $9.807 m/s^2$   
 ตัวห้อย 1 และ 2 คือตำแหน่งสภาวะ 1 และ 2 ในรูป ข-1 ขวา ตามลำดับ

เนื่องจากสภาวะ 1 เป็นอากาศนิ่ง และทั้งสองสภาวะอยู่ในระดับความสูงเดียวกัน ดังนั้น จะได้ความเร็วของอากาศ ตามสมการที่ (ข-5)



$$v_2 = \sqrt{\frac{2\Delta p}{\rho_{\text{air}}}} \quad (\text{ข-3})$$

การไหลผ่าน orifice จะเกิด Vena contracta ซึ่งจะทำให้การไหลจริงน้อยกว่าทฤษฎีเสมอ ดังนั้นเมื่อคิดการไหลแบบคงตัว จะได้อัตราการไหลโดยมวลของอากาศ คือ

$$\dot{m}_a = C_{DO} \rho_{\text{air}} v A_o \quad (\text{ข-4})$$

โดยที่  $C_{DO}$  คือ Discharge coefficient ของ orifice plate  
 $A_o$  คือขนาดของ orifice ( $\text{m}^2$ )

การวัดผลต่างความดันตกคร่อม orifice plate จะวัดโดยใช้मानอมิเตอร์ ซึ่งจะได้ค่า head ในหน่วย  $\text{mm.H}_2\text{O}$  ซึ่งสามารถนำมาคำนวณหาผลต่างความดันตกคร่อม orifice plate ได้จากสมการ

$$\Delta p = \rho_{\text{H}_2\text{O}} g \Delta h \quad (\text{ข-5})$$

โดยที่  $\Delta h$  คือ ผลต่าง Head ที่อ่านได้จากमानอมิเตอร์ ( $\text{mmH}_2\text{O}$ )  
 $\rho_{\text{H}_2\text{O}}$  คือ ความหนาแน่นของอากาศ ( $\text{kg/m}^3$ ) เท่ากับ  $997 \text{ kg/m}^3$

เมื่อนำสมการ (ข-5) และ (ข-7) มาแทนลงในสมการ (ข-6) จะได้สมการที่นำไปใช้งาน คือ

$$\dot{m}_a = C_{DO} A_o \sqrt{2\rho_{\text{air}} \rho_{\text{H}_2\text{O}} g \Delta h} \quad (\text{ข-6})$$

ดังนั้นจากสมการ (ข-2) และ (ข-8) จะสามารถหาอัตราส่วนผสมเชื้อเพลิงต่ออากาศ และ Equivalent ratio ได้จากสมการดังต่อไปนี้

$$F/A = \frac{\rho_f V/t}{C_{DO} A_o \sqrt{2\rho_{\text{air}} \rho_{\text{H}_2\text{O}} g \Delta h}} \quad (\text{ข-7})$$

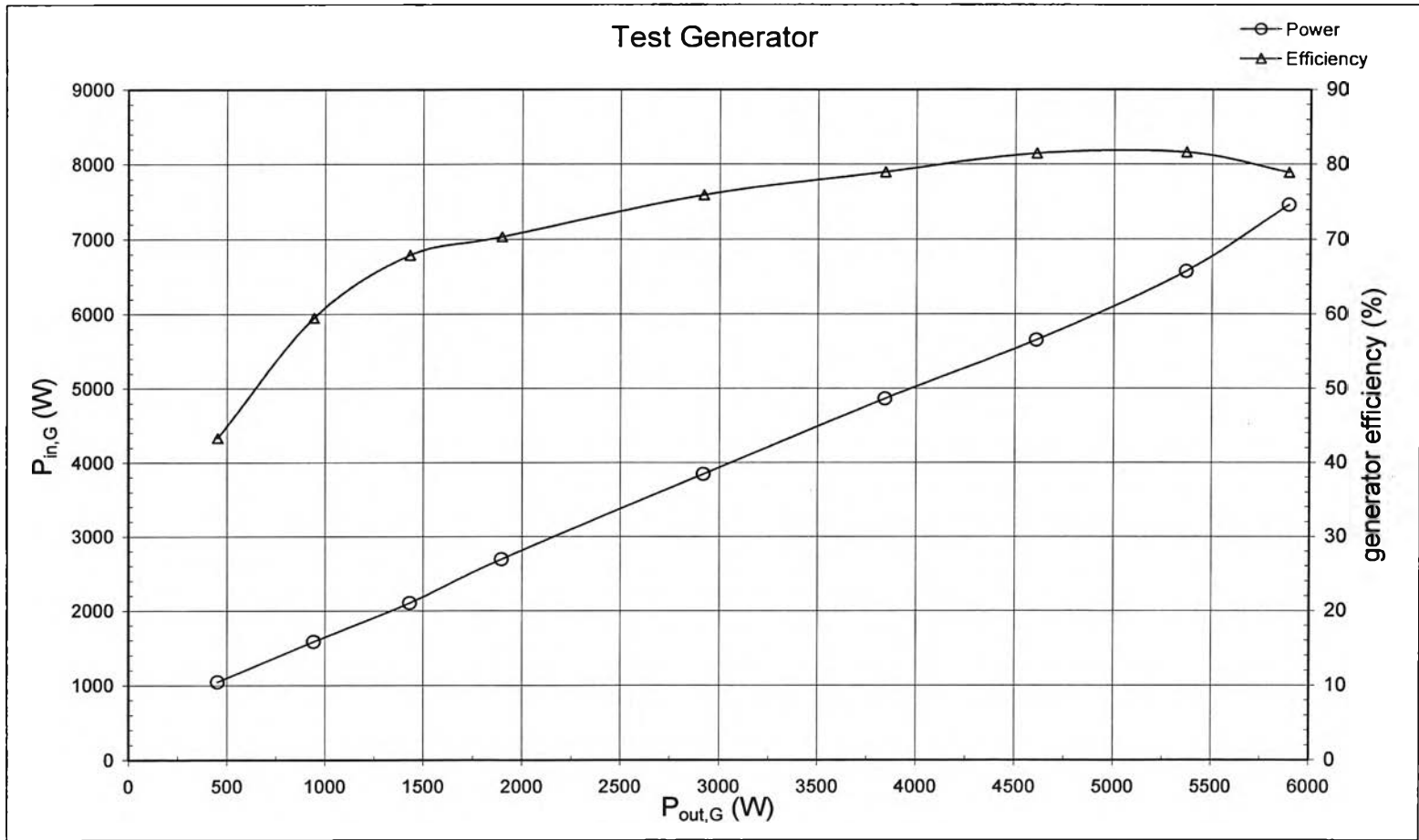
$$\text{Equivalent ratio} = \frac{(F/A)}{(F/A)_S}$$

ภาคผนวก ค

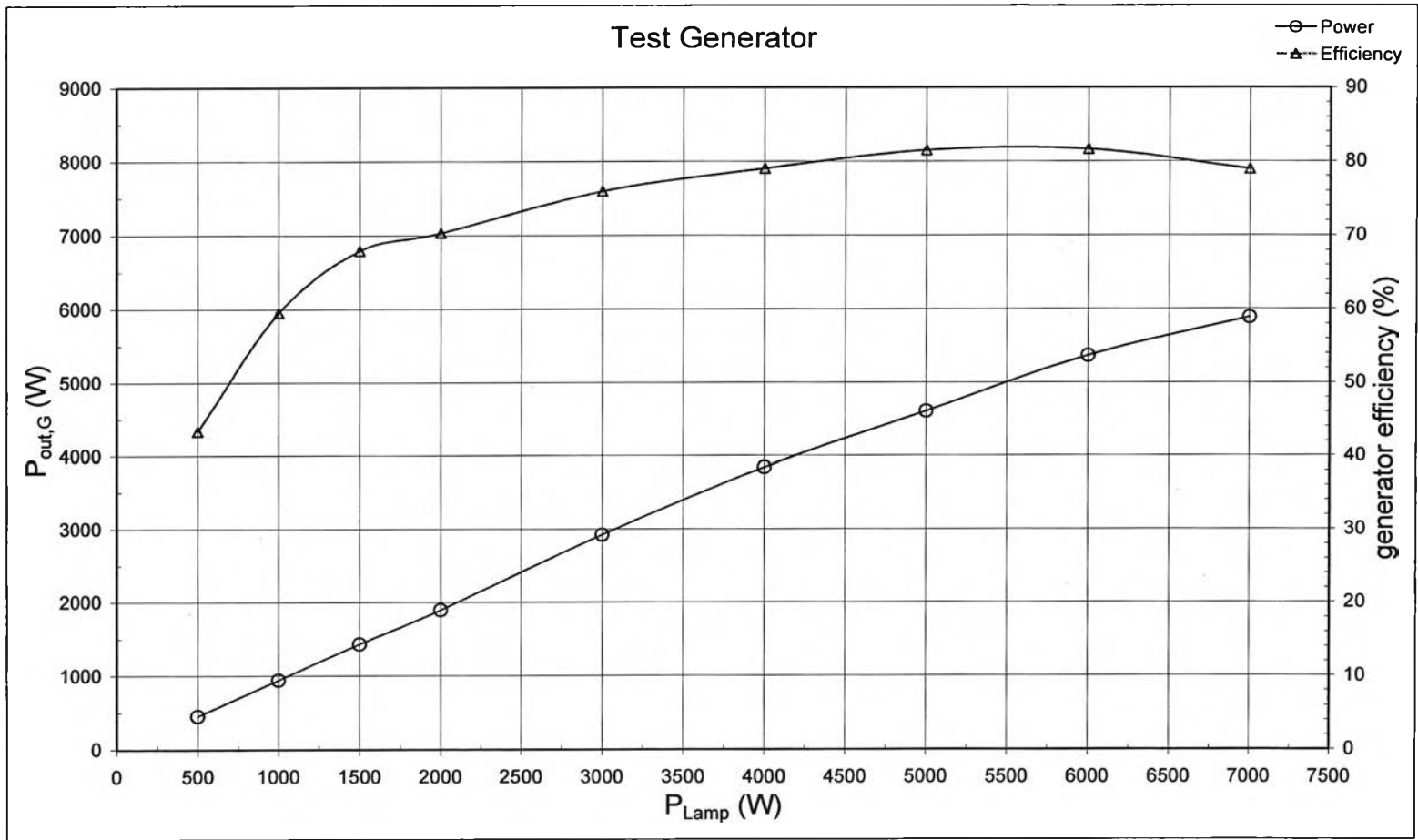
ข้อมูลการทดสอบประสิทธิภาพเครื่องกำเนิดไฟฟ้า

ตารางที่ ค-1 แสดงข้อมูลที่ได้จากการทดสอบเจนเนอเรเตอร์

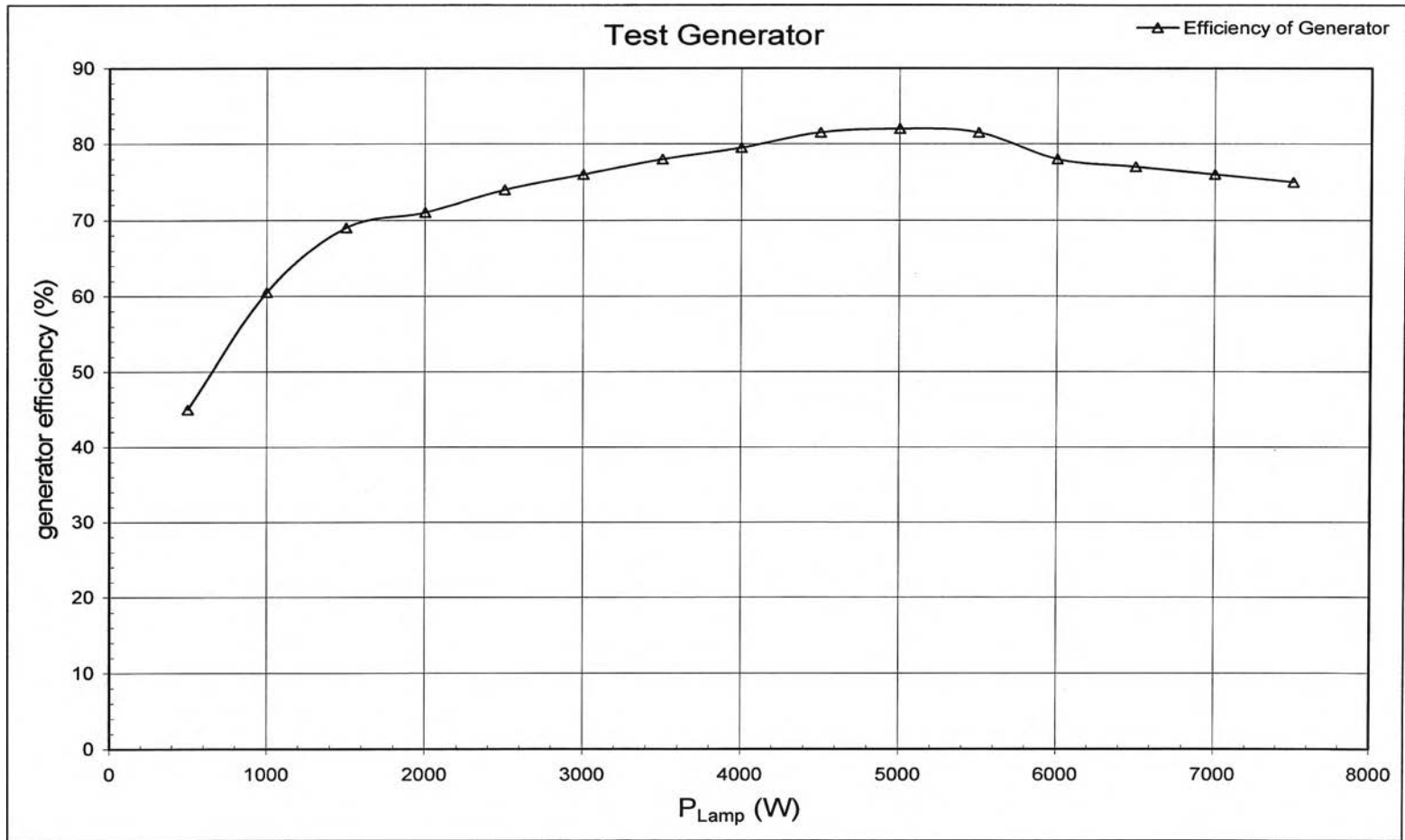
Load	Voltage at motor (volt)				Current at motor (amp.)				volt	amp.	Power at motor (W)		Power at gen.(W)			eff. (%)
	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>m</sub>	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	I <sub>m</sub>	V <sub>G</sub>	I <sub>G</sub>	P <sub>in,m</sub>	P <sub>out,m</sub>	P <sub>loss</sub>	P <sub>in,G</sub>	P <sub>out,G</sub>	η <sub>G</sub>
no gen.	389	392	391	390.67	5.90	5.80	6.20	5.97	-	-	3,552.89	2,984.43	908	2,076.43	-	
no load	387	390	388	388.33	6.40	6.20	6.50	6.37	227.0	0.0	3,768.43	1,884.21	908	976.21	-	0
500	387	390	387	388.00	6.70	6.40	6.70	6.60	226.0	2.0	3,903.18	1,951.59	908	1,043.59	452.00	43.3
1000	386	389	387	387.33	7.10	6.80	7.20	7.03	227.0	4.2	4,152.31	2,491.38	908	1,583.38	942.05	59.5
1500	381	382	382	381.67	7.40	7.20	7.60	7.40	227.0	6.3	4,304.86	3,013.40	908	2,105.40	1,430.10	67.9
2000	381	384	381	382.00	8.00	7.70	8.10	7.93	227.0	8.4	4,619.15	3,602.94	908	2,694.94	1,895.45	70.3
3000	382	384	382	382.67	9.80	9.40	9.90	9.70	229.0	12.8	5,657.64	4,752.42	908	3,844.42	2,919.75	75.9
4000	380	382	380	380.67	11.50	11.10	11.70	11.43	228.0	16.9	6,633.78	5,771.39	908	4,863.39	3,841.80	79.0
5000	380	382	380	380.67	13.10	12.70	13.20	13.00	222.0	20.8	7,542.78	6,562.22	908	5,654.22	4,606.50	81.5
6000	379	381	379	379.67	15.00	14.60	15.00	14.87	216.0	24.9	8,603.19	7,484.77	908	6,576.77	5,367.60	81.6
7000	377	378	379	378.00	16.90	16.30	16.90	16.70	210.0	28.1	9,621.69	8,370.87	908	7,462.87	5,890.50	78.9



รูปที่ ค-1 แสดงกราฟเปรียบเทียบกำลังที่เข้าเจนเนอเรเตอร์และกำลังที่ออกจากเจนเนอเรเตอร์ พร้อมแสดงค่าประสิทธิภาพ



รูปที่ ค-2 แสดงกราฟเปรียบเทียบกำลังที่ออกจากเจนเนอเรเตอร์ และกำลังที่โหลดไฟได้รับ พร้อมแสดงค่าประสิทธิภาพ



รูปที่ ค-3 แสดงกราฟเปรียบเทียบกำลังที่หลอดไฟได้รับ กับค่าประสิทธิภาพ

ภาคผนวก ง

ข้อมูลระบบก๊าซชีวภาพและก๊าซชีวภาพ

## ฟาร์มที่ทำการทดสอบ

สถานที่ตั้ง เอส.พี.เอ็ม. ฟาร์ม หมู่ที่ 5 ตำบลวังมะนาว อำเภอปากท่อ จังหวัดราชบุรี โทร 032-



รูปที่ ง-1 แสดงบ่อหมักก๊าซชีวภาพที่ เอส.พี.เอ็ม. ฟาร์ม

### ระบบก๊าซชีวภาพและระบบการทำงาน [18]

ระบบก๊าซชีวภาพที่เหมาะสมสำหรับใช้ในฟาร์มเลี้ยงสัตว์ โดยเฉพาะอย่างฟาร์มสุกรนั้น มีองค์ประกอบหลายอย่างที่ประกอบกันขึ้นมาเป็นระบบ ซึ่งแต่ละองค์ประกอบต้องมีขนาดที่ถูกต้อง และทำงานสัมพันธ์กันอย่างต่อเนื่อง ระบบจึงสามารถทำงานอย่างมีประสิทธิภาพ การทำงานของระบบก๊าซชีวภาพสามารถแบ่งเป็นลำดับขั้นการทำงานต่อเนื่องกัน ดังนี้

1. รางและท่อส่งน้ำเสีย (Waste water Transportation System) ทำหน้าที่รับน้ำเสียจากโรงเรือนเลี้ยงสัตว์ส่งไปยังระบบก๊าซชีวภาพ
2. บ่อรางน้ำเสีย (Collector Tank) ทำหน้าที่กักเก็บน้ำเสียไว้ระดับหนึ่งก่อนจะสูบส่งเข้าระบบก๊าซชีวภาพ



3. บ่อหมักแบบราง (Channel Digester) เป็นบ่อหมักที่ให้กลุ่มจุลินทรีย์ที่ไม่ต้องการอากาศทำหน้าที่ย่อยสลายสารอินทรีย์โมเลกุลใหญ่ที่มีอยู่ในน้ำเสียให้มีโมเลกุลเล็กลงจนกลายเป็นสารละลาย บางส่วนจะถูกเปลี่ยนเป็นก๊าซชีวภาพ ขณะเดียวกันบ่อหมักรางก็ทำหน้าที่เป็นบ่อตกตะกอน สารอินทรีย์โมเลกุลใหญ่ที่คงสภาพแล้วพร้อมทั้งช่วยกักเก็บน้ำบางส่วนที่ปนเปื้อนสารละลายอินทรีย์และคอลลอยด์ย่อยออกสู่องค์ประกอบของระบบขั้นต่อไปอย่างต่อเนื่อง

4. บ่อหมักแบบ UASB (Upflow Anaerobic Sludge Blanket) เป็นบ่อหมักไร้อากาศแบบเร็วทำหน้าที่ย่อยสลายสารอินทรีย์ในรูปของสารละลายที่ปนเปื้อนอยู่ในน้ำซึ่งลอยมาจากบ่อหมักย่อยจนคงสภาพแล้วจากบ่อหมักแบบรางให้เกิดเป็นก๊าซชีวภาพเช่นเดียวกัน ก๊าซที่ผลิตได้นั้นจะถูกส่งไปกักเก็บไว้ใต้พื้นพลาสติกเก็บก๊าซของบ่อหมักแบบราง

5. ลานกรองของแข็ง (Sand Bed Filter) ทำหน้าที่กรองแยกกากตะกอนของแข็งนอกจากน้ำมูลหมักย่อยจนคงสภาพแล้วจากบ่อหมักแบบรางตากให้แห้งเพื่อนำไปใช้หรือจำหน่ายเป็นปุ๋ยอินทรีย์คุณภาพดีต่อไป

6. ระบบบำบัดขั้นหลัง (Post Treatment) ทำหน้าที่บำบัดและลดปริมาณสารอินทรีย์ที่ยังหลงเหลืออยู่บ้างเล็กน้อยของน้ำเสียที่ผ่านการบำบัดจากระบบก๊าซชีวภาพโดยรวมมาแล้วให้มีความสะอาดมากยิ่งขึ้นเป็นการทำงานเลียนแบบธรรมชาติ โดยมีองค์ประกอบและหลักการทำงานดังนี้

6.1 สระปรับสภาพ (Stabilization Pond) ทำหน้าที่พักน้ำเสียที่ผ่านการกำจัดจากระบบก๊าซชีวภาพมาแล้วและส่งเข้าสู่บึงประดิษฐ์ต่อไป

6.2 บึงประดิษฐ์ (Wetland) ทำหน้าที่ปรับปรุงคุณภาพของน้ำเสีย โดยอาศัยกลุ่มสิ่งมีชีวิตในน้ำเช่น ต้นธูปฤาษี สาหร่าย จุลินทรีย์ และสิ่งมีชีวิตต่าง ๆ ที่ทำงานสัมพันธ์กันเป็นระบบนิเวศน์

6.3 สระพักน้ำ (Reservoir) ทำหน้าที่กักเก็บน้ำที่ผ่านการบำบัดแล้วเพื่อให้หมุนเวียนมาทำความสะอาดโรงเรือนเลี้ยงสัตว์ โดยเฉพาะอย่างยิ่งในฤดูแล้งและจะถูกปล่อยออกสู่ภายนอกในฤดูฝนเมื่อมีน้ำมากเกินความต้องการ

น้ำเสีย ที่ผ่านการบำบัดครบทุกขั้นตอนแล้วสามารถหมุนเวียนกลับมาใช้ภายในฟาร์มเพื่อทำความสะอาดคอกสัตว์ได้เป็นการช่วยลดปริมาณการใช้น้ำ ซึ่งสามารถลดค่าใช้จ่ายของฟาร์มได้อีกทางหนึ่งด้วย

### ข้อมูลก๊าซชีวภาพ [19]

โดยทำการตรวจวัดขนาดระบบ 4,000 ลบ.ม. ณ วันที่ 23 พ.ย. 2548 ดังนี้

1. ออกจากบ่อหมักราง

CH <sub>4</sub>	72% by Vol.
CO <sub>2</sub>	20% by Vol.
N <sub>2</sub>	6.5% by Vol.
O <sub>2</sub>	1.5% by Vol.
H <sub>2</sub> S	200 ppm

2. ตำแหน่งที่ออกจากชุดกรองก๊าซชีวภาพ

CH <sub>4</sub>	72% by Vol.
CO <sub>2</sub>	20% by Vol.
N <sub>2</sub>	6.5% by Vol.
O <sub>2</sub>	1.5% by Vol.
H <sub>2</sub> S	20 ppm

3. ตำแหน่งที่ใช้ในการทดสอบ

CH <sub>4</sub>	73% by Vol.
CO <sub>2</sub>	19% by Vol.
N <sub>2</sub>	6.5% by Vol.
O <sub>2</sub>	1.5% by Vol.
H <sub>2</sub> S	20 ppm

สำหรับก๊าซชีวภาพที่ใช้ในการทดสอบเครื่องยนต์ของงานวิจัยนี้ได้ผ่านกระบวนการกรอง H<sub>2</sub>S ออกบางส่วนแล้วในเบื้องต้น และค่าความร้อนของก๊าซชีวภาพที่ตำแหน่งทดสอบประมาณ 26.17 MJ/kg (คำนวณจากค่ามีเทนในก๊าซชีวภาพ 73% โดยปริมาตร)

## ภาคผนวก จ

ข้อมูลผลการทดสอบสมรรถนะของเครื่องยนต์เมื่อใช้น้ำมันดีเซล  
และใช้น้ำมันดีเซลร่วมกับก๊าซชีวภาพ

ตารางที่ จ-1 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1000 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล

Test No.	Load (W)	Torque (Nm)	Cortd.T (Nm)	Power (kW)	Cortd. P (kW)	Volt. (V.)	Cur. (A.)	V <sub>diesel</sub> (cc/min)	m <sub>diesel</sub> (kg/s)	sfc (die.) (g/kW.h)	V <sub>biogas</sub> (L/min)	ρ <sub>biogas</sub> (kg/m <sup>3</sup> )	m <sub>biogas</sub> (kg/s)	Dp <sub>air</sub> (mm H <sub>2</sub> O)	Dp <sub>air</sub> (kPa)	m <sub>a</sub> (kg/s)
1	500	11.36	11.16	0.536	1.1900	238	2.25	10.31	0.000142	430	-	-	-	9.46	92.50	0.0071
2	1000	17.51	17.28	1.109	1.8332	238	4.66	12.75	0.000176	345	-	-	-	8.24	80.57	0.0066
3	1500	22.49	22.30	1.625	2.3554	239	6.80	15.09	0.000208	318	-	-	-	8.00	78.22	0.0065
4	2000	29.64	29.28	2.204	3.1036	239	9.22	18.53	0.000255	296	-	-	-	8.00	78.22	0.0065
5	2500	35.40	34.98	2.743	3.7070	240	11.43	23.74	0.000327	318	-	-	-	8.06	78.81	0.0065
6	2700	37.97	37.51	3.022	3.9758	240	12.59	27.73	0.000382	346	-	-	-	8.00	78.22	0.0065

Test No.	Load (W)	η <sub>v</sub>	Φ	Oil T. (°C)	W.T. (°C)	Db.T. (°C)	Exh.T. (°C)	Int.airT. (°C)	Gas.T. (°C)	P atm. (mm Hg)	Correction Factor			ρ <sub>air</sub> (kg/m <sup>3</sup> )	Gen. %Eff	TECE %Eff	STEC MJ/kWh
											k	α	β				
1	500	0.0200	0.2901	70	76	32	199	34	33	774.80	1.016	1.018	0.997	1.1699	45.0	19.71	18.34
2	1000	0.0266	0.3852	74	82	33	239	35	34	774.00	1.011	1.013	0.998	1.1649	60.5	24.56	14.69
3	1500	0.0319	0.4621	79	89	34	288	34	34	773.56	1.007	1.009	0.999	1.1681	69.0	26.66	13.50
4	2000	0.0391	0.5676	81	92	33	354	34	33	773.30	1.010	1.012	0.998	1.1677	71.0	28.61	12.60
5	2500	0.0500	0.7244	84	95	33	465	34	33	773.30	1.010	1.012	0.998	1.1677	74.0	26.67	13.51
6	2700	0.0586	0.8493	86	96	33	486	34	33	773.30	1.010	1.012	0.998	1.1677	76.0	24.49	14.69

ตารางที่ จ-2 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1000 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ

Test	Load	Torque	Cortd.T	Power	Cortd. P	Volt.	Cur.	V <sub>diesel</sub>	m <sub>diesel</sub>	sfc (die.)	V <sub>biogas</sub>	ρ <sub>biogas</sub>	m <sub>biogas</sub>	Dp <sub>air</sub>	Dp <sub>air</sub>	m <sub>a</sub>
No.	(W)	(Nm)	(Nm)	(kW)	(kW)	(V.)	(A.)	(cc/min)	(kg/s)	(g/kW.h)	(L/min)	(kg/m <sup>3</sup> )	(kg/s)	(mm H <sub>2</sub> O)	(kPa)	(kg/s)
1	500	11.31	11.17	0.53312	1.1847	238	2.24	0.45	6.2E-06	18.839	20.1329	0.98709	0.00033	7.95	77.73	0.00649
2	1000	17.47	17.24	1.1067	1.8293	238	4.65	0.56	7.71E-06	15.183	20.2923	0.98735	0.00033	7.65	74.80	0.00637
3	1500	22.49	22.22	1.6252	2.3554	239	6.8	2.78	3.83E-05	58.537	22.3154	0.98846	0.00037	7.71	75.39	0.0064
4	2000	29.61	29.14	2.20119	3.1003	239	9.21	7.5	0.000103	119.980	20.7029	0.98837	0.00034	7.77	75.97	0.00643
5	2500	35.37	34.81	2.7408	3.7038	240	11.42	12.12	0.000167	162.294	18.4883	0.98851	0.0003	7.47	73.04	0.00631
6	2700	38.00	37.54	3.024	3.9789	240	12.6	17.86	0.000246	222.618	14.1853	0.98825	0.00023	7.55	73.82	0.00635

Test	Load	η <sub>v</sub>	Φ	Oil T.	W.T.	Db.T.	Exh.T.	Int.airT.	Gas.T.	P atm.	Correction Factor			ρ <sub>air</sub>	Gen.	TECE	STEC
No.	(W)	-	-	(°C)	(°C)	(°C)	(°C)	(°C)	(°C)	(mm Hg)	k	α	β	kg/m <sup>3</sup>	%Eff	%Eff	MJ/kWh
1	500	0.5355	0.4739	74	81	33	172	35	34	774	1.011	1.013	0.998	1.1649	13.26	13.26	27.14
2	1000	0.5253	0.4904	78	91	33	202	35	34	774	1.011	1.013	0.998	1.1649	20.18	20.18	17.84
3	1500	0.5267	0.6047	81	94	33	218	34	33	773.3	1.010	1.012	0.998	1.1677	20.94	20.94	17.19
4	2000	0.5288	0.7117	83	96	32	230	34	33	773.3	1.014	1.016	0.998	1.1677	23.28	23.28	15.46
5	2500	0.5176	0.8188	85	96	32	255	33	33	773.3	1.014	1.016	0.998	1.1715	24.58	24.58	14.65
6	2700	0.5204	0.8943	88	97	33	268	33	33	773.3	1.010	1.012	0.998	1.1715	24.01	24.01	14.99

ตารางที่ จ-3 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1200 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล

Test	Load	Torque	Cortd.T	Power	Cortd. P	Volt.	Cur.	V <sub>diesel</sub>	m <sub>diesel</sub>	sfc (die.)	V <sub>biogas</sub>	ρ <sub>biogas</sub>	m <sub>biogas</sub>	Dp <sub>air</sub>	Dp <sub>air</sub>	m <sub>a</sub>
No.	(W)	(Nm)	(Nm)	(kW)	(kW)	(V.)	(A.)	(cc/min)	(kg/s)	(g/kW.h)	(L/min)	(kg/m <sup>3</sup> )	(kg/s)	(mm H <sub>2</sub> O)	(kPa)	(kg/s)
1	500	9.35	9.20	0.529	1.1754	233	2.27	10.20	0.000141	430	-	-	-	11.92	116.55	0.00798
2	1000	13.97	13.70	1.062	1.7560	234	4.54	12.23	0.000168	345	-	-	-	12.03	117.62	0.00802
3	1500	18.47	17.90	1.601	2.3207	239	6.70	15.28	0.000211	327	-	-	-	11.85	115.86	0.00802
4	2000	24.19	23.35	2.158	3.0397	239	9.03	17.70	0.000244	289	-	-	-	11.74	114.79	0.00798
5	2500	29.50	28.45	2.743	3.7070	240	11.43	20.57	0.000283	275	-	-	-	11.56	113.03	0.00791
6	3000	35.08	33.83	3.350	4.4078	241	13.90	24.85	0.000342	280	-	-	-	11.51	112.54	0.00792
7	3500	40.24	38.66	3.945	5.0572	242	16.30	31.90	0.000439	313	-	-	-	11.45	111.95	0.00791

Test	Load	η <sub>v</sub>	Φ	Oil T.	W.T.	Db.T.	Exh.T.	Int.airT.	Gas.T.	P atm.	Correction Factor			ρ <sub>air</sub>	Gen.	TECE	STEC
No.	(W)	-	-	(°C)	(°C)	(°C)	(°C)	(°C)	(°C)	(mm Hg)	k	α	β	kg/m <sup>3</sup>	%Eff	%Eff	MJ/kWh
1	500	0.5447	0.2554	77	81	32	202	33	33	774.00	1.014	1.017	0.998	1.1725	45.0	19.68	18.29
2	1000	0.5465	0.3045	81	82	31	234	32	32	773.30	1.017	1.020	0.997	1.1753	60.5	24.52	14.65
3	1500	0.5389	0.3808	86	87	28	273	28	28	773.30	1.027	1.032	0.995	1.1909	69.0	25.94	13.92
4	2000	0.5363	0.4431	85	88	27	322	28	28	773.30	1.030	1.036	0.995	1.1909	71.0	29.33	12.26
5	2500	0.5329	0.5196	87	92	27	370	29	27	774.00	1.031	1.037	0.995	1.1881	74.0	30.78	11.71
6	3000	0.5299	0.6270	89	94	27	394	27	27	774.00	1.031	1.037	0.995	1.1960	76.0	30.29	11.88
7	3500	0.5277	0.8056	94	97	26	506	26	26	774.00	1.035	1.041	0.994	1.2000	78.0	27.08	13.29

ตารางที่ จ-4 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1200 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ

Test	Load	Torque	Cortd.T	Power	Cortd. P	Volt.	Cur.	V <sub>diesel</sub>	m <sub>diesel</sub>	sfc (die.)	V <sub>biogas</sub>	ρ <sub>biogas</sub>	m <sub>biogas</sub>	Dp <sub>air</sub>	Dp <sub>air</sub>	m <sub>a</sub>
No.	(W)	(Nm)	(Nm)	(kW)	(kW)	(V.)	(A.)	(cc/min)	(kg/s)	(g/kW.h)	(L/min)	(kg/m <sup>3</sup> )	(kg/s)	(mm H <sub>2</sub> O)	(kPa)	(kg/s)
1	500	9.35	9.17	0.52891	1.1754	233	2.27	0.47	6.48E-06	19.832	24.2649	0.99587	0.0004	11.62	113.62	0.00789
2	1000	14.00	13.63	1.0647	1.7598	234	4.55	0.56	7.71E-06	15.782	25.5592	1.00248	0.00043	11.3	110.49	0.0078
3	1500	18.41	17.78	1.59652	2.3138	239	5.68	2.38	3.28E-05	51.015	23.0169	1.00889	0.00039	11.16	109.12	0.00778
4	2000	24.22	23.38	2.16056	3.0430	239	9.04	5.1	7.03E-05	83.121	21.4672	1.00994	0.00036	11.46	112.05	0.00787
5	2500	29.47	28.31	2.7408	3.7038	240	11.42	6.78	9.34E-05	90.788	20.9574	1.01329	0.00035	11.16	109.12	0.0078
6	3000	35.08	33.70	3.3499	4.4078	241	13.9	11.3	0.000156	127.147	20.46	1.01324	0.00035	10.92	106.77	0.00771
7	3500	40.27	38.68	3.94702	5.0603	242	16.31	20.17	0.000278	197.687	16.224	1.01284	0.00027	11.15	109.02	0.00778

Test	Load	η <sub>v</sub>	Φ	Oil T.	W.T.	Db.T.	Exh.T.	Int.airT.	Gas.T.	P atm.	Correction Factor			ρ <sub>air</sub>	Gen.	TECE	STEC
No.	(W)	-	-	(°C)	(°C)	(°C)	(°C)	(°C)	(°C)	(mm Hg)	k	α	β	kg/m <sup>3</sup>	%Eff	%Eff	MJ/kWh
1	500	0.5371	0.4726	81	86	31	170	32	32	773.3	1.017	1.020	0.997	1.1753	45.00	10.87	33.12
2	1000	0.5279	0.5080	85	82	29	189	30	29	773.3	1.024	1.028	0.996	1.1831	60.50	15.30	23.53
3	1500	0.5229	0.5099	87	87	27	215	28	28	773.3	1.030	1.036	0.995	1.1909	69.00	20.08	17.93
4	2000	0.5308	0.5436	87	88	27	234	29	27	773.3	1.030	1.036	0.995	1.1870	71.00	24.46	14.72
5	2500	0.5218	0.5832	89	93	26	264	27	27	774	1.035	1.041	0.994	1.1960	74.00	27.99	12.86
6	3000	0.5162	0.6969	90	93	26	279	27	26	774	1.035	1.041	0.994	1.1960	76.00	28.15	12.79
7	3500	0.5225	0.8355	97	98	26	326	28	26	774	1.035	1.041	0.994	1.1920	78.00	26.67	13.50

ตารางที่ ๑-5 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1500 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล

Test No.	Load (W)	Torque (Nm)	Cortd.T (Nm)	Power (kW)	Cortd. P (kW)	Volt. (V.)	Cur. (A.)	V <sub>diesel</sub> (cc/min)	m <sub>diesel</sub> (kg/s)	sfc (die.) (g/kW.h)	V <sub>biogas</sub> (L/min)	ρ <sub>biogas</sub> (kg/m <sup>3</sup> )	m <sub>biogas</sub> (kg/s)	Dp <sub>air</sub> (mm H <sub>2</sub> O)	Dp <sub>air</sub> (kPa)	m <sub>a</sub> (kg/s)
1	500	7.51	7.35	0.531	1.1794	238	2.23	12.08	0.000166	508	-	-	-	20.38	199.27	0.01042
2	1000	11.37	11.26	1.081	1.7866	236	4.58	14.45	0.000199	401	-	-	-	21.15	206.80	0.01058
3	1500	14.83	14.74	1.607	2.3292	236	6.81	16.39	0.000226	349	-	-	-	19.57	191.35	0.01017
4	2000	20.00	19.83	2.230	3.1411	236	9.45	17.91	0.000247	283	-	-	-	19.10	186.75	0.01005
5	2500	24.20	23.93	2.813	3.8011	240	11.72	20.94	0.000288	273	-	-	-	18.98	185.58	0.01003
6	3000	28.68	28.25	3.424	4.5057	242	14.15	24.16	0.000333	266	-	-	-	19.10	186.75	0.01009
7	3500	32.20	31.72	3.945	5.0579	241	16.37	27.80	0.000383	273	-	-	-	19.33	189.00	0.01015
8	4000	36.38	35.70	4.514	5.7144	240	18.81	30.95	0.000426	269	-	-	-	19.10	186.75	0.01012
9	4500	40.30	39.39	5.064	6.3300	240	21.10	36.43	0.000502	285	-	-	-	18.96	185.38	0.01010
10	4800	43.11	41.97	5.417	6.7711	238	22.76	40.59	0.000559	297	-	-	-	18.69	182.74	0.01005



ตารางที่ ๑-5 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1500 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล (ต่อ)

Test No.	Load (W)	$\eta_v$	$\Phi$	Oil T. (°C)	W.T. (°C)	Db.T. (°C)	Exh.T. (°C)	Int.airT. (°C)	Gas.T. (°C)	P atm. (mm Hg)	Correction Factor			$\rho_{air}$ (kg/m <sup>3</sup> )	Gen. (%Eff)	TECE (%Eff)	STEC (MJ/kWh)
		-	-								k	$\alpha$	$\beta$				
1	500	0.5704	0.2316	70	73	30	192	33	33	772.20	1.019	1.022	0.997	1.1698	45.0	16.68	21.69
2	1000	0.5830	0.2728	74	76	33	215	35	34	772.20	1.009	1.010	0.998	1.1622	60.5	21.12	17.01
3	1500	0.5609	0.3218	79	81	34	244	35	34	771.80	1.005	1.006	0.999	1.1616	69.0	24.27	14.81
4	2000	0.5544	0.3561	83	85	33	275	35	34	771.00	1.007	1.009	0.999	1.1604	71.0	29.95	11.99
5	2500	0.5520	0.4172	85	88	32	316	34	33	770.30	1.010	1.011	0.998	1.1631	74.0	31.00	11.70
6	3000	0.5520	0.4783	88	93	31	355	32	31	770.30	1.013	1.015	0.998	1.1708	76.0	31.85	11.30
7	3500	0.5553	0.5471	90	95	31	398	32	31	770.30	1.013	1.015	0.998	1.1708	78.0	31.07	11.60
8	4000	0.5502	0.6107	90	95	30	446	30	30	770.30	1.016	1.019	0.997	1.1785	79.0	31.53	11.37
9	4500	0.5472	0.7203	91	98	29	525	29	29	770.30	1.020	1.023	0.997	1.1824	80.0	29.68	12.12
10	4800	0.5424	0.8070	96	100	28	551	28	28	770.30	1.023	1.027	0.996	1.1863	80.0	28.49	12.62

ตารางที่ ๑-6 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1500 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ

Test No.	Load (W)	Torque (Nm)	Cortd.T (Nm)	Power (kW)	Cortd. P (kW)	Volt. (V.)	Cur. (A.)	V <sub>diesel</sub> (cc/min)	m <sub>diesel</sub> (kg/s)	sfc (die.) (g/kW.h)	V <sub>biogas</sub> (L/min)	ρ <sub>biogas</sub> (kg/m <sup>3</sup> )	m <sub>biogas</sub> (kg/s)	Dp <sub>air</sub> (mm H <sub>2</sub> O)	Dp <sub>air</sub> (kPa)	m <sub>a</sub> (kg/s)
1	500	7.47	7.39	0.52836	1.1741	238	2.22	0.97	1.34E-05	40.973	24.4598	0.98055	0.0004	13.4	131.02	0.00842
2	1000	11.40	11.33	1.08324	1.7905	236	4.59	0.85	1.17E-05	23.545	24.4721	0.9796	0.0004	18.05	176.49	0.00977
3	1500	14.85	14.76	1.60952	2.3326	236	6.82	2.62	3.61E-05	55.706	22.9513	0.98279	0.00038	13.75	134.44	0.00853
4	2000	20.04	19.89	2.23492	3.1478	236	9.47	3.9	5.37E-05	61.448	25.507	0.9809	0.00042	17.47	170.81	0.00963
5	2500	24.01	23.74	2.7912	3.7719	240	11.63	5.6	7.71E-05	73.633	25.7269	0.98738	0.00042	17.94	175.41	0.00976
6	3000	28.68	28.25	3.4243	4.5057	242	14.15	6.91	9.52E-05	76.062	28.8508	0.99062	0.00048	17.58	171.89	0.00968
7	3500	32.16	31.68	3.94035	5.0517	241	16.35	10.97	0.000151	107.699	26.6445	0.99379	0.00044	17.82	174.24	0.00976
8	4000	36.53	35.71	4.53321	5.7382	241	18.81	14.57	0.000201	125.929	25.0071	0.99711	0.00042	17.75	173.55	0.00976
9	4500	40.34	39.42	5.0688	6.3360	240	21.12	18.28	0.000252	143.089	24.0103	0.99704	0.0004	17.93	175.31	0.00984
10	4800	43.16	41.98	5.42402	6.7800	238	22.79	22.98	0.000317	168.099	23.9685	0.99774	0.0004	17.82	174.24	0.00982

ตารางที่ ๑-6 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1500 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ (ต่อ)

Test	Load	$\eta_v$	$\Phi$	Oil T.	W.T.	Db.T.	Exh.T.	Int.airT.	Gas.T.	P atm.	Correction Factor			$\rho_{air}$	Gen.	TECE	STEC
No.	(W)	-	-	(°C)	(°C)	(°C)	(°C)	(°C)	(°C)	(mm Hg)	k	$\alpha$	$\beta$	kg/m <sup>3</sup>	%Eff	%Eff	MJ/kWh
1	500	0.4639	0.4511	74	76	33	176	35	35	772.56	1.009	1.011	0.998	1.1628	45.00	10.65	33.82
2	1000	0.5387	0.3862	80	81	34	191	35	35	771.8	1.005	1.006	0.999	1.1616	60.50	16.35	22.02
3	1500	0.4702	0.4590	84	88	34	206	35	34	771.8	1.005	1.006	0.999	1.1616	69.00	20.51	17.55
4	2000	0.5288	0.4713	87	91	33	221	33	34	770.3	1.006	1.007	0.999	1.1669	71.00	23.85	15.09
5	2500	0.5358	0.5057	88	94	32	240	33	32	770.3	1.010	1.011	0.998	1.1669	74.00	26.27	13.70
6	3000	0.5296	0.5864	90	97	31	269	32	31	770.3	1.013	1.015	0.998	1.1708	76.00	27.29	13.19
7	3500	0.5323	0.6322	91	97	31	283	31	30	770.3	1.013	1.015	0.998	1.1746	78.00	28.11	12.81
8	4000	0.5304	0.6823	92	98	29	315	30	29	770.3	1.020	1.023	0.997	1.1785	79.00	29.57	12.18
9	4500	0.5313	0.7367	94	99	29	360	28	29	770.3	1.020	1.023	0.997	1.1863	80.00	29.97	12.01
10	4800	0.5294	0.8339	97	101	28	380	28	29	771	1.024	1.028	0.996	1.1874	80.00	28.39	12.68

ตารางที่ ๑-7 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1800 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล

Test No.	Load (W)	Torque (Nm)	Cortd.T (Nm)	Power (kW)	Cortd. P (kW)	Volt. (V.)	Cur. (A.)	V <sub>diesel</sub> (cc/min)	m <sub>diesel</sub> (kg/s)	sfc (die.) (g/kW.h)	V <sub>biogas</sub> (L/min)	ρ <sub>biogas</sub> (kg/m <sup>3</sup> )	m <sub>biogas</sub> (kg/s)	Dp <sub>air</sub> (mm H <sub>2</sub> O)	Dp <sub>air</sub> (kPa)	m <sub>a</sub> (kg/s)
1	500	6.24	6.16	0.529	1.1756	230	2.30	13.71	0.000189	578	-	-	-	20.38	199.27	0.01043
2	1000	9.38	9.11	1.069	1.7676	234	4.57	16.18	0.000223	454	-	-	-	21.15	206.80	0.01068
3	1500	12.28	11.89	1.598	2.3155	236	6.77	17.83	0.000246	382	-	-	-	19.57	191.35	0.01029
4	2000	16.05	15.48	2.148	3.0248	236	9.10	20.08	0.000277	329	-	-	-	19.10	186.75	0.01018
5	2500	19.37	18.60	2.701	3.6504	238	11.35	22.53	0.000310	306	-	-	-	18.98	185.58	0.01018
6	3000	23.01	22.10	3.296	4.3366	239	13.79	25.02	0.000345	286	-	-	-	19.10	186.75	0.01022
7	3500	26.75	25.60	3.934	5.0431	240	16.39	28.72	0.000396	282	-	-	-	19.33	189.00	0.01028
8	4000	30.04	28.77	4.473	5.6620	241	18.56	31.23	0.000430	274	-	-	-	19.10	186.75	0.01023
9	4500	33.26	31.86	5.016	6.2700	240	20.90	34.73	0.000478	275	-	-	-	18.96	185.38	0.01017
10	5000	35.82	34.31	5.401	6.7518	239	22.60	37.70	0.000519	277	-	-	-	18.69	182.74	0.01012
11	5500	39.91	39.27	6.018	7.5225	236	25.50	42.34	0.000583	279	-	-	-	18.92	184.99	0.01005
12	5800	42.00	41.36	6.254	7.9165	236	26.50	47.12	0.000649	295	-	-	-	18.69	182.74	0.01000



ตารางที่ จ-7 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1800 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล (ต่อ)

Test No.	Load (W)	$\eta_v$	$\Phi$	Oil T. (°C)	W.T. (°C)	Db.T. (°C)	Exh.T. (°C)	Int.airT. (°C)	Gas.T. (°C)	P atm. (mm Hg)	Correction Factor			$\rho_{air}$ (kg/m <sup>3</sup> )	Gen. (%Eff)	TECE (%Eff)	STEC (MJ/kWh)
		-	-								k	$\alpha$	$\beta$				
1	500	0.4748	0.2626	71	77	33	205	33	33	774.00	1.011	1.013	0.998	1.1725	45.0	14.64	24.48
2	1000	0.4813	0.3027	75	80	29	226	30	30	774.00	1.025	1.029	0.996	1.1841	60.5	18.66	19.25
3	1500	0.4622	0.3462	81	82	28	251	29	29	774.00	1.028	1.033	0.995	1.1881	69.0	22.18	16.21
4	2000	0.4559	0.3940	83	82	27	273	28	27	774.00	1.031	1.037	0.995	1.1920	71.0	25.73	13.99
5	2500	0.4529	0.4419	85	84	26	302	26	27	774.00	1.035	1.041	0.994	1.2000	74.0	27.67	13.02
6	3000	0.4544	0.4892	85	84	26	331	26	26	774.00	1.035	1.041	0.994	1.2000	76.0	29.60	12.18
7	3500	0.4571	0.5582	86	87	25	365	26	27	774.00	1.038	1.045	0.994	1.2000	78.0	29.99	12.07
8	4000	0.4538	0.6099	90	90	25	408	25	25	773.30	1.037	1.044	0.994	1.2029	79.0	30.96	11.60
9	4500	0.4529	0.6819	91	93	25	449	26	25	773.30	1.037	1.044	0.994	1.1989	80.0	30.83	11.79
10	5000	0.4489	0.7443	92	95	25	499	25	25	773.30	1.037	1.044	0.994	1.2029	80.0	30.59	11.65
11	5500	0.4576	0.8418	93	96	33	532	34	33	776.00	1.014	1.016	0.998	1.1717	80.0	30.34	11.86
12	5800	0.4542	0.9413	96	100	33	572	33	32	775.56	1.013	1.016	0.998	1.1749	79.0	28.69	12.50

ตารางที่ ๑-8 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1800 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ

Test	Load	Torque	Cortd.T	Power	Cortd. P	Volt.	Cur.	V <sub>diesel</sub>	m <sub>diesel</sub>	sfc (die.)	V <sub>biogas</sub>	p <sub>biogas</sub>	m <sub>biogas</sub>	Dp <sub>air</sub>	Dp <sub>air</sub>	m <sub>g</sub>
No.	(W)	(Nm)	(Nm)	(kW)	(kW)	(V.)	(A.)	(cc/min)	(kg/s)	(g/kW.h)	(L/min)	(kg/m <sup>3</sup> )	(kg/s)	(mm H <sub>2</sub> O)	(kPa)	(kg/s)
1	500	6.26	6.14	0.5313	1.1807	230	2.31	1.14	1.57E-05	47.888	26.5445	1.00235	0.00044	13.4	131.02	0.00849
2	1000	9.40	9.13	1.07172	1.7714	234	4.58	1.18	1.63E-05	33.037	27.4444	1.00568	0.00046	18.05	176.49	0.00987
3	1500	12.30	11.91	1.60008	2.3190	236	6.78	1.82	2.51E-05	38.925	31.353	0.97915	0.00051	13.75	134.44	0.00862
4	2000	16.05	15.48	2.1476	3.0248	236	9.1	2.74	3.77E-05	44.926	31.9185	0.97812	0.00052	17.47	170.81	0.00974
5	2500	19.35	18.59	2.69892	3.6472	238	11.34	3.82	5.26E-05	51.946	31.1932	0.97195	0.00051	17.94	175.41	0.0099
6	3000	22.97	22.07	3.29103	4.3303	239	13.77	5.93	8.17E-05	67.918	32.8113	0.97303	0.00053	17.58	171.89	0.0098
7	3500	26.61	25.46	3.912	5.0154	240	16.3	9.14	0.000126	90.383	31.4179	0.97522	0.00051	17.82	174.24	0.00988
8	4000	30.10	28.84	4.4826	5.6742	241	18.6	11.05	0.000152	96.584	31.3136	0.98154	0.00051	17.75	173.55	0.00984
9	4500	32.93	31.54	4.9656	6.2070	240	20.69	14.34	0.000198	114.581	30.8506	0.98385	0.00051	17.93	175.31	0.00989
10	5000	36.20	34.68	5.45876	6.8235	239	22.84	16.56	0.000228	120.366	30.7179	0.98389	0.0005	17.82	174.24	0.00988
11	5500	39.92	39.14	6.02036	7.5255	236	25.51	19.78	0.000273	130.359	31.0402	0.98712	0.00051	17.81	174.14	0.00976
12	5800	42.16	41.51	6.2776	7.9463	236	26.6	24.21	0.000334	151.104	30.465	0.99032	0.0005	18.1	176.97	0.00984

ตารางที่ ๑-8 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 1800 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ (ต่อ)

Test No.	Load (W)	$\eta_v$	$\Phi$	Oil T. (°C)	W.T. (°C)	Db.T. (°C)	Exh.T. (°C)	Int.airT. (°C)	Gas.T. (°C)	P atm. (mm Hg)	Correction Factor			$\rho_{air}$ (kg/m <sup>3</sup> )	Gen. %Eff	TECE %Eff	STEC MJ/kWh
											k	$\alpha$	$\beta$				
1	500	0.3837	0.4982	74	78	31	187	31	31	774	1.018	1.021	0.997	1.1802	45.00	9.62	37.42
2	1000	0.4446	0.4445	81	82	29	195	30	30	774	1.025	1.029	0.996	1.1841	60.50	13.92	25.87
3	1500	0.3874	0.5773	85	84	28	206	29	29	774	1.028	1.033	0.995	1.1881	69.00	16.04	22.44
4	2000	0.4360	0.5382	86	88	27	225	28	28	774	1.031	1.037	0.995	1.1920	71.00	19.87	18.12
5	2500	0.4403	0.5374	88	85	26	249	26	27	774	1.035	1.041	0.994	1.2000	74.00	23.59	15.26
6	3000	0.4359	0.6106	91	91	26	275	26	27	774	1.035	1.041	0.994	1.2000	76.00	24.89	14.46
7	3500	0.4381	0.6507	91	95	25	301	25	26	774	1.038	1.045	0.994	1.2040	78.00	26.80	13.43
8	4000	0.4382	0.6936	93	93	25	310	26	25	773.3	1.037	1.044	0.994	1.1989	79.00	28.55	12.61
9	4500	0.4404	0.7507	93	95	25	324	26	26	773.3	1.037	1.044	0.994	1.1989	80.00	28.69	12.55
10	5000	0.4383	0.7947	94	97	25	360	25	25	773.3	1.037	1.044	0.994	1.2029	80.00	29.83	12.07
11	5500	0.4433	0.8764	96	98	32	390	33	33	776	1.017	1.020	0.997	1.1756	80.00	30.17	11.93
12	5800	0.4470	0.9524	97	101	33	412	33	33	775.56	1.013	1.016	0.998	1.1749	79.00	29.07	12.38

ตารางที่ ๑-9 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 2000 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล

Test No.	Load (W)	Torque (Nm)	Cortd.T (Nm)	Power (kW)	Cortd. P (kW)	Volt. (V.)	Cur. (A.)	V <sub>diesel</sub> (cc/min)	m <sub>diesel</sub> (kg/s)	sfc (die.) (g/kW.h)	V <sub>biogas</sub> (L/min)	ρ <sub>biogas</sub> (kg/m <sup>3</sup> )	m <sub>biogas</sub> (kg/s)	Dp <sub>air</sub> (mm H <sub>2</sub> O)	Dp <sub>air</sub> (kPa)	m <sub>a</sub> (kg/s)
1	500	6.24	6.16	0.529	1.1756	230	2.30	13.71	0.000189	578	-	-	-	20.38	199.27	0.01043
2	1000	9.38	9.11	1.069	1.7676	234	4.57	16.18	0.000223	454	-	-	-	21.15	206.80	0.01068
3	1500	12.28	11.89	1.598	2.3155	236	6.77	17.83	0.000246	382	-	-	-	19.57	191.35	0.01029
4	2000	16.05	15.48	2.148	3.0248	236	9.10	20.08	0.000277	329	-	-	-	19.10	186.75	0.01018
5	2500	19.37	18.60	2.701	3.6504	238	11.35	22.53	0.000310	306	-	-	-	18.98	185.58	0.01018
6	3000	23.01	22.10	3.296	4.3366	239	13.79	25.02	0.000345	286	-	-	-	19.10	186.75	0.01022
7	3500	26.75	25.60	3.934	5.0431	240	16.39	28.72	0.000396	282	-	-	-	19.33	189.00	0.01028
8	4000	30.04	28.77	4.473	5.6620	241	18.56	31.23	0.000430	274	-	-	-	19.10	186.75	0.01023
9	4500	33.26	31.86	5.016	6.2700	240	20.90	34.73	0.000478	275	-	-	-	18.96	185.38	0.01017
10	5000	35.82	34.31	5.401	6.7518	239	22.60	37.70	0.000519	277	-	-	-	18.69	182.74	0.01012
11	5500	39.91	39.27	6.018	7.5225	236	25.50	42.34	0.000583	279	-	-	-	18.92	184.99	0.01005
12	5800	42.00	41.36	6.254	7.9165	236	26.50	47.12	0.000649	295	-	-	-	18.69	182.74	0.01000



ตารางที่ จ-9 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 2000 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล (ต่อ)

Test No.	Load (W)	$\eta_v$	$\Phi$	Oil T. (°C)	W.T. (°C)	Db.T. (°C)	Exh.T. (°C)	Int.airT. (°C)	Gas.T. (°C)	P atm. (mm Hg)	Correction Factor			$\rho_{air}$ (kg/m <sup>3</sup> )	Gen. %Eff	TECE %Eff	STEC MJ/kWh
											k	$\alpha$	$\beta$				
1	500	0.4748	0.2626	71	77	33	205	33	33	774.00	1.011	1.013	0.998	1.1725	45.0	14.64	24.48
2	1000	0.4813	0.3027	75	80	29	226	30	30	774.00	1.025	1.029	0.996	1.1841	60.5	18.66	19.25
3	1500	0.4622	0.3462	81	82	28	251	29	29	774.00	1.028	1.033	0.995	1.1881	69.0	22.18	16.21
4	2000	0.4559	0.3940	83	82	27	273	28	27	774.00	1.031	1.037	0.995	1.1920	71.0	25.73	13.99
5	2500	0.4529	0.4419	85	84	26	302	26	27	774.00	1.035	1.041	0.994	1.2000	74.0	27.67	13.02
6	3000	0.4544	0.4892	85	84	26	331	26	26	774.00	1.035	1.041	0.994	1.2000	76.0	29.60	12.18
7	3500	0.4571	0.5582	86	87	25	365	26	27	774.00	1.038	1.045	0.994	1.2000	78.0	29.99	12.07
8	4000	0.4538	0.6099	90	90	25	408	25	25	773.30	1.037	1.044	0.994	1.2029	79.0	30.96	11.60
9	4500	0.4529	0.6819	91	93	25	449	26	25	773.30	1.037	1.044	0.994	1.1989	80.0	30.83	11.79
10	5000	0.4489	0.7443	92	95	25	499	25	25	773.30	1.037	1.044	0.994	1.2029	80.0	30.59	11.65
11	5500	0.4576	0.8418	93	96	33	532	34	33	776.00	1.014	1.016	0.998	1.1717	80.0	30.34	11.86
12	5800	0.4542	0.9413	96	100	33	572	33	32	775.56	1.013	1.016	0.998	1.1749	79.0	28.69	12.50

ตารางที่ จ-10 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 2000 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ

Test	Load	Torque	Cortd.T	Power	Cortd. P	Volt.	Cur.	V <sub>diesel</sub>	m <sub>diesel</sub>	sfc (die.)	V <sub>biogas</sub>	ρ <sub>biogas</sub>	m <sub>biogas</sub>	Dp <sub>air</sub>	Dp <sub>air</sub>	m <sub>a</sub>
No.	(W)	(Nm)	(Nm)	(kW)	(kW)	(V.)	(A.)	(cc/min)	(kg/s)	(g/kW.h)	(L/min)	(kg/m <sup>3</sup> )	(kg/s)	(mm H <sub>2</sub> O)	(kPa)	(kg/s)
1	500	6.26	6.14	0.5313	1.1807	230	2.31	1.14	1.57E-05	47.888	26.5445	1.00235	0.00044	13.4	131.02	0.00849
2	1000	9.40	9.13	1.07172	1.7714	234	4.58	1.18	1.63E-05	33.037	27.4444	1.00568	0.00046	18.05	176.49	0.00987
3	1500	12.30	11.91	1.60008	2.3190	236	6.78	1.82	2.51E-05	38.925	31.353	0.97915	0.00051	13.75	134.44	0.00862
4	2000	16.05	15.48	2.1476	3.0248	236	9.1	2.74	3.77E-05	44.926	31.9185	0.97812	0.00052	17.47	170.81	0.00974
5	2500	19.35	18.59	2.69892	3.6472	238	11.34	3.82	5.26E-05	51.946	31.1932	0.97195	0.00051	17.94	175.41	0.0099
6	3000	22.97	22.07	3.29103	4.3303	239	13.77	5.93	8.17E-05	67.918	32.8113	0.97303	0.00053	17.58	171.89	0.0098
7	3500	26.61	25.46	3.912	5.0154	240	16.3	9.14	0.000126	90.383	31.4179	0.97522	0.00051	17.82	174.24	0.00988
8	4000	30.10	28.84	4.4826	5.6742	241	18.6	11.05	0.000152	96.584	31.3136	0.98154	0.00051	17.75	173.55	0.00984
9	4500	32.93	31.54	4.9656	6.2070	240	20.69	14.34	0.000198	114.581	30.8506	0.98385	0.00051	17.93	175.31	0.00989
10	5000	36.20	34.68	5.45876	6.8235	239	22.84	16.56	0.000228	120.366	30.7179	0.98389	0.0005	17.82	174.24	0.00988
11	5500	39.92	39.14	6.02036	7.5255	236	25.51	19.78	0.000273	130.359	31.0402	0.98712	0.00051	17.81	174.14	0.00976
12	5800	42.16	41.51	6.2776	7.9463	236	26.6	24.21	0.000334	151.104	30.465	0.99032	0.0005	18.1	176.97	0.00984

ตารางที่ จ-10 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 2000 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ (ต่อ)

Test No.	Load (W)	$\eta_v$	$\Phi$	Oil T. (°C)	W.T. (°C)	Db.T. (°C)	Exh.T. (°C)	Int.airT. (°C)	Gas.T. (°C)	P atm. (mm Hg)	Correction Factor			$\rho_{air}$ (kg/m <sup>3</sup> )	Gen. %Eff	TECE %Eff	STEC MJ/kWh
											k	$\alpha$	$\beta$				
1	500	0.3837	0.4982	74	78	31	187	31	31	774	1.018	1.021	0.997	1.1802	45.00	9.62	37.42
2	1000	0.4446	0.4445	81	82	29	195	30	30	774	1.025	1.029	0.996	1.1841	60.50	13.92	25.87
3	1500	0.3874	0.5773	85	84	28	206	29	29	774	1.028	1.033	0.995	1.1881	69.00	16.04	22.44
4	2000	0.4360	0.5382	86	88	27	225	28	28	774	1.031	1.037	0.995	1.1920	71.00	19.87	18.12
5	2500	0.4403	0.5374	88	85	26	249	26	27	774	1.035	1.041	0.994	1.2000	74.00	23.59	15.26
6	3000	0.4359	0.6106	91	91	26	275	26	27	774	1.035	1.041	0.994	1.2000	76.00	24.89	14.46
7	3500	0.4381	0.6507	91	95	25	301	25	26	774	1.038	1.045	0.994	1.2040	78.00	26.80	13.43
8	4000	0.4382	0.6936	93	93	25	310	26	25	773.3	1.037	1.044	0.994	1.1989	79.00	28.55	12.61
9	4500	0.4404	0.7507	93	95	25	324	26	26	773.3	1.037	1.044	0.994	1.1989	80.00	28.69	12.55
10	5000	0.4383	0.7947	94	97	25	360	25	25	773.3	1.037	1.044	0.994	1.2029	80.00	29.83	12.07
11	5500	0.4433	0.8764	96	98	32	390	33	33	776	1.017	1.020	0.997	1.1756	80.00	30.17	11.93
12	5800	0.4470	0.9524	97	101	33	412	33	33	775.56	1.013	1.016	0.998	1.1749	79.00	29.07	12.38

ตารางที่ จ-11 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 2400 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล

Test No.	Load (W)	Torque (Nm)	Cortd.T (Nm)	Power (kW)	Cortd. P (kW)	Volt. (V.)	Cur. (A.)	V <sub>diesel</sub> (cc/min)	m <sub>diesel</sub> (kg/s)	sfc (die.) (g/kW.h)	V <sub>biogas</sub> (L/min)	ρ <sub>biogas</sub> (kg/m <sup>3</sup> )	m <sub>biogas</sub> (kg/s)	Dp <sub>air</sub> (mm H <sub>2</sub> O)	Dp <sub>air</sub> (kPa)	m <sub>a</sub> (kg/s)
1	500	4.62	4.49	0.522	1.1603	228	2.29	19.03	0.000262	813	-	-	-	32.64	319.14	0.01324
2	1000	6.85	6.73	1.042	1.7222	229	4.55	21.11	0.000291	608	-	-	-	31.77	310.63	0.01303
3	1500	9.28	9.15	1.610	2.3333	230	7.00	23.54	0.000324	500	-	-	-	32.12	314.06	0.01308
4	2000	12.34	12.16	2.201	3.1001	230	9.57	25.13	0.000346	402	-	-	-	31.95	312.39	0.01305
5	2500	14.97	14.83	2.784	3.7622	232	12.00	28.14	0.000388	371	-	-	-	31.77	310.63	0.01298
6	3000	17.30	17.22	3.304	4.3474	236	14.00	30.26	0.000417	345	-	-	-	31.71	310.05	0.01294
7	3500	19.74	19.66	3.870	4.9621	236	16.40	33.10	0.000456	331	-	-	-	31.59	308.87	0.01292
8	4000	21.85	21.75	4.338	5.4907	236	18.38	35.47	0.000489	320	-	-	-	31.59	308.87	0.01294
9	4500	24.53	24.34	4.931	6.1642	238	20.72	38.01	0.000524	306	-	-	-	31.60	308.97	0.01296
10	5000	26.98	26.77	5.424	6.7800	238	22.79	41.00	0.000565	300	-	-	-	31.59	308.87	0.01296
11	5500	29.34	29.01	5.900	7.3750	236	25.00	43.93	0.000605	295	-	-	-	31.59	308.87	0.01296
12	6000	32.11	31.73	6.376	8.0703	235	27.13	47.24	0.000651	290	-	-	-	31.48	307.80	0.01296
13	6500	35.12	34.57	6.973	8.8268	234	29.80	51.55	0.000710	290	-	-	-	30.90	302.13	0.01284
14	6800	36.65	35.93	7.277	9.2108	231	31.50	53.85	0.000742	290	-	-	-	30.12	294.50	0.01270

ตารางที่ ๑-11 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 2400 รอบต่อนาที สำหรับเชื้อเพลิงดีเซล (ต่อ)

Test No.	Load (W)	$\eta_v$	$\Phi$	Oil T. (°C)	W.T. (°C)	Db.T. (°C)	Exh.T. (°C)	Int.airT. (°C)	Gas.T. (°C)	P atm. (mm Hg)	Correction Factor			$\rho_{air}$ (kg/m <sup>3</sup> )	Gen. %Eff	TECE %Eff	STEC MJ/kWh
											k	$\alpha$	$\beta$				
1	500	0.4492	0.2870	88	83	29	237	31	31	774.00	1.025	1.029	0.996	1.1802	45.0	10.41	34.42
2	1000	0.4444	0.3236	89	88	32	253	33	33	774.80	1.016	1.018	0.997	1.1737	60.5	13.93	25.78
3	1500	0.4475	0.3595	90	94	33	274	34	33	774.80	1.012	1.014	0.998	1.1699	69.0	16.93	21.11
4	2000	0.4464	0.3848	92	95	33	296	34	33	774.70	1.012	1.014	0.998	1.1698	71.0	21.07	17.10
5	2500	0.4460	0.4330	95	95	34	318	35	34	774.00	1.008	1.009	0.999	1.1649	74.0	22.83	15.90
6	3000	0.4466	0.4670	95	95	35	341	36	36	773.30	1.004	1.004	0.999	1.1601	76.0	24.54	14.66
7	3500	0.4457	0.5119	97	97	35	366	36	35	773.30	1.004	1.004	0.999	1.1601	78.0	25.60	14.07
8	4000	0.4450	0.5476	97	98	35	389	35	35	773.30	1.004	1.004	0.999	1.1639	79.0	26.44	13.66
9	4500	0.4444	0.5859	98	98	34	417	34	33	773.00	1.007	1.008	0.999	1.1672	80.0	27.70	12.99
10	5000	0.4443	0.6321	99	98	34	449	34	34	773.00	1.007	1.008	0.999	1.1672	80.0	28.24	12.74
11	5500	0.4443	0.6773	100	98	33	477	34	33	773.00	1.010	1.012	0.998	1.1672	80.0	28.67	12.57
12	5800	0.4428	0.7282	101	98	33	510	33	33	773.30	1.010	1.012	0.998	1.1715	79.0	29.18	12.37
13	5500	0.4387	0.8021	101	99	32	546	33	33	773.30	1.014	1.016	0.998	1.1715	79.0	29.24	12.31
14	5800	0.4324	0.8473	102	102	31	567	32	32	773.30	1.017	1.020	0.997	1.1753	79.0	29.21	12.34

ตารางที่ ๑-12 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 2400 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ

Test	Load	Torque	Cordt.T	Power	Cordt. P	Volt.	Cur.	V <sub>diesel</sub>	m <sub>diesel</sub>	sfc (die.)	V <sub>biogas</sub>	ρ <sub>biogas</sub>	m <sub>biogas</sub>	Dp <sub>air</sub>	Dp <sub>air</sub>	m <sub>a</sub>
No.	(W)	(Nm)	(Nm)	(kW)	(kW)	(V.)	(A.)	(cc/min)	(kg/s)	(g/kW.h)	(L/min)	(kg/m <sup>3</sup> )	(kg/s)	(mm H <sub>2</sub> O)	(kPa)	(kg/s)
1	500	4.64	4.55	0.5244	1.1653	228	2.3	1.42	1.96E-05	60.434	40.1466	0.9906	0.00066	30.72	300.37	0.01281
2	1000	6.87	6.74	1.04424	1.7260	229	4.56	1.28	1.76E-05	36.780	40.2186	0.98533	0.00066	29.72	290.59	0.0126
3	1500	9.35	9.22	1.6215	2.3500	230	7.05	1.45	2E-05	30.602	40.2007	0.98852	0.00066	29.72	290.59	0.01258
4	2000	12.32	12.21	2.1988	3.0969	230	9.56	1.98	2.73E-05	31.709	40.5642	0.99826	0.00067	29.55	288.93	0.01252
5	2500	14.84	14.71	2.7608	3.7308	232	11.9	2.84	3.91E-05	37.754	44.0569	1.00167	0.00074	29.31	286.58	0.01247
6	3000	17.31	17.17	3.30636	4.3505	236	14.01	5.64	7.77E-05	64.297	43.7123	1.00485	0.00073	28.5	278.66	0.01229
7	3500	19.73	19.57	3.86804	4.9590	236	16.39	12.47	0.000172	124.714	40.0054	1.00843	0.00067	29.55	288.93	0.01251
8	4000	21.78	21.68	4.32352	5.4728	236	18.32	14.02	0.000193	127.053	40.113	1.00823	0.00067	30	293.33	0.01261
9	4500	24.54	24.35	4.93374	6.1672	238	20.73	16.62	0.000229	133.657	36.0812	0.99569	0.0006	29.43	287.75	0.01249
10	5000	26.99	26.68	5.4264	6.7830	238	22.8	18.65	0.000257	136.365	35.3614	0.98833	0.00058	29.5	288.44	0.01252
11	5500	29.31	28.97	5.89292	7.3662	236	24.97	20.39	0.000281	137.285	35.2652	0.98411	0.00058	30	293.33	0.01265
12	6000	32.02	31.51	6.35675	8.0465	235	27.05	23.75	0.000327	146.387	34.2427	0.98732	0.00056	29.54	288.83	0.01255
13	6500	35.13	34.58	6.97554	8.8298	234	29.81	27.97	0.000385	157.104	33.9428	0.97993	0.00055	29	283.55	0.01244
14	6800	36.60	35.89	7.26726	9.1991	231	31.46	31.87	0.000439	171.825	31.899	0.97993	0.00052	28.43	277.98	0.01233

ตารางที่ จ-12 แสดงตารางทดสอบสมรรถนะที่ ความเร็วรอบ 2400 รอบต่อนาที สำหรับเชื้อเพลิงดีเซลร่วมกับก๊าซชีวภาพ (ต่อ)

Test No.	Load (W)	$\eta_v$	$\Phi$	Oil T. (°C)	W.T. (°C)	Db.T. (°C)	Exh.T. (°C)	Int.airT. (°C)	Gas.T. (°C)	P atm. (mm Hg)	Correction Factor			$\rho_{air}$ (kg/m <sup>3</sup> )	Gen. %Eff	TECE %Eff	STEC MJ/kWh
											k	$\alpha$	$\beta$				
1	500	0.4370	0.4887	93	88	32	247	33	33	774.8	1.016	1.018	0.997	1.1737	45.00	6.41	56.15
2	1000	0.4298	0.4930	94	91	32	260	33	33	774.8	1.016	1.018	0.997	1.1737	60.50	9.57	37.61
3	1500	0.4305	0.4978	94	96	33	272	34	34	774.8	1.012	1.014	0.998	1.1699	69.00	12.93	27.85
4	2000	0.4302	0.5178	97	97	34	285	35	35	774	1.008	1.009	0.999	1.1649	71.00	16.45	21.88
5	2500	0.4284	0.5776	98	98	34	298	35	34	774	1.008	1.009	0.999	1.1649	74.00	17.84	20.18
6	3000	0.4227	0.6290	98	98	34	311	35	34	773.3	1.007	1.008	0.999	1.1639	76.00	19.37	18.59
7	3500	0.4304	0.6837	100	100	34	328	35	35	773.3	1.007	1.008	0.999	1.1639	78.00	19.92	18.07
8	4000	0.4336	0.7043	100	104	35	348	35	35	773.3	1.004	1.004	0.999	1.1639	79.00	21.17	17.00
9	4500	0.4296	0.6984	100	104	34	392	35	34	773	1.007	1.008	0.999	1.1634	80.00	24.28	14.83
10	5000	0.4294	0.7171	102	105	33	419	34	33	773	1.010	1.012	0.998	1.1672	80.00	25.93	13.89
11	5500	0.4323	0.7345	103	103	33	429	33	33	773	1.010	1.012	0.998	1.1710	80.00	27.21	13.23
12	6000	0.4289	0.7828	104	104	32	489	33	32	773.3	1.014	1.016	0.998	1.1715	79.00	28.08	12.82
13	6500	0.4250	0.8513	104	104	32	502	33	32	773.3	1.014	1.016	0.998	1.1715	79.00	28.59	12.59
14	6800	0.4201	0.8971	104	104	31	538	32	31	773.3	1.017	1.020	0.997	1.1753	79.00	28.49	12.64

ภาคผนวก จ

ตัวอย่างข้อมูลการทดสอบความทนทาน



ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,417	401	93	91	33.25	35	35	23.51	233.06	5.47924	34	0	0	0:37:54	19/3/2006
2,402	412	93	93	33.25	35	35	23.49	233.14	5.47646	34	0	0	0:38:23	19/3/2006
2,400	418	94	94	33.25	35	35	23.57	233.06	5.49322	34	0	0	0:38:53	19/3/2006
2,403	421	94	95	33.25	35	35	23.53	233.18	5.48673	34	0	0	0:39:22	19/3/2006
2,400	424	95	98	33.25	35	35	23.67	233.08	5.517	34	0	0	0:39:52	19/3/2006
2,405	424	94	99	22.33	35	35	23.66	233.08	5.51467	34	0	0	0:40:21	19/3/2006
2,401	426	94	99	22.33	35	35	23.47	233.16	5.47227	34	0	0	0:40:51	19/3/2006
2,406	427	96	100	22.33	35	35	23.54	233.39	5.494	34	0	10.08	0:41:20	19/3/2006
2,406	424	97	100	22.33	35	35	23.11	233.37	5.39318	34	25.35	10.08	0:41:50	19/3/2006
2,400	424	98	100	22.33	35	35	22.97	233.28	5.35844	34	25.35	10.08	0:42:19	19/3/2006
2,400	424	98	100	22.29	35	35	23.04	233.45	5.37869	34	25.35	10.08	0:42:49	19/3/2006
2,400	424	98	100	22.29	35	35	22.93	233.45	5.35301	34	25.35	10.08	0:43:18	19/3/2006
2,400	424	98	100	22.29	35	35	22.93	233.31	5.3498	34	25.35	10.08	0:43:48	19/3/2006
2,400	424	98	101	22.29	35	35	22.96	233.26	5.35565	34	25.35	10.08	0:44:18	19/3/2006
2,400	424	99	101	22.29	35	35	23	233.51	5.37073	34	25.35	10.08	0:44:47	19/3/2006
2,400	424	98	100	23.54	35	35	23.05	233.47	5.38148	34	25.35	10.08	0:45:17	19/3/2006
2,400	424	98	100	23.54	35	35	23.04	233.55	5.38099	34	25.35	10.08	0:45:46	19/3/2006
2,399	424	100	100	23.54	35	35	22.96	233.55	5.36231	34	25.35	10.08	0:46:16	19/3/2006
2,400	424	100	100	23.54	35	35	23.05	233.55	5.38333	34	25.35	10.08	0:46:45	19/3/2006
2,399	426	99	100	23.54	35	35	23.02	233.61	5.3777	34	25.35	10.08	0:47:15	19/3/2006
2,399	425	100	100	21.4	35	35	23.04	233.57	5.38145	34	25.35	10.08	0:47:44	19/3/2006
2,394	427	99	100	21.4	35	35	22.98	233.61	5.36836	34	25.35	10.08	0:48:14	19/3/2006
2,398	427	100	100	53.82	35	35	23.08	233.51	5.38941	34	25.35	10.08	0:48:43	19/3/2006
2,388	427	101	101	53.82	35	35	23.06	233.31	5.38013	34	25.35	10.08	0:49:13	19/3/2006
2,389	427	101	101	53.82	35	35	22.99	233.41	5.3661	34	25.35	10.08	0:49:43	19/3/2006
2,388	427	102	101	53.82	35	35	23.01	233.43	5.37122	34	25.35	10.08	0:50:12	19/3/2006
2,388	427	103	102	53.82	35	35	23.19	233.22	5.40837	34	25.35	10.08	0:50:42	19/3/2006
2,389	427	102	101	21.73	35	35	23.04	233.41	5.37777	34	25.35	10.08	0:51:11	19/3/2006
2,388	427	102	101	21.73	35	35	23.04	233.06	5.3697	34	25.35	10.08	0:51:41	19/3/2006
2,388	427	101	101	21.73	35	35	22.99	233.18	5.36081	34	25.35	10.08	0:52:10	19/3/2006
2,388	427	101	100	21.73	35	35	23.02	233.2	5.36826	34	25.35	10.08	0:52:40	19/3/2006
2,388	427	101	101	23.1	35	35	23.14	233.02	5.39208	34	25.35	10.08	0:53:09	19/3/2006
2,388	427	103	101	23.1	35	35	22.98	233	5.35434	34	25.35	10.08	0:53:39	19/3/2006
2,388	427	101	100	23.1	35	35	23.02	233	5.36366	34	25.35	10.08	0:54:08	19/3/2006
2,388	427	101	100	23.1	35	35	23.04	232.98	5.36786	34	25.35	10.08	0:54:38	19/3/2006
2,388	427	101	100	23.1	35	35	22.85	232.98	5.32359	34	25.35	10.08	0:55:07	19/3/2006
2,388	427	102	100	23.44	35	35	23.28	232.98	5.42377	34	25.35	10.08	0:55:37	19/3/2006
2,388	427	102	100	276.5	35	35	22.95	232.98	5.34689	34	25.35	10.08	0:56:07	19/3/2006
2,384	427	101	101	251.8	35	35	22.92	232.92	5.33853	34	25.35	10.08	0:56:36	19/3/2006
2,387	427	101	100	251.8	35	35	22.99	232.98	5.35621	34	25.35	10.08	0:57:06	19/3/2006
2,384	427	101	100	251.8	35	35	22.64	232.94	5.27376	34	25.35	10.08	0:57:35	19/3/2006
2,384	427	101	100	251.8	35	35	23.17	232.78	5.39351	34	25.35	10.08	0:58:05	19/3/2006
2,384	427	102	100	23.96	35	35	23.3	232.96	5.42797	34	25.35	10.08	0:58:34	19/3/2006
2,382	427	102	100	23.96	35	35	23.36	232.78	5.43774	34	25.35	10.08	0:59:04	19/3/2006
2,382	427	102	100	23.96	35	35	22.57	232.82	5.25475	34	25.35	10.08	0:59:33	19/3/2006
2,378	427	102	100	23.96	35	35	22.97	232.62	5.34328	34	25.35	10.08	1:00:03	19/3/2006

ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,388	427	100	100	24.42	35	35	23.1	232.96	5.38138	34	25.35	10.08	1:01:32	19/3/2006
2,388	427	101	100	24.42	35	35	22.84	232.92	5.31989	34	25.35	10.08	1:02:01	19/3/2006
2,388	427	102	101	24.42	35	35	22.72	232.9	5.29149	34	25.35	10.08	1:02:31	19/3/2006
2,385	427	102	100	24.42	35	35	23.04	232.42	5.35496	34	25.35	10.08	1:03:00	19/3/2006
2,387	427	102	100	23.88	35	35	23.33	232.52	5.42469	34	25.35	10.08	1:03:30	19/3/2006
2,387	427	102	100	23.88	35	35	22.92	232.16	5.32111	34	25.35	10.08	1:03:59	19/3/2006
2,387	427	103	100	23.88	35	35	23.09	232.52	5.36889	34	25.35	10.08	1:04:29	19/3/2006
2,387	427	103	101	23.88	35	36	23.35	232.68	5.43308	34	25.35	10.08	1:04:58	19/3/2006
2,387	427	101	100	23.96	35	36	23.41	232.5	5.44283	34	25.35	10.08	1:05:28	19/3/2006
2,385	427	100	100	23.96	35	35	23.03	232.74	5.36	34	25.35	10.08	1:05:57	19/3/2006
2,376	427	101	100	23.96	35	35	23.31	232.38	5.41678	34	25.35	10.08	1:06:27	19/3/2006
2,385	427	102	100	23.96	35	36	23.04	232.26	5.35127	34	25.35	10.08	1:06:56	19/3/2006
2,386	427	103	100	23.96	35	36	23.07	232.04	5.35316	34	25.35	10.08	1:07:26	19/3/2006
2,387	427	103	101	24.02	35	36	22.91	232.62	5.32932	34	25.35	10.08	1:07:55	19/3/2006
2,381	427	103	101	24.02	36	36	23.32	232.16	5.41397	34	25.35	10.08	1:08:25	19/3/2006
2,383	427	102	100	24.02	36	36	23.01	232.03	5.33901	34	25.35	10.08	1:08:55	19/3/2006
2,378	427	103	101	24.02	36	36	22.59	232.03	5.24156	34	25.35	10.08	1:09:24	19/3/2006
2,380	427	101	100	23.46	35	36	22.92	232.01	5.31767	34	25.35	10.08	1:09:54	19/3/2006
2,387	427	101	100	23.46	36	36	23.08	232.44	5.36472	34	25.35	10.08	1:10:23	19/3/2006
2,388	427	101	100	23.46	35	36	22.74	232.46	5.28614	34	25.35	10.08	1:10:53	19/3/2006
2,388	427	100	100	23.46	36	36	23.36	232.54	5.43213	34	25.35	10.08	1:11:22	19/3/2006
2,388	429	100	101	23.46	36	36	22.85	232.56	5.314	34	25.35	10.08	1:11:52	19/3/2006
2,388	429	101	100	24.21	35	36	22.73	232.74	5.29018	34	25.35	10.08	1:12:21	19/3/2006
2,388	430	101	100	24.21	35	36	22.79	232.66	5.30232	34	25.35	10.08	1:12:51	19/3/2006
2,388	430	101	100	24.21	35	36	23.18	232.46	5.38842	34	25.35	10.08	1:13:20	19/3/2006
2,388	430	101	100	24.21	35	36	22.89	232.54	5.32284	34	25.35	10.08	1:13:50	19/3/2006
2,388	428	102	100	23.88	35	36	22.84	232.56	5.31167	34	25.35	10.08	1:14:19	19/3/2006
2,388	427	103	101	23.88	36	36	22.91	232.36	5.32337	34	25.35	10.08	1:14:49	19/3/2006
2,389	427	102	101	23.88	36	36	22.98	232.84	5.35066	34	25.35	10.08	1:15:19	19/3/2006
2,388	427	101	100	23.88	36	36	23.09	232.88	5.3772	34	25.35	10.08	1:15:48	19/3/2006
2,388	427	101	101	23.88	36	36	22.78	232.78	5.30273	34	25.35	10.08	1:16:18	19/3/2006
2,388	427	101	100	23.86	36	36	23.01	232.96	5.36041	34	25.35	10.08	1:16:47	19/3/2006
2,389	427	101	100	106.8	36	36	23.11	232.98	5.38417	34	25.35	10.08	1:17:17	19/3/2006
2,389	427	102	100	174.1	36	36	23.11	232.98	5.38417	34	25.35	10.08	1:17:46	19/3/2006
2,389	427	101	100	174.1	36	36	23.11	232.98	5.38417	34	25.35	10.08	1:18:16	19/3/2006
2,389	427	101	100	174.1	36	36	23.04	232.98	5.36786	34	25.35	10.08	1:18:45	19/3/2006
2,389	427	101	100	174.1	36	36	23.02	233.12	5.36642	34	25.35	10.08	1:19:15	19/3/2006
2,388	427	102	100	174.1	36	36	23.04	232.98	5.36786	34	25.35	10.08	1:19:44	19/3/2006
2,389	427	101	100	854.6	36	36	23.05	233	5.37065	34	25.35	10.08	1:20:14	19/3/2006
2,399	427	102	100	169.9	36	36	23.05	233.12	5.37342	34	25.35	10.08	1:20:44	19/3/2006
2,395	427	101	100	169.9	36	36	23.07	233.08	5.37716	34	25.35	10.08	1:21:13	19/3/2006
2,399	427	101	100	169.9	36	36	23.12	233.02	5.38742	34	25.35	10.08	1:21:43	19/3/2006
2,400	427	101	100	169.9	36	36	23.05	233.43	5.38056	34	25.35	10.08	1:22:12	19/3/2006
2,399	427	101	101	169.9	36	36	23.16	233.06	5.39767	34	25.35	10.08	1:22:42	19/3/2006
2,400	427	103	101	22.54	36	36	23.06	233.06	5.37436	34	25.35	10.08	1:23:11	19/3/2006
2,395	427	104	101	22.54	36	36	22.98	232.98	5.35388	34	25.35	10.08	1:23:41	19/3/2006

ตาราง ฉ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OiiT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	427	102	101	22.54	36	36	23.08	233.08	5.37949	34	25.35	10.08	1:25:09	19/3/2006
2,400	424	102	101	22.19	36	36	23.06	233.26	5.37898	34	25.35	10.08	1:25:39	19/3/2006
2,400	424	102	100	22.19	36	36	23.12	233.63	5.40153	34	25.35	10.08	1:26:08	19/3/2006
2,400	425	102	101	22.19	36	36	23.01	233.2	5.36593	34	25.35	10.08	1:26:38	19/3/2006
2,400	424	101	101	22.19	36	36	23.08	233.41	5.3871	34	25.35	10.08	1:27:07	19/3/2006
2,400	426	101	101	22.19	36	36	23.1	233.31	5.38946	34	25.35	10.08	1:27:37	19/3/2006
2,400	426	102	101	21.91	36	36	23.13	233.31	5.39646	34	25.35	10.08	1:28:07	19/3/2006
2,400	424	103	101	21.91	36	36	23.16	233.43	5.40624	34	25.35	10.08	1:28:36	19/3/2006
2,400	426	102	101	21.91	36	36	23.11	233.39	5.39364	34	25.35	10.08	1:29:06	19/3/2006
2,400	425	104	101	21.91	36	36	23.23	233.43	5.42258	34	25.35	10.08	1:29:35	19/3/2006
2,400	426	102	101	21.91	36	36	23.15	233.35	5.40205	34	25.35	10.08	1:30:05	19/3/2006
2,400	427	103	101	21.56	36	36	23.2	233.69	5.42161	34	25.35	10.08	1:30:34	19/3/2006
2,400	425	103	101	909.7	36	36	22.99	233.49	5.36794	34	25.35	10.08	1:31:04	19/3/2006
2,400	424	101	101	909.7	36	36	23.09	233.57	5.39313	34	25.35	10.08	1:31:33	19/3/2006
2,400	427	102	101	909.7	36	36	23.16	233.65	5.41133	34	25.35	10.08	1:32:03	19/3/2006
2,400	426	101	102	909.7	35	36	23.09	233.61	5.39405	34	25.35	10.08	1:32:32	19/3/2006
2,400	426	101	101	909.7	35	36	23.18	233.43	5.41091	34	25.35	10.08	1:33:02	19/3/2006
2,400	427	102	101	21.01	35	36	23.27	233.67	5.4375	34	25.35	10.08	1:33:32	19/3/2006
2,400	426	103	101	21.01	36	36	23.14	233.57	5.40481	34	25.35	10.08	1:34:01	19/3/2006
2,400	427	102	101	21.01	36	36	23.06	233.53	5.3852	34	25.35	10.08	1:34:31	19/3/2006
2,400	427	102	101	21.01	35	36	23.09	233.75	5.39729	34	25.35	10.08	1:35:00	19/3/2006
2,400	427	101	101	21.01	35	36	23.11	233.59	5.39826	34	25.35	10.08	1:35:30	19/3/2006
2,400	427	100	101	21.12	35	36	23.15	233.63	5.40853	34	25.35	10.08	1:35:59	19/3/2006
2,400	427	100	101	21.12	35	36	23.14	233.69	5.40759	34	25.35	10.08	1:36:29	19/3/2006
2,400	427	101	101	21.12	35	36	23.16	233.79	5.41458	34	25.35	10.08	1:36:58	19/3/2006
2,400	427	101	101	21.12	35	36	23.2	233.59	5.41929	34	25.35	10.08	1:37:28	19/3/2006
2,400	427	101	101	21.12	35	36	23.17	233.63	5.41321	34	25.35	10.08	1:37:57	19/3/2006
2,400	427	102	101	21.08	35	36	23.12	233.51	5.39875	34	25.35	10.08	1:38:27	19/3/2006
2,400	427	102	101	1880	35	36	23.1	233.65	5.39732	34	25.35	10.08	1:38:56	19/3/2006
2,400	426	102	101	1880	35	36	23.14	233.69	5.40759	34	25.35	10.08	1:39:26	19/3/2006
2,400	425	104	102	1880	35	36	23.19	233.77	5.42113	34	25.35	10.08	1:39:55	19/3/2006
2,400	424	104	103	1880	36	36	23.04	233.49	5.37961	34	25.35	10.08	1:40:25	19/3/2006
2,400	424	104	103	1880	36	36	23.12	233.75	5.4043	34	25.35	10.08	1:40:55	19/3/2006
2,400	424	103	103	20.51	36	36	23.17	233.59	5.41228	34	25.35	10.08	1:41:24	19/3/2006
2,400	424	102	103	20.51	36	36	23.11	233.49	5.39595	34	25.35	10.08	1:41:54	19/3/2006
2,400	426	102	103	20.51	36	36	23.17	233.77	5.41645	34	25.35	10.08	1:42:23	19/3/2006
2,400	427	101	102	20.51	36	36	23.13	233.79	5.40756	34	25.35	10.08	1:42:53	19/3/2006
2,400	427	101	102	20.51	36	36	23.23	233.77	5.43048	34	25.35	10.08	1:43:22	19/3/2006
2,400	427	103	102	20.55	36	36	23.17	233.77	5.41645	34	25.35	10.08	1:43:52	19/3/2006
2,400	427	102	102	20.55	36	36	23.16	233.85	5.41597	34	25.35	10.08	1:44:21	19/3/2006
2,400	427	103	102	20.55	36	36	23.14	233.71	5.40805	34	25.35	10.08	1:44:51	19/3/2006
2,400	427	103	102	20.55	36	36	23.15	233.67	5.40946	34	25.35	10.08	1:45:20	19/3/2006
2,400	427	103	102	20.55	36	36	23.09	233.71	5.39636	34	25.35	10.08	1:45:50	19/3/2006
2,400	427	102	102	20.23	36	36	23.22	233.71	5.42675	34	25.35	10.08	1:46:19	19/3/2006
2,400	427	102	101	20.23	36	36	23.08	233.83	5.3968	34	25.35	10.08	1:46:49	19/3/2006
2,400	427	102	101	20.23	36	36	23.18	233.73	5.41786	34	25.35	10.08	1:47:19	19/3/2006

ตาราง ฉ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	427	102	102	20.23	36	36	23.11	233.67	5.40011	34	25.35	10.08	1:48:47	19/3/2006
2,400	427	103	102	20.13	36	36	23.11	233.57	5.3978	34	25.35	10.08	1:49:17	19/3/2006
2,400	427	102	102	20.13	36	36	23.1	233.67	5.39778	34	25.35	10.08	1:49:46	19/3/2006
2,400	427	104	103	20.13	36	36	23.15	233.71	5.41039	34	25.35	10.08	1:50:16	19/3/2006
2,400	427	104	102	20.13	36	36	23.18	233.65	5.41601	34	25.35	10.08	1:50:45	19/3/2006
2,400	426	104	103	20.13	36	36	23.14	233.67	5.40712	34	25.35	10.08	1:51:15	19/3/2006
2,400	426	105	103	20.2	36	36	23.23	233.65	5.42769	34	25.35	10.08	1:51:44	19/3/2006
2,400	427	103	103	20.2	36	36	23.14	233.61	5.40574	34	25.35	10.08	1:52:14	19/3/2006
2,400	427	102	102	20.2	36	36	23.21	233.67	5.42348	34	25.35	10.08	1:52:43	19/3/2006
2,400	427	102	102	20.2	36	36	23.18	233.57	5.41415	34	25.35	10.08	1:53:13	19/3/2006
2,400	427	102	102	20.2	36	36	23.09	233.67	5.39544	34	25.35	10.08	1:53:43	19/3/2006
2,400	427	104	103	20.2	36	36	23.08	233.61	5.39172	34	25.35	10.08	1:54:12	19/3/2006
2,400	427	104	103	20.07	36	36	23.11	233.55	5.39734	34	25.35	10.08	1:54:42	19/3/2006
2,400	427	103	103	20.07	36	36	23.15	233.71	5.41039	34	25.35	10.08	1:55:11	19/3/2006
2,400	427	103	102	20.07	36	36	23.13	233.65	5.40432	34	25.35	10.08	1:55:41	19/3/2006
2,400	427	103	102	20.07	36	36	23.11	233.51	5.39642	34	25.35	10.08	1:56:10	19/3/2006
2,400	427	104	103	20.07	36	36	23.17	233.63	5.41321	34	25.35	10.08	1:56:40	19/3/2006
2,400	427	104	103	20.24	36	36	23.12	233.55	5.39968	34	25.35	10.08	1:57:09	19/3/2006
2,400	426	104	103	20.24	36	36	23.13	233.83	5.40849	34	25.35	10.08	1:57:39	19/3/2006
2,400	427	102	102	20.24	36	36	23.11	233.79	5.40289	34	25.35	10.08	1:58:08	19/3/2006
2,400	427	102	102	20.24	36	36	23.19	233.83	5.42252	34	25.35	10.08	1:58:38	19/3/2006
2,400	427	103	102	20.24	36	36	23.21	233.73	5.42487	34	25.35	10.08	1:59:07	19/3/2006
2,400	427	104	102	19.93	36	36	23.1	233.77	5.40009	34	25.35	10.08	1:59:37	19/3/2006
2,400	427	103	102	19.93	36	36	23.11	233.67	5.40011	34	25.35	10.08	2:00:07	19/3/2006
2,400	426	103	102	19.93	36	36	23.2	233.81	5.42439	34	25.35	10.08	2:00:36	19/3/2006
2,400	427	103	101	19.93	36	36	23.1	233.83	5.40147	34	25.35	10.08	2:01:06	19/3/2006
2,401	427	104	102	19.93	36	36	23.03	233.89	5.38649	34	25.35	10.08	2:01:35	19/3/2006
2,400	427	103	102	19.93	36	36	23.19	233.87	5.42345	34	25.35	10.08	2:02:05	19/3/2006
2,400	426	104	102	19.94	36	36	23.18	233.83	5.42018	34	25.35	10.08	2:02:34	19/3/2006
2,400	426	103	102	19.94	36	36	23.18	233.69	5.41693	34	25.35	10.08	2:03:04	19/3/2006
2,400	426	104	102	19.94	36	36	23.13	233.61	5.4034	34	25.35	10.08	2:03:33	19/3/2006
2,400	427	103	101	19.94	36	36	23.12	233.77	5.40476	34	25.35	10.08	2:04:03	19/3/2006
2,400	427	103	102	19.94	36	36	23.09	233.75	5.39729	34	25.35	10.08	2:04:32	19/3/2006
2,400	427	102	101	19.94	36	36	23.17	233.83	5.41784	34	25.35	10.08	2:05:02	19/3/2006
2,400	427	102	101	19.82	36	36	23.23	233.85	5.43234	34	25.35	10.08	2:05:31	19/3/2006
2,400	427	101	102	19.82	36	36	23.17	233.75	5.41599	34	25.35	10.08	2:06:01	19/3/2006
2,400	427	101	101	19.82	36	36	23.12	233.75	5.4043	34	25.35	10.08	2:06:31	19/3/2006
2,400	427	101	101	19.82	36	36	23.18	233.65	5.41601	34	25.35	10.08	2:07:00	19/3/2006
2,400	427	101	102	19.82	36	36	23.16	233.75	5.41365	34	25.35	10.08	2:07:30	19/3/2006
2,400	427	103	101	19.85	36	36	23.12	233.83	5.40615	34	25.35	10.08	2:07:59	19/3/2006
2,400	427	103	102	19.85	36	36	23.15	233.69	5.40992	34	25.35	10.08	2:08:29	19/3/2006
2,400	427	103	102	19.85	36	36	23.14	233.75	5.40898	34	25.35	10.08	2:08:58	19/3/2006
2,400	427	103	102	19.85	36	36	23.22	233.83	5.42953	34	25.35	10.08	2:09:28	19/3/2006
2,400	426	103	102	19.85	36	36	23.23	233.79	5.43094	34	25.35	10.08	2:09:57	19/3/2006
2,400	424	104	102	19.9	36	36	23.09	233.85	5.3996	34	25.35	10.08	2:10:27	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	427	102	102	19.9	36	36	23.27	233.02	5.42238	34	25.35	10.08	2:12:25	19/3/2006
2,400	427	103	102	19.9	36	36	23.18	232.98	5.40048	34	25.35	10.08	2:12:55	19/3/2006
2,400	427	103	101	20.83	36	36	23.17	232.98	5.39815	34	25.35	10.08	2:13:24	19/3/2006
2,400	427	103	101	20.83	36	36	23.17	232.98	5.39815	34	25.35	10.08	2:13:54	19/3/2006
2,400	427	103	101	20.83	36	36	23.15	232.98	5.39349	34	25.35	10.08	2:14:23	19/3/2006
2,400	427	104	101	20.83	36	36	23.08	233	5.37764	34	25.35	10.08	2:14:53	19/3/2006
2,400	426	104	101	20.83	36	36	23.08	233.02	5.3781	34	25.35	10.08	2:15:22	19/3/2006
2,400	424	104	101	20.81	36	36	23.11	233.04	5.38555	34	25.35	10.08	2:15:52	19/3/2006
2,400	424	105	101	20.81	36	36	23.08	233.14	5.38087	34	25.35	10.08	2:16:21	19/3/2006
2,400	427	103	101	20.81	36	36	23.11	233.2	5.38925	34	25.35	10.08	2:16:51	19/3/2006
2,400	427	104	102	20.81	36	36	23.18	233.16	5.40465	34	25.35	10.08	2:17:20	19/3/2006
2,400	427	102	101	20.81	36	36	23.15	233.14	5.39719	34	25.35	10.08	2:17:50	19/3/2006
2,400	427	102	101	20.92	36	36	23.12	233.18	5.39112	34	25.35	10.08	2:18:19	19/3/2006
2,400	427	102	101	20.92	36	36	23.12	233.35	5.39505	34	25.35	10.08	2:18:49	19/3/2006
2,400	427	102	101	20.92	36	36	23.23	233.3	5.41956	34	25.35	10.08	2:19:19	19/3/2006
2,400	426	102	101	20.92	36	36	23.18	233.31	5.40813	34	25.35	10.08	2:19:48	19/3/2006
2,400	424	104	101	20.92	37	36	23.2	233.14	5.40885	34	25.35	10.08	2:20:18	19/3/2006
2,400	426	103	101	20.92	37	36	23.11	233.14	5.38787	34	25.35	10.08	2:20:47	19/3/2006
2,400	427	102	101	20.77	36	36	23.16	233.39	5.40531	34	25.35	10.08	2:21:17	19/3/2006
2,400	427	102	100	20.77	36	36	23.14	233.22	5.39671	34	25.35	10.08	2:21:46	19/3/2006
2,400	427	102	101	20.77	36	36	23.03	233.1	5.36829	34	25.35	10.08	2:22:16	19/3/2006
2,400	427	102	100	41.29	36	36	23.14	233.35	5.39972	34	25.35	10.08	2:22:45	19/3/2006
2,400	427	102	101	41.29	36	36	23.18	233.24	5.4065	34	25.35	10.08	2:23:15	19/3/2006
2,400	427	101	101	41.29	36	36	23.18	233.06	5.40233	34	25.35	10.08	2:23:44	19/3/2006
2,400	427	101	101	41.29	36	36	23.16	233.06	5.39767	34	25.35	10.08	2:24:14	19/3/2006
2,400	427	102	101	41.29	36	36	23.08	233.04	5.37856	34	25.35	10.08	2:24:43	19/3/2006
2,400	427	104	101	21.01	36	36	23.16	232.98	5.39582	34	25.35	10.08	2:25:13	19/3/2006
2,400	427	103	101	21.01	36	36	23.12	232.98	5.3865	34	25.35	10.08	2:25:43	19/3/2006
2,400	427	102	101	21.01	36	36	23.21	233.1	5.41025	34	25.35	10.08	2:26:12	19/3/2006
2,400	427	101	100	21.01	36	36	23.09	232.98	5.37951	34	25.35	10.08	2:26:42	19/3/2006
2,400	427	103	101	21.01	36	36	23.03	233.08	5.36783	34	25.35	10.08	2:27:11	19/3/2006
2,400	427	103	101	20.94	36	36	23.2	233.31	5.41279	34	25.35	10.08	2:27:41	19/3/2006
2,400	427	103	101	20.94	36	36	23.07	233.04	5.37623	34	25.35	10.08	2:28:10	19/3/2006
2,400	427	103	102	76.63	36	36	23.14	233.08	5.39347	34	25.35	10.08	2:28:40	19/3/2006
2,400	427	103	101	76.63	36	36	22.93	232.98	5.34223	34	25.35	10.08	2:29:09	19/3/2006
2,400	427	103	101	76.63	36	36	22.98	233.02	5.3548	34	25.35	10.08	2:29:39	19/3/2006
2,400	427	104	101	76.63	36	36	23.14	233	5.39162	34	25.35	10.08	2:30:08	19/3/2006
2,400	427	103	101	76.63	36	36	23.15	233	5.39395	34	25.35	10.08	2:30:38	19/3/2006
2,400	427	102	100	76.63	36	36	23.06	233.02	5.37344	34	25.35	10.08	2:31:07	19/3/2006
2,400	427	102	100	21.08	36	36	23.11	232.98	5.38417	34	25.35	10.08	2:31:37	19/3/2006
2,400	427	101	100	21.08	36	36	23.16	232.98	5.39582	34	25.35	10.08	2:32:07	19/3/2006
2,400	429	101	101	21.08	36	36	23.11	233	5.38463	34	25.35	10.08	2:32:36	19/3/2006
2,400	427	101	100	21.08	35	36	23.18	233.06	5.40233	34	25.35	10.08	2:33:06	19/3/2006
2,400	427	101	100	21.08	36	36	23.1	232.98	5.38184	34	25.35	10.08	2:33:35	19/3/2006
2,400	429	100	100	21.01	36	36	23.13	233.04	5.39022	34	25.35	10.08	2:34:05	19/3/2006

ตาราง ฉ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	429	102	100	21.01	36	36	23.17	233	5.39861	34	25.35	10.08	2:36:03	19/3/2006
2,400	427	101	100	21.01	36	36	23.15	233.18	5.39812	34	25.35	10.08	2:36:32	19/3/2006
2,400	427	101	100	21.01	36	36	23.18	233.06	5.40233	34	25.35	10.08	2:37:02	19/3/2006
2,400	427	101	100	21.01	36	36	23.17	233.08	5.40046	34	25.35	10.08	2:37:31	19/3/2006
2,400	427	101	100	21.01	35	36	22.98	233.06	5.35572	34	25.35	10.08	2:38:01	19/3/2006
2,400	427	100	100	21.01	36	36	23.27	233.02	5.42238	34	25.35	10.08	2:38:31	19/3/2006
2,400	429	100	100	20.97	36	36	23.15	233.08	5.3958	34	25.35	10.08	2:39:00	19/3/2006
2,400	428	99	100	20.97	36	36	23.17	233.02	5.39907	34	25.35	10.08	2:39:30	19/3/2006
2,400	429	99	101	20.97	36	36	23.1	233.22	5.38738	34	25.35	10.08	2:39:59	19/3/2006
2,400	427	101	101	20.97	36	36	23.09	233.14	5.3832	34	25.35	10.08	2:40:29	19/3/2006
2,400	427	101	100	20.97	36	36	23.2	233.06	5.40699	34	25.35	10.08	2:40:58	19/3/2006
2,400	427	101	100	20.97	35	36	23.2	233.1	5.40792	34	25.35	10.08	2:41:28	19/3/2006
2,400	428	101	100	20.94	36	36	23.13	233.14	5.39253	34	25.35	10.08	2:41:57	19/3/2006
2,400	427	100	100	225.6	35	36	23.05	233.14	5.37388	34	25.35	10.08	2:42:27	19/3/2006
2,400	430	99	100	225.6	35	36	23.01	233.1	5.36363	34	25.35	10.08	2:42:56	19/3/2006
2,399	430	100	100	225.6	35	36	23.03	232.98	5.36553	34	25.35	10.08	2:43:26	19/3/2006
2,400	429	99	100	225.6	35	36	23.12	233.1	5.38927	34	25.35	10.08	2:43:55	19/3/2006
2,400	428	99	100	225.6	35	36	23.15	233.02	5.39441	34	25.35	10.08	2:44:25	19/3/2006
2,400	427	99	100	21.23	35	36	23.04	233.02	5.36878	34	25.35	10.08	2:44:55	19/3/2006
2,400	430	98	100	21.23	35	36	23.14	233.14	5.39486	34	25.35	10.08	2:45:24	19/3/2006
2,400	428	101	100	21.23	35	36	23.09	233.12	5.38274	34	25.35	10.08	2:45:54	19/3/2006
2,400	428	101	100	21.23	35	36	22.96	232.98	5.34922	34	25.35	10.08	2:46:23	19/3/2006
2,400	427	102	100	21.23	36	36	23.13	232.98	5.38883	34	25.35	10.08	2:46:53	19/3/2006
2,400	427	102	100	20.97	35	36	23.05	233.2	5.37526	34	25.35	10.08	2:47:22	19/3/2006
2,399	427	102	100	20.97	36	36	23.12	232.98	5.3865	34	25.35	10.08	2:47:52	19/3/2006
2,400	426	102	100	20.97	36	36	23.07	232.98	5.37485	34	25.35	10.08	2:48:21	19/3/2006
2,400	424	102	101	20.97	36	36	23.09	232.98	5.37951	34	25.35	10.08	2:48:51	19/3/2006
2,400	424	101	100	20.97	35	36	23.19	232.98	5.40281	34	25.35	10.08	2:49:20	19/3/2006
2,400	427	100	100	21.01	35	36	23.2	232.98	5.40514	34	25.35	10.08	2:49:50	19/3/2006
2,400	427	101	100	21.01	36	36	23.12	232.98	5.3865	34	25.35	10.08	2:50:19	19/3/2006
2,400	428	102	101	21.01	36	36	23.05	233	5.37065	34	25.35	10.08	2:50:49	19/3/2006
2,400	428	101	101	21.01	36	36	23.2	232.98	5.40514	34	25.35	10.08	2:51:19	19/3/2006
2,400	428	101	100	21.01	35	36	23.21	232.98	5.40747	34	25.35	10.08	2:51:48	19/3/2006
2,400	428	101	100	21.33	36	36	23.08	232.98	5.37718	34	25.35	10.08	2:52:18	19/3/2006
2,400	427	99	100	21.33	35	36	23.15	233	5.39395	34	25.35	10.08	2:52:47	19/3/2006
2,400	430	99	100	21.33	35	36	23.1	233	5.3823	34	25.35	10.08	2:53:17	19/3/2006
2,400	431	99	100	21.33	35	36	23.09	232.98	5.37951	34	25.35	10.08	2:53:46	19/3/2006
2,400	432	99	100	21.33	35	36	23.26	232.98	5.41911	34	25.35	10.08	2:54:16	19/3/2006
2,400	432	100	100	21.12	35	36	23.23	232.98	5.41213	34	25.35	10.08	2:54:45	19/3/2006
2,400	430	100	100	21.12	35	36	23.21	232.98	5.40747	34	25.35	10.08	2:55:15	19/3/2006
2,400	430	100	100	21.12	35	36	23.13	232.98	5.38883	34	25.35	10.08	2:55:44	19/3/2006
2,400	433	100	101	21.12	35	36	23.15	232.98	5.39349	34	25.35	10.08	2:56:14	19/3/2006
2,399	433	100	100	21.12	35	36	23.11	232.98	5.38417	34	25.35	10.08	2:56:43	19/3/2006
2,399	430	100	100	21.23	35	36	23.19	232.98	5.40281	34	25.35	10.08	2:57:13	19/3/2006
2,400	430	99	100	21.23	35	36	23.15	232.98	5.39349	34	25.35	10.08	2:57:43	19/3/2006

ตาราง ฉ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	416	101	100	21.23	35	36	20.77	234.13	4.86288	34	25.35	10.08	2:59:11	19/3/2006
2,408	409	102	100	20.87	35	36	20.82	234.37	4.87958	34	25.35	10.08	2:59:41	19/3/2006
2,403	407	101	100	20.87	35	36	20.85	234.37	4.88661	34	25.35	10.08	3:00:10	19/3/2006
2,404	406	101	100	20.87	36	36	20.74	234.39	4.86125	34	25.35	10.08	3:00:40	19/3/2006
2,400	406	101	100	20.87	36	36	20.88	234.39	4.89406	34	25.35	10.08	3:01:09	19/3/2006
2,400	406	101	100	20.87	36	36	20.87	234.51	4.89422	34	25.35	10.08	3:01:39	19/3/2006
2,401	407	100	100	20.87	35	36	20.85	234.6	4.89141	34	25.35	10.08	3:02:08	19/3/2006
2,408	408	100	100	19.17	35	36	20.82	234.41	4.88042	34	25.35	10.08	3:02:38	19/3/2006
2,405	406	100	100	19.17	36	36	20.82	234.45	4.88125	34	25.35	10.08	3:03:07	19/3/2006
2,412	404	100	100	19.17	36	36	20.71	234.43	4.85505	34	25.35	10.08	3:03:37	19/3/2006
2,408	406	99	100	19.17	36	36	20.83	234.53	4.88526	34	25.35	10.08	3:04:07	19/3/2006
2,400	406	101	99	19.17	36	36	20.76	234.43	4.86677	34	25.35	10.08	3:04:36	19/3/2006
2,400	404	101	99	19.13	36	36	20.8	234.37	4.8749	34	25.35	10.08	3:05:06	19/3/2006
2,402	405	101	99	19.13	36	36	20.84	234.45	4.88594	34	25.35	10.08	3:05:35	19/3/2006
2,402	406	99	99	19.13	36	36	20.8	234.55	4.87864	34	25.35	10.08	3:06:05	19/3/2006
2,400	408	99	99	19.13	36	36	20.82	234.39	4.88	34	25.35	10.08	3:06:34	19/3/2006
2,405	409	99	99	19.13	36	36	20.78	234.49	4.8727	34	25.35	10.08	3:07:04	19/3/2006
2,406	408	99	100	19.13	36	36	20.83	234.51	4.88484	34	25.35	10.08	3:07:33	19/3/2006
2,406	406	100	99	19.21	36	36	20.77	234.47	4.86994	34	25.35	10.08	3:08:03	19/3/2006
2,405	406	99	98	19.21	36	36	20.74	234.49	4.86332	34	25.35	10.08	3:08:32	19/3/2006
2,399	403	101	100	19.21	36	36	20.73	234.23	4.85559	34	25.35	10.08	3:09:02	19/3/2006
2,400	401	102	100	19.21	36	36	20.68	234.37	4.84677	34	25.12	11.84	3:09:31	19/3/2006
2,400	402	100	99	19.21	36	36	20.88	234.45	4.89532	34	25.12	11.84	3:10:01	19/3/2006
2,400	403	101	100	19.21	36	36	20.82	234.45	4.88125	34	25.12	11.84	3:10:30	19/3/2006
2,400	403	101	100	18.4	36	36	20.86	234.43	4.89021	34	25.12	11.84	3:11:00	19/3/2006
2,400	401	102	100	18.4	36	36	20.82	234.21	4.87625	34	25.12	11.84	3:11:30	19/3/2006
2,399	401	101	100	18.4	36	36	20.74	234.13	4.85586	34	25.12	11.84	3:11:59	19/3/2006
2,400	400	101	100	18.4	36	36	20.76	234.31	4.86428	34	25.12	11.84	3:12:29	19/3/2006
2,400	400	100	100	18.4	36	36	20.75	234.29	4.86152	34	25.12	11.84	3:12:58	19/3/2006
2,398	403	99	100	18.4	36	36	20.83	234.41	4.88276	34	25.12	11.84	3:13:28	19/3/2006
2,399	403	100	100	17.65	36	36	20.74	234.37	4.86083	34	25.12	11.84	3:13:57	19/3/2006
2,400	403	101	100	17.65	36	36	20.83	234.21	4.87859	34	25.12	11.84	3:14:27	19/3/2006
2,400	404	101	100	17.65	36	36	20.79	234.39	4.87297	34	25.12	11.84	3:14:56	19/3/2006
2,400	403	101	100	17.65	36	36	20.8	234.41	4.87573	34	25.12	11.84	3:15:26	19/3/2006
2,400	403	100	100	17.65	36	36	20.73	234.23	4.85559	34	25.12	11.84	3:15:55	19/3/2006
2,399	404	99	100	17.65	36	36	20.79	234.29	4.87089	34	25.12	11.84	3:16:25	19/3/2006
2,400	405	99	100	17.68	36	36	20.85	234.31	4.88536	34	25.12	11.84	3:16:55	19/3/2006
2,399	406	98	100	17.68	36	36	20.84	234.25	4.88177	34	25.12	11.84	3:17:24	19/3/2006
2,399	406	101	100	17.68	36	36	20.91	234.43	4.90193	34	25.12	11.84	3:17:54	19/3/2006
2,400	406	99	100	17.68	36	36	20.85	234.29	4.88495	34	25.12	11.84	3:18:23	19/3/2006
2,399	406	100	100	17.68	36	36	20.81	234.43	4.87849	34	25.12	11.84	3:18:53	19/3/2006
2,400	407	99	100	17.68	36	36	20.78	234.31	4.86896	34	25.12	11.84	3:19:22	19/3/2006
2,399	409	99	100	18.04	36	36	20.76	234.33	4.86469	34	25.12	11.84	3:19:52	19/3/2006
2,400	408	100	100	18.04	36	36	20.83	234.31	4.88068	34	25.12	11.84	3:20:21	19/3/2006

ตาราง ฉ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	403	99	99	18.04	36	36	20.71	234.35	4.85339	34	25.12	11.84	3:22:19	19/3/2006
2,400	403	101	100	18.14	36	36	20.85	234.23	4.8837	34	25.12	11.84	3:22:49	19/3/2006
2,400	403	101	100	18.14	36	36	20.83	234.23	4.87901	34	25.12	11.84	3:23:19	19/3/2006
2,399	403	101	100	110.6	36	36	20.7	234.29	4.8498	34	25.12	11.84	3:23:48	19/3/2006
2,399	403	101	100	110.6	36	36	20.79	234.15	4.86798	34	25.12	11.84	3:24:18	19/3/2006
2,399	402	101	100	110.6	36	36	20.86	234.23	4.88604	34	25.12	11.84	3:24:47	19/3/2006
2,400	403	101	100	110.6	36	36	20.78	234.11	4.86481	34	25.12	11.84	3:25:17	19/3/2006
2,400	403	101	100	110.6	36	36	20.81	234.17	4.87308	34	25.12	11.84	3:25:46	19/3/2006
2,400	403	99	100	110.6	36	36	20.79	234.27	4.87047	34	25.12	11.84	3:26:16	19/3/2006
2,400	403	99	100	17.89	36	36	20.8	234.33	4.87406	34	25.12	11.84	3:26:45	19/3/2006
2,400	405	99	100	17.89	36	36	20.82	234.31	4.87833	34	25.12	11.84	3:27:15	19/3/2006
2,400	406	99	100	17.89	36	36	20.67	234.35	4.84401	34	25.12	11.84	3:27:44	19/3/2006
2,400	406	99	100	17.89	36	36	20.82	234.33	4.87875	34	25.12	11.84	3:28:14	19/3/2006
2,400	403	100	99	17.89	36	36	20.83	234.41	4.88276	34	25.12	11.84	3:28:43	19/3/2006
2,362	406	101	100	17.89	36	36	20.7	230.99	4.78149	34	25.12	11.84	3:29:13	19/3/2006
2,364	406	99	99	19.08	36	36	20.69	230.74	4.77401	34	25.12	11.84	3:29:43	19/3/2006
2,353	400	99	98	185.5	36	36	20.6	229.98	4.73759	34	25.12	11.84	3:30:12	19/3/2006
2,352	400	98	98	185.5	36	36	20.59	230	4.7357	34	25.12	11.84	3:30:42	19/3/2006
2,352	400	98	97	185.5	36	36	20.63	230	4.7449	34	25.12	11.84	3:31:11	19/3/2006
2,352	400	99	96	37.3	36	36	20.61	230	4.7403	34	25.12	11.84	3:31:41	19/3/2006
2,353	397	99	95	37.3	36	36	20.67	230	4.7541	34	25.12	11.84	3:32:10	19/3/2006
2,352	399	99	95	37.3	36	36	20.74	230	4.7702	34	25.12	11.84	3:32:40	19/3/2006
2,353	398	98	94	36.96	36	36	20.69	230	4.7587	34	25.12	11.84	3:33:09	19/3/2006
2,353	397	98	93	36.96	36	36	20.61	230	4.7403	34	25.12	11.84	3:33:39	19/3/2006
2,353	395	99	93	36.96	36	36	20.61	230	4.7403	34	25.12	11.84	3:34:08	19/3/2006
2,352	394	98	93	36.91	36	36	20.67	230	4.7541	34	25.12	11.84	3:34:38	19/3/2006
2,353	394	98	93	36.91	36	36	20.64	230.02	4.74761	34	25.12	11.84	3:35:07	19/3/2006
2,353	392	97	93	36.91	36	36	20.68	230.02	4.75681	34	25.12	11.84	3:35:37	19/3/2006
2,352	392	97	93	37.01	36	36	20.58	230	4.7334	34	25.12	11.84	3:36:07	19/3/2006
2,353	392	96	93	37.01	36	36	20.62	230	4.7426	34	25.12	11.84	3:36:36	19/3/2006
2,353	394	96	93	37.01	36	36	20.47	230.18	4.71178	34	25.12	11.84	3:37:06	19/3/2006
2,353	395	96	93	37.01	36	36	20.63	230	4.7449	34	25.12	11.84	3:37:35	19/3/2006
2,352	395	97	93	36.91	36	36	20.67	230.14	4.75699	34	25.12	11.84	3:38:05	19/3/2006
2,352	394	97	93	36.91	36	36	20.6	230.4	4.74624	34	25.12	11.84	3:38:34	19/3/2006
2,352	392	98	93	36.91	36	36	20.57	230	4.7311	34	25.12	11.84	3:39:04	19/3/2006
2,353	392	98	93	36.91	36	36	20.59	230.14	4.73858	34	25.12	11.84	3:39:33	19/3/2006
2,353	391	97	93	36.91	36	36	20.59	230	4.7357	34	25.12	11.84	3:40:03	19/3/2006
2,353	391	96	93	36.91	36	36	20.67	230.18	4.75782	34	25.12	11.84	3:40:32	19/3/2006
2,353	391	95	92	37.01	36	36	20.54	230.12	4.72666	34	25.12	11.84	3:41:02	19/3/2006
2,353	394	94	93	37.01	35	36	20.62	230.46	4.75209	34	25.12	11.84	3:41:31	19/3/2006
2,353	394	95	92	37.01	35	36	20.62	230.26	4.74796	34	25.12	11.84	3:42:01	19/3/2006
2,353	394	96	92	37.2	36	36	20.6	230.52	4.74871	34	25.12	11.84	3:42:31	19/3/2006
2,353	394	95	92	37.2	36	36	20.64	230.4	4.75546	34	25.12	11.84	3:43:00	19/3/2006
2,353	394	95	92	37.35	36	36	20.58	230.36	4.74081	34	25.12	11.84	3:43:30	19/3/2006
2,353	394	95	92	37.35	36	36	20.59	230.4	4.74394	34	25.12	11.84	3:43:59	19/3/2006



ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,353	394	95	92	49.13	36	36	20.55	230.08	4.72814	34	25.12	11.84	3:45:57	19/3/2006
2,353	394	95	92	36.81	36	36	20.56	230.36	4.7362	34	25.12	11.84	3:46:27	19/3/2006
2,353	394	96	92	36.81	36	36	20.68	230.36	4.76384	34	25.12	11.84	3:46:56	19/3/2006
2,353	394	96	92	36.81	36	36	20.69	230.44	4.7678	34	25.12	11.84	3:47:26	19/3/2006
2,353	394	95	92	36.91	36	36	20.61	230.42	4.74896	34	25.12	11.84	3:47:55	19/3/2006
2,353	395	95	92	36.91	36	36	20.64	230.4	4.75546	34	25.12	11.84	3:48:25	19/3/2006
2,353	391	96	93	36.91	36	36	20.65	230.28	4.75528	34	25.12	11.84	3:48:55	19/3/2006
2,353	391	96	92	37.2	36	36	20.63	230.32	4.7515	34	25.12	11.84	3:49:24	19/3/2006
2,353	391	95	92	168.9	36	36	20.64	230.48	4.75711	34	25.12	11.84	3:49:54	19/3/2006
2,353	391	95	92	168.9	36	36	20.59	230.7	4.75011	34	25.12	11.84	3:50:23	19/3/2006
2,353	391	95	92	168.9	36	36	20.71	230.68	4.77738	34	25.12	11.84	3:50:53	19/3/2006
2,353	391	96	93	331.8	36	36	20.61	230.77	4.75617	34	25.12	11.84	3:51:22	19/3/2006
2,353	391	95	93	331.8	36	36	20.57	230.38	4.73892	34	25.12	11.84	3:51:52	19/3/2006
2,353	391	96	93	331.8	36	36	20.68	230.28	4.76219	34	25.12	11.84	3:52:21	19/3/2006
2,353	391	97	93	36.86	36	36	20.6	230.52	4.74871	34	25.12	11.84	3:52:51	19/3/2006
2,354	391	96	93	36.86	36	36	20.68	230.52	4.76715	34	25.12	11.84	3:53:20	19/3/2006
2,353	391	96	92	36.86	36	36	20.71	230.52	4.77407	34	25.12	11.84	3:53:50	19/3/2006
2,354	384	96	93	37.3	36	36	18.51	230.99	4.27562	34	25.12	11.84	3:54:19	19/3/2006
2,387	380	95	92	37.3	36	36	18.48	233.75	4.3197	34	25.12	11.84	3:54:49	19/3/2006
2,388	380	95	92	37.3	36	36	18.45	234.09	4.31896	34	25.12	11.84	3:55:19	19/3/2006
2,399	380	95	93	37.3	36	36	18.52	234.68	4.34627	34	25.12	11.84	3:55:48	19/3/2006
2,389	382	94	92	26.21	36	36	18.58	234.88	4.36407	34	25.12	11.84	3:56:18	19/3/2006
2,400	382	94	93	26.21	36	36	18.58	234.96	4.36556	34	25.12	11.84	3:56:47	19/3/2006
2,400	380	95	93	26.21	36	36	18.59	234.96	4.36791	34	25.12	11.84	3:57:17	19/3/2006
2,400	381	97	94	26.21	36	36	18.55	234.96	4.35851	34	25.12	11.84	3:57:46	19/3/2006
2,399	380	96	94	26.21	36	36	18.58	234.96	4.36556	34	25.12	11.84	3:58:16	19/3/2006
2,400	381	97	95	19.9	36	36	18.59	234.96	4.36791	34	25.12	11.84	3:58:45	19/3/2006
2,395	380	97	95	19.9	36	36	18.7	234.96	4.39375	34	25.12	11.84	3:59:15	19/3/2006
2,399	380	97	96	19.9	36	36	18.55	234.96	4.35851	34	25	11.84	3:59:44	19/3/2006
2,398	380	98	97	19.9	36	36	18.6	234.96	4.37026	34	25	11.84	4:00:14	19/3/2006
2,399	380	97	97	19.9	36	36	18.56	234.96	4.36086	34	25	11.84	4:00:43	19/3/2006
2,398	380	97	97	19.9	36	36	18.58	234.98	4.36593	34	25	11.84	4:01:13	19/3/2006
2,400	380	95	96	19.9	36	36	18.55	234.96	4.35851	34	25	11.84	4:01:42	19/3/2006
2,400	382	95	96	17.49	36	36	18.55	234.96	4.35851	34	25	11.84	4:02:12	19/3/2006
2,400	383	97	97	92.46	36	36	18.55	234.96	4.35851	34	25	11.84	4:02:41	19/3/2006
2,399	385	96	97	92.46	35	36	18.56	234.96	4.36086	34	25	11.84	4:03:11	19/3/2006
2,399	386	96	97	92.46	36	36	18.51	234.96	4.34911	34	25	11.84	4:03:40	19/3/2006
2,399	385	96	97	92.46	36	36	18.54	234.96	4.35616	34	25	11.84	4:04:10	19/3/2006
2,400	386	96	97	92.46	36	36	18.64	234.96	4.37965	34	25	11.84	4:04:40	19/3/2006
2,396	386	95	97	92.46	35	36	18.59	234.96	4.36791	34	25	11.84	4:05:09	19/3/2006
2,400	386	94	96	17.02	36	36	18.51	234.96	4.34911	34	25	11.84	4:05:39	19/3/2006
2,400	386	94	97	17.02	35	36	18.58	234.98	4.36593	34	25	11.84	4:06:08	19/3/2006
2,399	386	94	96	17.02	36	36	18.56	234.96	4.36086	34	25	11.84	4:06:38	19/3/2006

ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,398	385	98	97	17.02	36	36	18.52	234.96	4.35146	34	25	11.84	4:08:36	19/3/2006
2,398	384	96	97	17.15	36	36	18.52	234.96	4.35146	34	25	11.84	4:09:05	19/3/2006
2,399	386	96	97	17.15	36	36	18.58	234.96	4.36556	34	25	11.84	4:09:35	19/3/2006
2,398	386	95	97	17.15	36	36	18.63	234.96	4.3773	34	25	11.84	4:10:05	19/3/2006
2,397	386	94	97	17.15	35	36	18.49	234.96	4.34441	34	25	11.84	4:10:34	19/3/2006
2,395	385	95	97	17.15	36	36	18.55	234.96	4.35851	34	25	11.84	4:11:04	19/3/2006
2,392	386	96	97	17.15	35	36	18.48	234.96	4.34206	34	25	11.84	4:11:33	19/3/2006
2,400	386	96	96	17.17	35	36	18.55	234.96	4.35851	34	25	11.84	4:12:03	19/3/2006
2,400	386	96	97	17.17	35	36	18.53	234.96	4.35381	34	25	11.84	4:12:32	19/3/2006
2,396	386	96	97	17.17	35	36	18.7	234.96	4.39375	34	25	11.84	4:13:02	19/3/2006
2,388	386	96	97	17.17	36	36	18.6	234.88	4.36877	34	25	11.84	4:13:32	19/3/2006
2,389	386	96	97	17.17	36	36	18.58	234.96	4.36556	34	25	11.84	4:14:01	19/3/2006
2,388	384	97	97	17.17	36	36	18.6	234.94	4.36988	34	25	11.84	4:14:31	19/3/2006
2,389	384	95	97	17.17	36	36	18.58	234.96	4.36556	34	25	11.84	4:15:00	19/3/2006
2,400	385	96	97	17.12	36	36	18.58	234.96	4.36556	34	25	11.84	4:15:30	19/3/2006
2,388	382	98	98	17.12	36	36	18.48	234.82	4.33947	34	25	11.84	4:15:59	19/3/2006
2,388	380	99	98	73.63	36	36	18.54	234.49	4.34744	34	25	11.84	4:16:29	19/3/2006
2,388	380	98	98	73.63	35	36	18.56	234.84	4.35863	34	25	11.84	4:16:58	19/3/2006
2,388	380	98	97	73.63	36	36	18.57	234.68	4.35801	34	25	11.84	4:17:28	19/3/2006
2,388	380	98	97	73.63	36	36	18.59	234.66	4.36233	34	25	11.84	4:17:57	19/3/2006
2,388	380	98	97	73.63	36	36	18.4	234.72	4.31885	34	25	11.84	4:18:27	19/3/2006
2,386	380	96	98	73.63	36	36	18.55	234.62	4.3522	34	25	11.84	4:18:56	19/3/2006
2,388	380	96	97	73.63	36	36	18.52	234.62	4.34516	34	25	11.84	4:19:26	19/3/2006
2,388	380	96	97	13.78	36	36	18.58	234.53	4.35757	34	25	11.84	4:19:55	19/3/2006
2,388	381	96	97	13.78	36	36	18.55	234.68	4.35331	34	25	11.84	4:20:25	19/3/2006
2,387	381	96	97	13.78	36	36	18.61	234.53	4.3646	34	25	11.84	4:20:55	19/3/2006
2,387	383	98	97	13.78	36	36	18.61	234.41	4.36237	34	25	11.84	4:21:24	19/3/2006
2,387	380	98	97	13.78	36	36	18.67	234.51	4.3783	34	25	11.84	4:21:54	19/3/2006
2,387	380	99	98	13.78	36	36	18.54	234.43	4.34633	34	25	11.84	4:22:23	19/3/2006
2,386	380	98	98	13.78	36	36	18.8	234.05	4.40014	34	25	11.84	4:22:53	19/3/2006
2,387	380	96	97	13.78	36	36	18.79	234.37	4.40381	34	25	11.84	4:23:22	19/3/2006
2,388	380	97	97	14.02	36	36	18.6	234.45	4.36077	34	25	11.84	4:23:52	19/3/2006
2,388	380	96	98	14.02	36	36	18.63	234.43	4.36743	34	25	11.84	4:24:22	19/3/2006
2,387	380	98	98	14.02	36	36	18.56	234.74	4.35677	34	25	11.84	4:24:51	19/3/2006
2,387	380	96	97	14.02	36	36	18.42	234.7	4.32317	34	25	11.84	4:25:21	19/3/2006
2,386	380	98	98	14.02	36	36	18.67	234.15	4.37158	34	25	11.84	4:25:50	19/3/2006
2,386	380	98	98	14.02	36	36	18.67	234.39	4.37606	34	25	11.84	4:26:20	19/3/2006
2,383	380	98	98	14.02	36	36	18.67	234.11	4.37083	34	25	11.84	4:26:49	19/3/2006
2,387	380	98	97	14.4	36	36	18.57	234.23	4.34965	34	25	11.84	4:27:19	19/3/2006
2,386	380	98	98	14.4	36	36	18.69	234.11	4.37552	34	25	11.84	4:27:48	19/3/2006
2,385	380	98	98	14.4	36	36	18.8	234.15	4.40202	34	25	11.84	4:28:18	19/3/2006
2,386	380	96	98	14.4	36	36	18.42	234.09	4.31194	34	25	11.84	4:28:47	19/3/2006
2,384	380	96	98	14.4	35	36	18.3	234.23	4.28641	34	25	11.84	4:29:17	19/3/2006
2,381	380	96	98	14.4	36	36	18.39	233.99	4.30308	34	25	11.84	4:29:47	19/3/2006
2,383	381	98	98	14.4	35	36	18.55	233.97	4.34014	34	25	11.84	4:30:16	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,385	380	97	97	14.43	36	36	18.78	234.33	4.40072	34	25	11.84	4:32:14	19/3/2006
2,386	380	97	97	14.43	36	36	18.5	234.47	4.3377	34	25	11.84	4:32:44	19/3/2006
2,381	380	97	97	14.43	36	36	18.8	234.11	4.40127	34	25	11.84	4:33:13	19/3/2006
2,377	380	96	97	14.43	36	36	18.48	234.01	4.3245	34	25	11.84	4:33:43	19/3/2006
2,383	380	96	98	14.43	35	36	18.16	233.99	4.24926	34	25	11.84	4:34:12	19/3/2006
2,385	380	97	98	14.44	35	36	18.57	234.09	4.34705	34	25	11.84	4:34:42	19/3/2006
2,380	383	98	98	14.44	36	36	18.54	234.15	4.34114	34	25	11.84	4:35:12	19/3/2006
2,379	382	98	98	14.44	35	36	18.76	234.05	4.39078	34	25	11.84	4:35:41	19/3/2006
2,385	382	97	98	14.44	35	36	18.6	234.03	4.35296	34	25	11.84	4:36:11	19/3/2006
2,384	382	97	99	14.44	36	36	18.39	234.27	4.30823	34	25	11.84	4:36:40	19/3/2006
2,384	380	97	98	14.44	36	36	18.63	234.27	4.36445	34	25	11.84	4:37:10	19/3/2006
2,384	380	97	98	14.44	36	36	18.39	234.17	4.30639	34	25	11.84	4:37:39	19/3/2006
2,384	380	98	98	14.48	36	36	18.6	234.15	4.35519	34	25	11.84	4:38:09	19/3/2006
2,380	380	98	98	14.48	36	36	18.34	234.17	4.29468	34	25	11.84	4:38:39	19/3/2006
2,385	380	98	98	71.57	36	36	18.25	234.17	4.2736	34	25	11.84	4:39:08	19/3/2006
2,386	380	99	98	71.57	36	36	18.55	234.31	4.34645	34	25	11.84	4:39:38	19/3/2006
2,383	380	99	98	71.57	36	36	18.48	234.27	4.32931	34	25	11.84	4:40:07	19/3/2006
2,380	380	99	98	71.57	36	36	18.72	233.95	4.37954	34	25	11.84	4:40:37	19/3/2006
2,380	380	98	99	71.57	36	36	18.75	234.01	4.38769	34	25	11.84	4:41:06	19/3/2006
2,383	380	97	98	71.57	36	36	18.72	234.09	4.38216	34	25	11.84	4:41:36	19/3/2006
2,384	380	98	98	71.57	36	36	18.49	234.09	4.32832	34	25	11.84	4:42:05	19/3/2006
2,386	380	97	98	71.57	36	36	18.73	234.09	4.38451	34	25	11.84	4:42:35	19/3/2006
2,388	380	99	99	14.35	36	36	18.79	234.15	4.39968	34	25	11.84	4:43:04	19/3/2006
2,381	380	98	100	14.35	36	36	18.73	234.09	4.38451	34	25	11.84	4:43:34	19/3/2006
2,379	382	98	99	66.51	36	36	18.31	234.11	4.28655	34	25	11.84	4:44:03	19/3/2006
2,387	380	99	98	66.51	36	36	18.36	234.33	4.3023	34	25	11.84	4:44:33	19/3/2006
2,378	380	99	98	66.51	36	36	18.4	234.13	4.30799	34	25	11.84	4:45:03	19/3/2006
2,379	380	98	98	66.51	36	36	18.19	233.99	4.25628	34	25	11.84	4:45:32	19/3/2006
2,384	380	97	98	66.51	36	36	18.6	234.25	4.35705	34	25	11.84	4:46:02	19/3/2006
2,383	380	98	98	66.51	36	36	18.57	233.97	4.34482	34	25	11.84	4:46:31	19/3/2006
2,379	380	98	98	66.51	36	36	18.55	234.03	4.34126	34	25	11.84	4:47:01	19/3/2006
2,382	380	98	98	66.51	36	36	18.68	234.11	4.37317	34	25	11.84	4:47:30	19/3/2006
2,388	380	98	98	14.23	36	36	18.43	234.33	4.3187	34	25	11.84	4:48:00	19/3/2006
2,384	380	98	98	14.23	36	36	18.64	234.25	4.36642	34	25	11.84	4:48:29	19/3/2006
2,384	380	98	98	14.23	36	36	18.55	234.13	4.34311	34	25	11.84	4:48:59	19/3/2006
2,387	380	98	98	14.23	36	36	18.54	234.49	4.34744	34	25	11.84	4:49:29	19/3/2006
2,387	380	99	98	14.23	36	36	18.8	234.33	4.4054	34	25	11.84	4:49:58	19/3/2006
2,387	380	98	98	14.23	36	36	18.4	234.66	4.31774	34	25	11.84	4:50:28	19/3/2006
2,388	380	98	98	14.23	36	36	18.52	234.39	4.3409	34	25	11.84	4:50:57	19/3/2006
2,385	380	100	98	14.23	36	36	18.52	234.33	4.33979	34	25	11.84	4:51:27	19/3/2006
2,388	380	98	97	14.11	36	36	18.48	234.17	4.32746	34	25	11.84	4:51:56	19/3/2006
2,387	380	99	97	14.11	36	36	18.81	234.15	4.40436	34	25	11.84	4:52:26	19/3/2006
2,386	380	98	98	14.11	36	36	18.35	234.41	4.30142	34	25	11.84	4:52:55	19/3/2006
2,385	380	98	97	14.11	36	36	18.42	234.15	4.31304	34	25	11.84	4:53:25	19/3/2006
2,386	380	98	98	14.11	36	36	18.34	234.43	4.29945	34	25	11.84	4:53:55	19/3/2006

ตาราง ฉ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,387	380	98	98	14.16	36	36	18.64	234.25	4.36642	34	25	11.84	4:55:53	19/3/2006
2,388	380	98	98	243.1	36	36	18.4	234.29	4.31094	34	25	11.84	4:56:22	19/3/2006
2,387	380	98	98	243.1	36	36	18.55	234.27	4.34571	34	25	11.84	4:56:52	19/3/2006
2,385	380	98	97	243.1	36	36	18.71	234.23	4.38244	34	25	11.84	4:57:21	19/3/2006
2,381	380	97	97	243.1	36	36	18.48	234.17	4.32746	34	25	11.84	4:57:51	19/3/2006
2,381	380	98	98	243.1	36	36	18.68	234.03	4.37168	34	25	11.84	4:58:20	19/3/2006
2,388	380	99	98	243.1	36	36	18.75	234.31	4.39331	34	25	11.84	4:58:50	19/3/2006
2,388	380	99	98	243.1	36	36	18.62	234.21	4.36099	34	25	11.84	4:59:20	19/3/2006
2,387	380	99	98	14.16	36	36	18.8	234.21	4.40315	34	25	11.84	4:59:49	19/3/2006
2,386	380	99	97	14.16	36	36	18.36	234.37	4.30303	34	25	11.84	5:00:19	19/3/2006
2,387	380	99	97	14.16	36	36	18.43	234.17	4.31575	34	25	11.84	5:00:48	19/3/2006
2,388	380	98	97	14.16	36	36	18.52	234.25	4.33831	34	25	11.84	5:01:18	19/3/2006
2,385	380	98	98	14.16	36	36	18.43	234.39	4.31981	34	25	11.84	5:01:47	19/3/2006
2,387	380	98	98	14.16	36	36	18.48	234.11	4.32635	34	25	11.84	5:02:17	19/3/2006
2,386	380	98	98	14.16	36	36	18.74	234.11	4.38722	34	25	11.84	5:02:46	19/3/2006
2,386	380	96	98	14.16	36	36	18.36	234.49	4.30524	34	25	11.84	5:03:16	19/3/2006
2,385	380	96	98	14.01	36	36	18.37	234.35	4.30501	34	25	11.84	5:03:46	19/3/2006
2,386	382	98	98	14.01	36	36	18.39	234.6	4.31429	34	25	11.84	5:04:15	19/3/2006
2,388	380	98	97	14.01	36	36	18.36	234.43	4.30413	34	25	11.84	5:04:45	19/3/2006
2,388	380	98	98	14.01	36	36	18.49	234.64	4.33849	34	25	11.84	5:05:14	19/3/2006
2,388	380	98	98	14.01	36	36	18.55	234.45	4.34905	34	25	11.84	5:05:44	19/3/2006
2,387	380	99	98	14.01	36	36	18.5	234.27	4.334	34	25	11.84	5:06:13	19/3/2006
2,385	380	99	98	14.01	36	36	18.39	234.15	4.30602	34	25	11.84	5:06:43	19/3/2006
2,388	380	99	98	14.01	36	36	18.66	234.49	4.37558	34	25	11.84	5:07:12	19/3/2006
2,387	380	98	99	14.01	36	36	18.31	234.43	4.29241	34	25	11.84	5:07:42	19/3/2006
2,384	380	99	99	14.01	36	36	18.27	234.07	4.27646	34	25	11.84	5:08:11	19/3/2006
2,384	380	98	99	14.01	36	36	18.59	234.09	4.35173	34	25	11.84	5:08:41	19/3/2006
2,382	380	98	98	14.01	36	36	18.55	234.29	4.34608	34	25	11.84	5:09:10	19/3/2006
2,387	380	98	98	14.01	36	36	18.61	234.35	4.36125	34	25	11.84	5:09:40	19/3/2006
2,386	380	98	98	14.01	36	36	18.61	234.29	4.36014	34	25	11.84	5:10:10	19/3/2006
2,388	380	98	98	14.01	36	36	18.52	234.53	4.3435	34	25	11.84	5:10:39	19/3/2006
2,387	380	99	99	14	36	36	18.57	234.19	4.34891	34	25	11.84	5:11:09	19/3/2006
2,382	380	98	99	14	36	36	18.4	234.15	4.30836	34	25	11.84	5:11:38	19/3/2006
2,380	380	98	98	14	36	36	18.31	234.09	4.28619	34	25	11.84	5:12:08	19/3/2006
2,382	380	99	98	14	36	36	18.49	234.17	4.3298	34	25	11.84	5:12:37	19/3/2006
2,374	382	98	98	14	36	36	22.62	231.69	5.24083	34	25	11.84	5:13:07	19/3/2006
2,394	412	98	99	14	36	36	23.14	233.93	5.41314	34	25	11.84	5:13:36	19/3/2006
2,388	424	98	100	14	36	36	23.13	233.22	5.39438	34	25	11.84	5:14:06	19/3/2006
2,397	427	98	100	17.04	36	36	23.14	233.81	5.41036	34	25	11.84	5:14:35	19/3/2006
2,400	427	99	100	17.04	36	36	23.29	233.83	5.4459	34	24.59	11.52	5:15:04	19/3/2006
2,400	433	100	100	17.04	36	36	23.17	233.93	5.42016	34	24.59	11.52	5:15:34	19/3/2006
2,400	433	100	100	17.04	36	36	23.11	233.89	5.4052	34	24.59	11.52	5:16:03	19/3/2006
2,400	432	99	100	17.04	36	36	23.08	233.93	5.3991	34	24.59	11.52	5:16:33	19/3/2006
2,400	433	99	100	23.19	36	36	23.14	233.93	5.41314	34	24.78	10.08	5:17:02	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	430	99	100	23.19	36	36	23.12	233.83	5.40615	34	24.78	10.08	5:19:01	19/3/2006
2,400	430	98	100	21.48	36	36	23.09	233.71	5.39636	34	24.78	10.08	5:19:30	19/3/2006
2,400	430	99	100	21.48	36	36	23.08	233.85	5.39726	34	24.78	10.08	5:20:00	19/3/2006
2,400	431	100	100	21.48	36	36	23.13	233.59	5.40294	34	24.78	10.08	5:20:29	19/3/2006
2,400	430	100	100	21.48	36	36	23.14	233.67	5.40712	34	24.78	10.08	5:20:59	19/3/2006
2,400	430	99	100	21.48	36	36	23.16	233.65	5.41133	34	24.78	10.08	5:21:28	19/3/2006
2,400	430	99	100	21.41	36	36	23.15	233.57	5.40715	34	24.78	10.08	5:21:58	19/3/2006
2,400	432	98	100	327.9	36	36	23.03	233.51	5.37774	34	24.78	10.08	5:22:27	19/3/2006
2,400	432	98	100	327.9	36	36	23.21	233.75	5.42534	34	24.78	10.08	5:22:57	19/3/2006
2,400	433	98	100	327.9	36	36	23.11	233.75	5.40196	34	24.78	10.08	5:23:27	19/3/2006
2,400	433	98	100	327.9	36	36	23.07	233.57	5.38846	34	24.78	10.08	5:23:56	19/3/2006
2,400	432	99	100	327.9	36	36	23.06	233.69	5.38889	34	24.78	10.08	5:24:26	19/3/2006
2,400	432	99	100	21.59	35	36	23.1	233.55	5.39501	34	24.78	10.08	5:24:55	19/3/2006
2,400	430	99	100	21.59	35	36	23.15	233.67	5.40946	34	24.78	10.08	5:25:25	19/3/2006
2,400	430	98	99	21.59	35	36	23.11	233.67	5.40011	34	24.78	10.08	5:25:54	19/3/2006
2,400	429	99	99	21.59	36	36	23.1	233.57	5.39547	34	24.78	10.08	5:26:24	19/3/2006
2,400	429	99	99	21.59	36	36	23.12	233.67	5.40245	34	24.78	10.08	5:26:53	19/3/2006
2,400	427	99	100	21.25	36	36	23.17	233.59	5.41228	34	24.78	10.08	5:27:23	19/3/2006
2,400	427	98	100	21.25	36	36	23.08	233.49	5.38895	34	24.78	10.08	5:27:53	19/3/2006
2,400	427	100	100	21.25	36	36	23.1	233.51	5.39408	34	24.78	10.08	5:28:22	19/3/2006
2,400	428	100	100	21.25	36	36	23.07	233.49	5.38661	34	24.78	10.08	5:28:52	19/3/2006
2,400	427	100	100	21.25	36	36	23.09	233.47	5.39082	34	24.78	10.08	5:29:21	19/3/2006
2,400	427	99	99	21.46	35	36	23.09	233.49	5.39128	34	24.78	10.08	5:29:51	19/3/2006
2,400	427	98	99	21.46	35	36	23.13	233.55	5.40201	34	24.78	10.08	5:30:20	19/3/2006
2,400	427	99	99	21.46	35	36	23.11	233.67	5.40011	34	24.78	10.08	5:30:50	19/3/2006
2,400	427	99	99	21.46	36	36	23.08	233.57	5.3908	34	24.78	10.08	5:31:19	19/3/2006
2,400	427	98	99	21.46	36	36	23.11	233.57	5.3978	34	24.78	10.08	5:31:49	19/3/2006
2,400	427	98	99	21.46	36	36	23.07	233.45	5.38569	34	24.78	10.08	5:32:18	19/3/2006
2,400	427	99	99	21.19	36	36	23.16	233.65	5.41133	34	24.78	10.08	5:32:48	19/3/2006
2,400	427	99	99	339.8	36	36	23.08	233.49	5.38895	34	24.78	10.08	5:33:18	19/3/2006
2,400	427	100	99	339.8	36	36	23.14	233.59	5.40527	34	24.78	10.08	5:33:47	19/3/2006
2,400	427	100	100	339.8	36	36	23.09	233.55	5.39267	34	24.78	10.08	5:34:17	19/3/2006
2,400	427	98	99	339.8	35	36	23.08	233.63	5.39218	34	24.78	10.08	5:34:46	19/3/2006
2,400	427	98	100	339.8	35	36	23.1	233.65	5.39732	34	24.78	10.08	5:35:16	19/3/2006
2,400	427	98	99	21.03	35	36	23.15	233.59	5.40761	34	24.78	10.08	5:35:45	19/3/2006
2,400	428	98	99	21.03	35	36	23.12	233.43	5.3969	34	24.78	10.08	5:36:15	19/3/2006
2,400	427	98	99	21.03	35	36	23.09	233.53	5.39221	34	24.78	10.08	5:36:44	19/3/2006
2,400	427	99	99	21.03	35	36	23.08	233.49	5.38895	34	24.78	10.08	5:37:14	19/3/2006
2,400	427	99	99	21.33	35	36	23.12	233.69	5.40291	34	24.78	10.08	5:37:43	19/3/2006
2,400	427	99	99	21.33	35	36	23.11	233.39	5.39364	34	24.78	10.08	5:38:13	19/3/2006
2,400	427	99	99	21.33	35	36	23.14	233.57	5.40481	34	24.78	10.08	5:38:43	19/3/2006
2,400	427	98	98	21.33	35	36	23.09	233.47	5.39082	34	24.78	10.08	5:39:12	19/3/2006
2,400	427	98	98	21.33	35	36	23.11	233.57	5.3978	34	24.78	10.08	5:39:42	19/3/2006
2,400	427	98	98	21.33	35	36	23.09	233.47	5.39082	34	24.78	10.08	5:40:11	19/3/2006
2,400	427	98	98	21.17	35	36	23.21	233.49	5.4193	34	24.78	10.08	5:40:41	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	λmbT	PAir	PGas	H-Meter	Date
2,400	426	100	100	21.17	36	36	23.13	233.33	5.39692	34	24.78	10.08	5:42:39	19/3/2006
2,400	427	101	100	21.08	36	36	23.18	233.49	5.4123	34	24.78	10.08	5:43:08	19/3/2006
2,400	426	100	100	21.08	35	36	23.04	233.39	5.37731	34	24.78	10.08	5:43:38	19/3/2006
2,400	427	99	99	21.08	35	36	23.06	233.35	5.38105	34	24.78	10.08	5:44:08	19/3/2006
2,400	427	99	99	21.08	36	36	23.09	233.41	5.38944	34	24.78	10.08	5:44:37	19/3/2006
2,400	427	99	99	21.08	35	36	23.21	233.3	5.41489	34	24.78	10.08	5:45:07	19/3/2006
2,400	427	99	99	21.03	35	36	23.17	233.35	5.40672	34	24.78	10.08	5:45:36	19/3/2006
2,400	427	99	98	5640	35	36	23.18	233.16	5.40465	34	24.78	10.08	5:46:06	19/3/2006
2,400	427	100	99	5640	35	36	23.08	233.26	5.38364	34	24.78	10.08	5:46:35	19/3/2006
2,400	427	101	99	5640	35	36	23.15	233.3	5.4009	34	24.78	10.08	5:47:05	19/3/2006
2,400	427	100	99	5640	35	36	23.21	233.26	5.41396	34	24.78	10.08	5:47:34	19/3/2006
2,400	426	99	99	5640	35	36	23.12	233.28	5.39343	34	24.78	10.08	5:48:04	19/3/2006
2,400	427	98	99	21.19	35	36	23.15	233.31	5.40113	34	24.78	10.08	5:48:33	19/3/2006
2,400	427	98	98	21.19	35	36	23.16	233.31	5.40346	34	24.78	10.08	5:49:03	19/3/2006
2,400	427	98	98	21.19	35	36	23.09	233.3	5.3869	34	24.78	10.08	5:49:33	19/3/2006
2,400	427	98	99	21.19	35	36	23.11	233.35	5.39272	34	24.78	10.08	5:50:02	19/3/2006
2,400	427	99	98	21.19	35	36	23.24	233.41	5.42445	34	24.78	10.08	5:50:32	19/3/2006
2,400	427	99	99	21.14	35	36	23.1	233.22	5.38738	34	24.78	10.08	5:51:01	19/3/2006
2,400	427	99	99	21.14	35	36	23.12	233.3	5.3939	34	24.78	10.08	5:51:31	19/3/2006
2,400	427	99	99	21.14	35	36	23.04	233.37	5.37684	34	24.78	10.08	5:52:00	19/3/2006
2,400	427	99	99	21.14	35	36	23.13	233.51	5.40109	34	24.78	10.08	5:52:30	19/3/2006
2,400	427	99	100	21.14	35	36	23.11	233.47	5.39549	34	24.78	10.08	5:52:59	19/3/2006
2,400	427	98	99	21.09	35	36	23.18	233.35	5.40905	34	24.78	10.08	5:53:29	19/3/2006
2,400	427	98	99	21.09	35	36	23.06	233.31	5.38013	34	24.78	10.08	5:53:58	19/3/2006
2,400	427	100	99	21.09	35	36	23.15	233.33	5.40159	34	24.78	10.08	5:54:28	19/3/2006
2,400	427	99	99	21.09	35	36	23.14	233.26	5.39764	34	24.78	10.08	5:54:57	19/3/2006
2,400	427	99	98	21.09	35	36	23.13	233.14	5.39253	34	24.78	10.08	5:55:27	19/3/2006
2,400	427	99	98	21.14	35	36	23.09	233.31	5.38713	34	24.78	10.08	5:55:57	19/3/2006
2,400	427	99	99	21.14	35	36	23.24	233.2	5.41957	34	24.78	10.08	5:56:26	19/3/2006
2,400	427	99	99	21.14	35	36	23.06	233.16	5.37667	34	24.78	10.08	5:56:56	19/3/2006
2,400	427	98	99	21.14	35	36	23.16	233.35	5.40439	34	24.78	10.08	5:57:25	19/3/2006
2,400	426	99	99	21.14	35	36	23.09	233.33	5.38759	34	24.78	10.08	5:57:55	19/3/2006
2,400	425	99	99	21.01	35	36	23.17	233.31	5.40579	34	24.78	10.08	5:58:24	19/3/2006
2,400	427	99	99	21.01	35	36	23.02	233.3	5.37057	34	24.78	10.08	5:58:54	19/3/2006
2,400	427	100	99	21.01	35	36	23.11	233.1	5.38694	34	24.78	10.08	5:59:23	19/3/2006
2,400	427	99	99	21.01	35	36	23.14	233.18	5.39579	34	24.78	10.08	5:59:53	19/3/2006
2,400	427	98	99	21.01	35	36	23.06	233.33	5.38059	34	24.78	10.08	6:00:23	19/3/2006
2,400	427	98	99	20.95	35	36	23.1	233.31	5.38946	34	24.78	10.08	6:00:52	19/3/2006
2,400	427	98	98	532.1	35	36	23.09	233.28	5.38644	34	24.78	10.08	6:01:21	19/3/2006
2,400	427	98	98	532.1	35	36	23.12	233.24	5.39251	34	24.78	10.08	6:01:51	19/3/2006
2,400	427	98	98	532.1	35	36	23.08	233.37	5.38618	34	24.78	10.08	6:02:21	19/3/2006
2,400	427	99	99	532.1	35	36	23.18	233.41	5.41044	34	24.78	10.08	6:02:50	19/3/2006
2,400	427	99	98	532.1	35	36	23.14	233.2	5.39625	34	24.78	10.08	6:03:20	19/3/2006
2,400	427	98	98	532.1	35	35	23.08	233.08	5.37949	34	24.78	10.08	6:03:49	19/3/2006
2,400	427	98	98	20.95	35	35	23.08	233.26	5.38364	34	24.78	10.08	6:04:19	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	427	98	99	193.2	35	36	23.14	233.14	5.39486	34	24.78	10.08	6:06:17	19/3/2006
2,400	425	100	99	193.2	35	36	23.1	233.1	5.38461	34	24.78	10.08	6:06:46	19/3/2006
2,400	426	99	98	21.03	35	36	23.15	233.37	5.40252	34	24.78	10.08	6:07:16	19/3/2006
2,400	424	100	98	135.6	35	36	23.18	233.24	5.4065	34	24.78	10.08	6:07:45	19/3/2006
2,400	425	99	99	135.6	35	36	23.17	233.18	5.40278	34	24.78	10.08	6:08:15	19/3/2006
2,400	426	99	99	135.6	35	36	23.13	233.2	5.39392	34	24.78	10.08	6:08:45	19/3/2006
2,400	426	99	99	135.6	35	36	23.16	233.16	5.39999	34	24.78	10.08	6:09:14	19/3/2006
2,400	426	98	99	135.6	35	36	23.07	233.3	5.38223	34	24.78	10.08	6:09:44	19/3/2006
2,400	427	97	99	20.87	35	36	23.04	233.26	5.37431	34	24.78	10.08	6:10:13	19/3/2006
2,400	427	96	100	20.87	35	36	23.18	233.51	5.41276	34	24.78	10.08	6:10:43	19/3/2006
2,400	427	98	99	20.87	35	36	23.03	233.37	5.37451	34	24.78	10.08	6:11:12	19/3/2006
2,400	427	99	99	20.87	35	36	23.17	233.39	5.40765	34	24.78	10.08	6:11:42	19/3/2006
2,400	427	99	98	20.87	35	36	23.09	233.33	5.38759	34	24.78	10.08	6:12:11	19/3/2006
2,400	427	99	98	21.09	35	36	23.11	233.57	5.3978	34	24.78	10.08	6:12:41	19/3/2006
2,400	427	98	98	2014	35	35	23.16	233.47	5.40717	34	24.78	10.08	6:13:10	19/3/2006
2,400	424	98	98	2014	35	35	23.12	233.3	5.3939	34	24.78	10.08	6:13:40	19/3/2006
2,400	425	99	98	2014	35	35	23.21	233.26	5.41396	34	24.78	10.08	6:14:10	19/3/2006
2,400	427	99	99	2014	35	35	23.08	233.28	5.3841	34	24.78	10.08	6:14:39	19/3/2006
2,400	427	98	98	2014	35	35	23.18	233.06	5.40233	34	24.78	10.08	6:15:09	19/3/2006
2,400	427	99	98	21.01	35	35	23.12	233.37	5.39551	34	24.78	10.08	6:15:38	19/3/2006
2,400	427	100	98	21.01	35	35	23.14	233.28	5.3981	34	24.78	10.08	6:16:08	19/3/2006
2,400	424	99	99	21.01	35	35	23.14	233.28	5.3981	34	24.78	10.08	6:16:37	19/3/2006
2,400	424	98	100	21.01	35	35	23.1	233.16	5.386	34	24.78	10.08	6:17:07	19/3/2006
2,400	427	98	100	21.01	35	35	23.14	233.3	5.39856	34	24.78	10.08	6:17:37	19/3/2006
2,399	427	98	100	21.32	35	35	23.03	233.18	5.37014	34	24.78	10.08	6:18:06	19/3/2006
2,400	425	101	99	21.32	35	35	23.15	233.16	5.39765	34	24.78	10.08	6:18:36	19/3/2006
2,400	424	100	99	21.32	35	35	23.14	233.39	5.40064	34	24.78	10.08	6:19:05	19/3/2006
2,400	424	101	99	21.32	35	35	23.14	233.33	5.39926	34	24.78	10.08	6:19:35	19/3/2006
2,400	425	99	99	21.32	35	35	23.15	233.33	5.40159	34	24.78	10.08	6:20:04	19/3/2006
2,400	426	98	99	21.28	35	35	23.03	233.31	5.37313	34	24.78	10.08	6:20:34	19/3/2006
2,400	426	98	98	21.28	35	35	23.03	233.43	5.37589	34	24.78	10.08	6:21:03	19/3/2006
2,400	425	99	99	21.28	35	35	23.15	233.53	5.40622	34	24.78	10.08	6:21:33	19/3/2006
2,400	424	100	98	21.28	35	35	23.13	233.3	5.39623	34	24.78	10.08	6:22:02	19/3/2006
2,400	424	100	98	21.28	35	35	23.14	233.43	5.40157	34	24.78	10.08	6:22:32	19/3/2006
2,400	427	99	99	21.08	35	35	23.2	233.59	5.41929	34	24.78	10.08	6:23:01	19/3/2006
2,400	427	98	99	21.08	35	35	23.14	233.41	5.40111	34	24.78	10.08	6:23:31	19/3/2006
2,400	427	98	99	21.08	35	35	23.15	233.3	5.4009	34	24.78	10.08	6:24:00	19/3/2006
2,400	425	99	98	21.08	35	35	23.12	233.33	5.39459	34	24.78	10.08	6:24:30	19/3/2006
2,400	425	98	98	21.08	35	35	23.2	233.35	5.41372	34	24.78	10.08	6:25:00	19/3/2006
2,400	425	98	98	20.52	35	35	23.17	233.55	5.41135	34	24.78	10.08	6:25:29	19/3/2006
2,400	424	99	99	20.52	35	35	23.13	233.49	5.40062	34	24.78	10.08	6:25:59	19/3/2006
2,400	424	101	99	20.52	35	35	23.15	233.51	5.40576	34	24.78	10.08	6:26:28	19/3/2006
2,400	424	100	99	20.52	35	35	23.16	233.57	5.40948	34	24.78	10.08	6:26:58	19/3/2006
2,400	424	101	99	20.52	35	35	23.1	233.37	5.39085	34	24.78	10.08	6:27:27	19/3/2006
2,400	424	100	98	20.52	35	35	23.16	233.55	5.40902	34	24.78	10.08	6:27:57	19/3/2006

ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	427	97	98	21	35	35	23.16	233.37	5.40485	34	24.78	10.08	6:29:55	19/3/2006
2,400	427	98	98	21	35	35	23.23	233.43	5.42258	34	24.78	10.08	6:30:25	19/3/2006
2,400	425	99	98	20.86	35	35	23.17	233.49	5.40996	34	24.78	10.08	6:30:54	19/3/2006
2,400	424	99	97	20.86	35	35	23.24	233.39	5.42398	34	24.78	10.08	6:31:24	19/3/2006
2,400	424	100	98	20.86	35	35	23.11	233.31	5.39179	34	24.78	10.08	6:31:53	19/3/2006
2,400	424	99	98	20.86	35	35	23.19	233.2	5.40791	34	24.78	10.08	6:32:23	19/3/2006
2,400	426	98	98	20.86	35	35	23.07	233.18	5.37946	34	24.78	10.08	6:32:52	19/3/2006
2,400	426	98	97	21.4	35	35	22.99	233.14	5.35989	34	24.78	10.08	6:33:22	19/3/2006
2,400	426	98	98	21.4	35	35	23.04	233.28	5.37477	34	24.78	10.08	6:33:51	19/3/2006
2,400	426	97	97	21.4	35	35	23.08	233.26	5.38364	34	24.78	10.08	6:34:21	19/3/2006
2,400	427	99	97	21.4	35	35	23.17	233.2	5.40324	34	24.78	10.08	6:34:50	19/3/2006
2,400	426	99	97	21.4	35	35	23.13	233.35	5.39739	34	24.78	10.08	6:35:20	19/3/2006
2,400	426	99	97	21.43	35	35	23.17	233.2	5.40324	34	24.78	10.08	6:35:49	19/3/2006
2,400	425	98	97	21.43	35	35	23.1	233.08	5.38415	34	24.78	10.08	6:36:19	19/3/2006
2,399	424	99	98	100	35	35	23.17	233.16	5.40232	34	24.78	10.08	6:36:49	19/3/2006
2,400	425	97	97	100	34	35	23.08	233.14	5.38087	34	24.78	10.08	6:37:18	19/3/2006
2,400	427	96	97	100	34	35	23.18	233.06	5.40233	34	24.78	10.08	6:37:48	19/3/2006
2,400	427	97	97	100	34	35	23.06	233.12	5.37575	34	24.78	10.08	6:38:17	19/3/2006
2,400	427	98	97	100	34	35	23.1	233.16	5.386	34	24.78	10.08	6:38:47	19/3/2006
2,400	427	98	97	21.56	34	35	23.04	233.1	5.37062	34	24.78	10.08	6:39:16	19/3/2006
2,400	427	97	97	225.6	34	35	23.14	233.04	5.39255	34	24.78	10.08	6:39:46	19/3/2006
2,400	427	97	97	225.6	34	35	23.23	233	5.41259	34	24.78	10.08	6:40:15	19/3/2006
2,400	427	98	98	225.6	34	35	23.14	232.98	5.39116	34	24.78	10.08	6:40:45	19/3/2006
2,400	427	97	97	225.6	34	35	23.09	232.98	5.37951	34	24.78	10.08	6:41:14	19/3/2006
2,400	427	97	97	225.6	34	34	23.1	232.98	5.38184	34	24.78	10.08	6:41:44	19/3/2006
2,400	427	96	97	21.64	34	35	23.15	232.98	5.39349	34	24.78	10.08	6:42:13	19/3/2006
2,400	427	99	97	21.64	34	35	23.11	233.04	5.38555	34	24.78	10.08	6:42:43	19/3/2006
2,400	427	98	97	21.64	34	35	23.01	232.98	5.36087	34	24.78	10.08	6:43:12	19/3/2006
2,400	426	99	97	21.64	35	34	22.98	232.98	5.35388	34	24.78	10.08	6:43:42	19/3/2006
2,399	427	98	97	21.64	34	34	23.04	232.98	5.36786	34	24.78	10.08	6:44:12	19/3/2006
2,400	427	97	97	21.95	34	34	23.01	232.98	5.36087	34	24.78	10.08	6:44:41	19/3/2006
2,399	427	97	98	21.95	34	34	23.06	232.98	5.37252	34	24.78	10.08	6:45:11	19/3/2006
2,397	429	96	98	21.95	34	34	23.18	232.98	5.40048	34	24.78	10.08	6:45:40	19/3/2006
2,398	430	96	97	21.95	34	34	23.11	232.98	5.38417	34	24.78	10.08	6:46:10	19/3/2006
2,397	430	96	97	21.95	34	34	23.18	233.04	5.40187	34	24.78	10.08	6:46:39	19/3/2006
2,399	430	98	97	22.17	34	34	23.17	232.98	5.39815	34	24.78	10.08	6:47:09	19/3/2006
2,394	430	98	97	22.17	34	34	23.04	232.98	5.36786	34	24.78	10.08	6:47:38	19/3/2006
2,395	428	98	97	22.17	34	34	23.02	233.02	5.36412	34	24.78	10.08	6:48:08	19/3/2006
2,399	427	97	97	22.17	34	34	23.11	232.98	5.38417	34	24.78	10.08	6:48:37	19/3/2006
2,395	429	97	97	22.17	34	34	23.19	232.98	5.40281	34	24.78	10.08	6:49:07	19/3/2006
2,399	430	98	97	22.15	34	34	23.08	232.98	5.37718	34	24.78	10.08	6:49:37	19/3/2006
2,397	427	98	97	22.15	34	34	23.08	232.98	5.37718	34	24.78	10.08	6:50:06	19/3/2006
2,400	427	97	97	22.15	34	34	23.08	232.98	5.37718	34	24.78	10.08	6:50:36	19/3/2006
2,392	427	96	97	22.15	34	34	23.14	232.98	5.39116	34	24.78	10.08	6:51:05	19/3/2006
2,399	427	98	97	22.15	34	34	23.16	232.98	5.39582	34	24.78	10.08	6:51:35	19/3/2006



ตาราง ฉ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,398	427	96	98	22.36	34	34	23.12	232.98	5.3865	34	24.78	10.08	6:53:33	19/3/2006
2,402	425	96	97	21.98	34	34	19.33	234.19	4.52689	34	24.78	10.08	6:54:03	19/3/2006
2,389	409	96	96	21.98	34	34	20.73	233.45	4.83942	34	24.78	10.08	6:54:32	19/3/2006
2,389	403	98	96	21.98	34	34	20.78	233.35	4.84901	34	24.78	10.08	6:55:01	19/3/2006
2,388	400	98	96	21.98	34	34	20.77	233.2	4.84356	34	24.78	11.36	6:55:31	19/3/2006
2,389	400	98	96	21.98	34	34	20.74	233.43	4.84134	34	24.47	11.36	6:56:00	19/3/2006
2,388	400	98	96	21.98	34	34	20.71	233.26	4.83081	34	24.47	11.36	6:56:30	19/3/2006
2,388	400	98	96	19.17	34	34	20.62	233.3	4.81065	34	24.47	11.36	6:56:59	19/3/2006
2,388	399	98	97	19.17	34	34	20.87	233.43	4.87168	34	24.47	11.36	6:57:29	19/3/2006
2,389	398	97	96	19.17	34	34	20.89	233.55	4.87886	34	24.47	11.36	6:57:58	19/3/2006
2,388	400	96	96	19.17	34	34	20.77	233.65	4.85291	34	24.47	11.36	6:58:28	19/3/2006
2,388	400	96	96	19.17	34	34	20.89	233.47	4.87719	34	24.47	11.36	6:58:57	19/3/2006
2,388	399	98	96	19.17	34	34	20.88	233.41	4.8736	34	24.47	11.36	6:59:27	19/3/2006
2,388	399	98	96	19.17	34	34	20.65	233.39	4.8195	34	24.47	11.36	6:59:56	19/3/2006
2,388	400	97	96	18.48	34	34	20.65	233.3	4.81765	34	24.47	11.36	7:00:26	19/3/2006
2,389	400	96	96	18.48	34	34	20.82	233.49	4.86126	34	24.47	11.36	7:00:56	19/3/2006
2,388	400	96	96	18.48	33	34	20.82	233.28	4.85689	34	24.47	11.36	7:01:25	19/3/2006
2,388	400	96	96	18.48	33	33	20.82	233.18	4.85481	34	24.47	11.36	7:01:55	19/3/2006
2,389	400	95	96	18.48	33	33	20.92	233.47	4.88419	34	24.47	11.36	7:02:24	19/3/2006
2,388	400	96	96	18.48	33	33	20.7	233.49	4.83324	34	24.47	11.36	7:02:54	19/3/2006
2,388	400	96	95	18.29	33	33	20.74	233.69	4.84673	34	24.47	11.36	7:03:23	19/3/2006
2,388	400	98	95	18.29	33	33	20.85	233.65	4.8716	34	24.47	11.36	7:03:53	19/3/2006
2,389	399	97	95	18.29	33	33	20.68	233.77	4.83436	34	24.47	11.36	7:04:22	19/3/2006
2,389	398	97	96	18.29	33	33	20.68	233.69	4.83271	34	24.47	11.36	7:04:52	19/3/2006
2,388	399	97	96	18.29	33	33	20.85	233.75	4.87369	34	24.47	11.36	7:05:21	19/3/2006
2,388	398	97	96	18.29	33	33	20.88	233.79	4.88154	34	24.47	11.36	7:05:51	19/3/2006
2,388	398	96	95	18.16	33	33	20.78	233.77	4.85774	34	24.47	11.36	7:06:21	19/3/2006
2,388	397	97	95	18.16	33	33	20.77	233.63	4.8525	34	24.47	11.36	7:06:50	19/3/2006
2,388	397	96	95	18.16	33	33	20.8	233.71	4.86117	34	24.47	11.36	7:07:20	19/3/2006
2,388	397	98	95	18.16	33	33	20.85	233.73	4.87327	34	24.47	11.36	7:07:49	19/3/2006
2,388	397	98	95	18.16	33	33	20.99	233.75	4.90641	34	24.47	11.36	7:08:19	19/3/2006
2,388	397	97	95	18.16	33	33	20.91	233.85	4.8898	34	24.47	11.36	7:08:48	19/3/2006
2,388	397	96	95	18.07	33	33	20.64	233.87	4.82708	34	24.47	11.36	7:09:18	19/3/2006
2,388	398	97	95	18.07	33	33	20.92	233.91	4.8934	34	24.47	11.36	7:09:47	19/3/2006
2,388	400	96	95	18.07	33	33	20.71	233.95	4.8451	34	24.47	11.36	7:10:17	19/3/2006
2,388	399	96	95	18.07	33	33	20.94	233.91	4.89808	34	24.47	11.36	7:10:46	19/3/2006
2,388	397	96	95	18.07	33	33	20.89	233.89	4.88596	34	24.47	11.36	7:11:16	19/3/2006
2,388	400	96	96	18.07	33	33	20.66	233.81	4.83051	34	24.47	11.36	7:11:46	19/3/2006
2,387	400	96	96	18.07	33	33	20.8	233.87	4.8645	34	24.47	11.36	7:12:15	19/3/2006
2,388	400	98	96	231.2	33	33	20.93	233.89	4.89532	34	24.47	11.36	7:12:45	19/3/2006
2,388	398	98	96	231.2	33	33	20.86	233.87	4.87853	34	24.47	11.36	7:13:14	19/3/2006
2,388	398	97	95	231.2	33	33	20.66	233.79	4.8301	34	24.47	11.36	7:13:44	19/3/2006
2,388	397	98	96	231.2	33	33	20.91	233.79	4.88855	34	24.47	11.36	7:14:13	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,388	396	97	97	129.4	33	33	20.74	233.77	4.84839	34	24.47	11.36	7:16:11	19/3/2006
2,388	397	98	97	414.7	33	33	20.69	233.75	4.83629	34	24.47	11.36	7:16:41	19/3/2006
2,388	397	98	97	414.7	33	33	20.67	233.69	4.83037	34	24.47	11.36	7:17:10	19/3/2006
2,388	398	98	97	73.82	33	33	20.68	233.89	4.83685	34	24.47	11.36	7:17:40	19/3/2006
2,388	398	97	96	73.82	32	33	20.71	233.71	4.84013	34	24.47	11.36	7:18:10	19/3/2006
2,388	400	96	97	73.82	32	33	20.73	233.75	4.84564	34	24.47	11.36	7:18:39	19/3/2006
2,388	400	96	97	73.82	33	33	20.85	233.73	4.87327	34	24.47	11.36	7:19:09	19/3/2006
2,388	400	95	97	73.82	32	33	20.82	233.79	4.86751	34	24.47	11.36	7:19:38	19/3/2006
2,388	400	95	97	73.82	32	33	20.92	233.79	4.89089	34	24.47	11.36	7:20:08	19/3/2006
2,388	400	98	97	18.34	32	33	20.85	233.85	4.87577	34	24.47	11.36	7:20:37	19/3/2006
2,388	400	97	97	18.34	32	33	20.75	233.89	4.85322	34	24.47	11.36	7:21:07	19/3/2006
2,388	399	98	97	18.34	32	33	20.82	233.93	4.87042	34	24.47	11.36	7:21:36	19/3/2006
2,388	400	96	97	18.34	32	33	20.95	233.77	4.89748	34	24.47	11.36	7:22:06	19/3/2006
2,388	400	96	97	18.34	32	33	20.84	233.95	4.87552	34	24.47	11.36	7:22:35	19/3/2006
2,388	400	97	97	18.34	32	33	20.82	233.89	4.86959	34	24.47	11.36	7:23:05	19/3/2006
2,387	400	97	97	18.49	32	33	20.83	233.79	4.86985	34	24.47	11.36	7:23:34	19/3/2006
2,387	399	96	97	18.49	32	33	20.89	233.69	4.88178	34	24.47	11.36	7:24:04	19/3/2006
2,387	400	95	97	47.24	32	33	20.73	233.87	4.84813	34	24.47	11.36	7:24:34	19/3/2006
2,387	400	97	97	47.24	32	33	20.88	233.81	4.88195	34	24.47	11.36	7:25:03	19/3/2006
2,387	400	96	97	47.24	32	33	20.75	233.67	4.84865	34	24.47	11.36	7:25:33	19/3/2006
2,388	400	96	97	47.24	32	32	20.89	233.81	4.88429	34	24.47	11.36	7:26:02	19/3/2006
2,387	400	97	97	47.24	32	32	20.92	233.67	4.88838	34	24.47	11.36	7:26:32	19/3/2006
2,388	400	98	97	47.24	32	32	20.94	233.95	4.89891	34	24.47	11.36	7:27:01	19/3/2006
2,387	400	97	97	47.24	32	32	20.88	233.77	4.88112	34	24.47	11.36	7:27:31	19/3/2006
2,388	400	96	97	18.3	32	32	20.92	233.91	4.8934	34	24.47	11.36	7:28:00	19/3/2006
2,388	400	96	97	18.3	32	32	20.86	233.87	4.87853	34	24.47	11.36	7:28:30	19/3/2006
2,388	400	97	97	18.3	32	32	20.81	233.85	4.86642	34	24.47	11.36	7:28:59	19/3/2006
2,386	400	98	97	18.3	32	32	20.85	233.73	4.87327	34	24.47	11.36	7:29:29	19/3/2006
2,388	400	98	97	18.3	32	32	20.93	233.83	4.89406	34	24.47	11.36	7:29:59	19/3/2006
2,388	400	98	97	18.47	32	32	20.74	233.81	4.84922	34	24.47	11.36	7:30:28	19/3/2006
2,386	400	97	97	18.47	32	32	20.76	233.81	4.8539	34	24.47	11.36	7:30:58	19/3/2006
2,387	399	98	97	66.04	32	32	20.87	233.75	4.87836	34	24.47	11.36	7:31:27	19/3/2006
2,387	399	96	96	66.04	32	32	20.79	233.79	4.86049	34	24.47	11.36	7:31:57	19/3/2006
2,386	398	96	96	66.04	32	32	20.82	233.87	4.86917	34	24.47	11.36	7:32:26	19/3/2006
2,387	398	98	97	66.04	32	32	20.76	233.69	4.8514	34	24.47	11.36	7:32:56	19/3/2006
2,386	399	97	96	66.04	32	32	20.8	233.77	4.86242	34	24.47	11.36	7:33:25	19/3/2006
2,384	400	97	96	66.04	32	32	20.76	233.75	4.85265	34	24.47	11.36	7:33:55	19/3/2006
2,388	399	98	97	18.37	32	32	20.72	233.77	4.84371	34	24.47	11.36	7:34:24	19/3/2006
2,387	400	98	97	18.37	32	32	20.97	233.73	4.90132	34	24.47	11.36	7:34:54	19/3/2006
2,384	398	97	97	61.04	32	32	20.89	233.83	4.88471	34	24.47	11.36	7:35:24	19/3/2006
2,384	400	96	97	61.04	32	32	20.91	233.79	4.88855	34	24.47	11.36	7:35:53	19/3/2006
2,384	398	96	97	61.04	32	32	20.85	233.65	4.8716	34	24.47	11.36	7:36:23	19/3/2006
2,381	398	96	97	61.04	32	32	20.94	233.83	4.8964	34	24.47	11.36	7:36:52	19/3/2006
2,383	397	98	97	61.04	32	32	20.7	233.71	4.8378	34	24.47	11.36	7:37:22	19/3/2006
2,383	398	99	97	18.53	32	32	21	233.67	4.90707	34	24.47	11.36	7:37:51	19/3/2006

ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	λmbT	PAir	PGas	H-Meter	Date
2,379	399	96	96	18.53	32	32	20.82	233.51	4.86168	34	24.47	11.36	7:39:49	19/3/2006
2,387	400	95	96	18.53	32	32	20.92	233.79	4.89089	34	24.47	11.36	7:40:19	19/3/2006
2,380	400	97	96	18.53	32	32	20.9	233.83	4.88705	34	24.47	11.36	7:40:49	19/3/2006
2,386	400	98	96	18.53	32	32	20.64	233.77	4.82501	34	24.47	11.36	7:41:18	19/3/2006
2,381	398	98	96	18.53	32	32	20.99	233.67	4.90473	34	24.47	11.36	7:41:48	19/3/2006
2,386	397	98	97	18.53	32	32	20.89	233.87	4.88554	34	24.47	11.36	7:42:17	19/3/2006
2,385	398	99	97	18.53	32	32	20.98	233.67	4.9024	34	24.47	11.36	7:42:47	19/3/2006
2,385	398	98	97	18.53	32	32	20.84	233.79	4.87218	34	24.47	11.36	7:43:16	19/3/2006
2,387	397	98	96	18.34	32	32	20.8	233.83	4.86366	34	24.47	11.36	7:43:46	19/3/2006
2,384	397	98	96	18.34	32	32	20.7	233.75	4.83863	34	24.47	11.36	7:44:15	19/3/2006
2,386	397	98	96	18.34	32	32	21.01	233.77	4.91151	34	24.47	11.36	7:44:45	19/3/2006
2,386	398	98	96	39.61	32	32	20.83	233.91	4.87235	34	24.47	11.36	7:45:14	19/3/2006
2,383	400	97	96	39.61	32	32	20.93	233.91	4.89574	34	24.47	11.36	7:45:44	19/3/2006
2,385	400	96	96	39.61	32	32	20.88	233.77	4.88112	34	24.47	11.36	7:46:13	19/3/2006
2,383	400	96	96	39.61	32	32	20.92	233.77	4.89047	34	24.47	11.36	7:46:43	19/3/2006
2,386	400	96	95	39.61	32	32	20.8	233.81	4.86325	34	24.47	11.36	7:47:13	19/3/2006
2,387	400	96	95	24.39	32	32	20.94	233.85	4.89682	34	24.47	11.36	7:47:42	19/3/2006
2,387	400	96	95	24.39	31	32	20.76	233.83	4.85431	34	24.47	11.36	7:48:12	19/3/2006
2,387	400	97	96	24.39	32	32	20.79	233.81	4.86091	34	24.47	11.36	7:48:41	19/3/2006
2,387	400	98	96	24.39	32	32	20.82	233.67	4.86501	34	24.47	11.36	7:49:11	19/3/2006
2,386	397	98	95	24.39	32	32	20.98	233.85	4.90617	34	24.47	11.36	7:49:40	19/3/2006
2,383	397	98	96	24.39	32	32	20.76	233.63	4.85016	34	24.47	11.36	7:50:10	19/3/2006
2,386	397	97	95	18.5	32	32	20.72	233.61	4.8404	34	24.47	11.36	7:50:39	19/3/2006
2,384	396	97	95	18.5	32	32	20.92	233.83	4.89172	34	24.47	11.36	7:51:09	19/3/2006
2,389	390	96	96	18.5	32	32	18.62	234.55	4.36732	34	24.47	11.36	7:51:38	19/3/2006
2,389	381	95	95	18.5	32	32	18.67	234.66	4.3811	34	24.47	11.36	7:52:08	19/3/2006
2,388	380	98	95	18.5	31	32	18.54	234.7	4.35134	34	24.47	11.36	7:52:38	19/3/2006
2,388	380	97	95	18.5	31	32	18.63	234.72	4.37283	34	24.47	11.36	7:53:07	19/3/2006
2,388	380	96	94	17.08	31	32	18.55	234.53	4.35053	34	24.47	11.36	7:53:37	19/3/2006
2,388	380	96	94	17.08	31	32	18.69	234.55	4.38374	34	24.47	11.36	7:54:06	19/3/2006
2,388	380	96	94	17.08	31	32	18.72	234.57	4.39115	34	24.47	11.36	7:54:36	19/3/2006
2,388	380	97	94	17.08	32	32	18.52	234.62	4.34516	34	24.47	11.36	7:55:05	19/3/2006
2,388	380	96	94	17.08	32	32	18.49	234.47	4.33535	34	24.47	11.36	7:55:35	19/3/2006
2,397	379	94	94	17.08	31	32	18.57	234.37	4.35225	34	24.47	11.36	7:56:04	19/3/2006
2,400	380	94	94	17.08	31	32	18.64	234.39	4.36903	34	24.47	11.84	7:56:34	19/3/2006
2,398	380	95	95	16.35	31	32	18.61	234.47	4.36349	34	24.41	11.84	7:57:04	19/3/2006
2,398	380	95	94	16.35	31	32	18.58	234.47	4.35645	34	24.41	11.84	7:57:33	19/3/2006
2,399	380	96	94	16.35	31	32	18.63	234.29	4.36482	34	24.41	11.84	7:58:03	19/3/2006
2,399	377	96	94	16.35	31	32	18.54	234.31	4.34411	34	24.41	11.84	7:58:32	19/3/2006
2,400	377	95	94	16.35	31	32	18.58	234.31	4.35348	34	24.41	11.84	7:59:02	19/3/2006
2,399	377	96	94	16.35	31	32	18.55	234.45	4.34905	34	24.41	11.84	7:59:31	19/3/2006
2,400	377	96	94	16.35	31	32	18.63	234.45	4.3678	34	24.41	11.84	8:00:01	19/3/2006
2,400	377	94	94	14.75	31	32	18.6	234.43	4.3604	34	24.41	11.84	8:00:30	19/3/2006

ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,399	380	95	93	14.75	31	31	18.49	234.41	4.33424	34	24.41	11.84	8:02:29	19/3/2006
2,395	380	94	93	14.75	31	31	18.51	234.37	4.33819	34	24.41	11.84	8:02:58	19/3/2006
2,397	380	95	93	14.75	31	32	18.53	234.31	4.34176	34	24.41	11.84	8:03:28	19/3/2006
2,394	380	94	94	15.1	31	32	18.5	234.23	4.33326	34	24.41	11.84	8:03:57	19/3/2006
2,397	380	94	94	15.1	31	32	18.47	234.19	4.32549	34	24.41	11.84	8:04:27	19/3/2006
2,399	380	96	95	15.1	31	32	18.43	234.31	4.31833	34	24.41	11.84	8:04:56	19/3/2006
2,396	377	96	95	15.1	31	32	18.53	234.21	4.33991	34	24.41	11.84	8:05:26	19/3/2006
2,398	377	96	95	15.1	31	32	18.48	234.23	4.32857	34	24.41	11.84	8:05:56	19/3/2006
2,392	377	95	95	15.1	31	32	18.51	234.23	4.3356	34	24.41	11.84	8:06:25	19/3/2006
2,399	377	96	95	15.1	31	32	18.5	234.17	4.33215	34	24.41	11.84	8:06:55	19/3/2006
2,339	377	95	95	15.1	31	32	18.24	229.96	4.19447	34	24.41	11.84	8:07:24	19/3/2006
2,388	421	90	96	23.4	30	31	23.48	232.98	5.47037	34	23.83	10.24	9:28:39	19/3/2006
2,388	421	91	97	22.27	30	31	23.41	232.98	5.45406	34	23.83	10.24	9:29:09	19/3/2006
2,388	421	91	97	22.27	30	31	23.53	232.98	5.48202	34	23.83	10.24	9:29:38	19/3/2006
2,388	421	92	97	22.27	30	31	23.45	232.98	5.46338	34	23.83	10.24	9:30:08	19/3/2006
2,388	421	92	97	22.27	30	31	23.4	232.98	5.45173	34	23.83	10.24	9:30:37	19/3/2006
2,388	421	92	97	22.27	30	31	23.42	232.98	5.45639	34	23.83	10.24	9:31:07	19/3/2006
2,388	421	93	97	21.83	30	30	23.47	232.98	5.46804	34	23.83	10.24	9:31:37	19/3/2006
2,388	420	94	97	324.1	30	31	23.39	232.98	5.4494	34	23.83	10.24	9:32:06	19/3/2006
2,388	419	93	97	324.1	30	30	23.56	232.96	5.48854	34	23.83	10.24	9:32:36	19/3/2006
2,388	420	93	97	324.1	30	30	23.43	232.98	5.45872	34	23.83	10.24	9:33:05	19/3/2006
2,389	419	93	97	324.1	30	30	23.41	232.98	5.45406	34	23.83	10.24	9:33:35	19/3/2006
2,388	421	93	97	324.1	30	30	23.55	232.98	5.48668	34	23.83	10.24	9:34:04	19/3/2006
2,388	421	93	97	21.76	30	30	23.45	232.98	5.46338	34	23.83	10.24	9:34:34	19/3/2006
2,388	421	94	97	21.76	30	31	23.45	232.98	5.46338	34	23.83	10.24	9:35:04	19/3/2006
2,388	419	96	97	21.76	30	31	23.37	232.98	5.44474	34	23.83	10.24	9:35:33	19/3/2006
2,388	421	95	97	21.76	30	30	23.48	232.98	5.47037	34	23.83	10.24	9:36:03	19/3/2006
2,388	421	95	97	21.76	30	31	23.42	232.98	5.45639	34	23.83	10.24	9:36:32	19/3/2006
2,388	420	95	97	21.76	30	31	23.56	232.98	5.48901	34	23.83	10.24	9:37:02	19/3/2006
2,388	421	94	97	21.76	30	30	23.5	232.98	5.47503	34	23.83	10.24	9:37:31	19/3/2006
2,381	427	94	97	21.76	30	30	23.17	232.9	5.39629	34	23.83	10.24	9:38:01	19/3/2006
2,388	420	95	97	21.76	30	30	23.2	232.98	5.40514	34	23.83	10.24	9:38:30	19/3/2006
2,388	418	96	98	21.74	30	30	23.18	232.98	5.40048	34	23.83	10.24	9:39:00	19/3/2006
2,388	418	96	98	21.74	30	31	23.09	232.98	5.37951	34	23.83	10.24	9:39:30	19/3/2006
2,388	418	96	98	21.74	30	30	23.16	232.98	5.39582	34	23.83	10.24	9:39:59	19/3/2006
2,388	418	95	98	21.74	30	31	23.2	232.98	5.40514	34	23.83	10.24	9:40:29	19/3/2006
2,388	418	97	98	21.74	30	31	23.2	232.98	5.40514	34	23.83	10.24	9:40:58	19/3/2006
2,388	418	96	97	21.25	30	30	23.14	232.98	5.39116	34	23.83	10.24	9:41:28	19/3/2006
2,388	418	96	98	21.25	30	30	23.17	232.98	5.39815	34	23.83	10.24	9:41:57	19/3/2006
2,388	421	96	98	21.25	30	30	23.15	232.98	5.39349	34	23.83	10.24	9:42:27	19/3/2006
2,388	422	96	98	21.25	30	30	23.17	232.98	5.39815	34	23.83	10.24	9:42:56	19/3/2006
2,388	421	96	98	21.25	30	30	23.14	232.98	5.39116	34	23.83	10.24	9:43:26	19/3/2006
2,388	421	96	97	21.41	30	30	23.09	232.98	5.37951	34	23.83	10.24	9:43:56	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,388	423	94	99	21.41	30	30	23.12	232.98	5.3865	34	23.83	10.24	9:45:54	19/3/2006
2,388	424	96	99	21.32	30	30	23.2	232.98	5.40514	34	23.83	10.24	9:46:23	19/3/2006
2,388	424	96	98	21.32	30	30	23.13	232.98	5.38883	34	23.83	10.24	9:46:53	19/3/2006
2,388	424	98	98	21.32	30	30	23.06	232.98	5.37252	34	23.83	10.24	9:47:23	19/3/2006
2,388	421	97	98	21.32	30	30	23.08	232.98	5.37718	34	23.83	10.24	9:47:52	19/3/2006
2,388	422	96	98	21.32	30	30	23.02	232.98	5.3632	34	23.83	10.24	9:48:22	19/3/2006
2,388	421	95	97	21.49	30	30	23.09	232.98	5.37951	34	23.83	10.24	9:48:51	19/3/2006
2,388	421	96	98	21.49	30	30	23.12	232.98	5.3865	34	23.83	10.24	9:49:21	19/3/2006
2,388	423	94	98	21.49	30	30	23.03	232.98	5.36553	34	23.83	10.24	9:49:50	19/3/2006
2,388	424	96	97	21.49	30	30	23.12	232.98	5.3865	34	23.83	10.24	9:50:20	19/3/2006
2,388	424	95	97	21.49	30	30	23.17	232.98	5.39815	34	23.83	10.24	9:50:49	19/3/2006
2,388	421	96	97	21.49	30	30	23.15	232.98	5.39349	34	23.83	10.24	9:51:19	19/3/2006
2,388	418	96	97	21.49	30	30	23.09	232.98	5.37951	34	23.83	10.24	9:51:49	19/3/2006
2,388	418	95	97	21.49	30	30	23.07	232.98	5.37485	34	23.83	10.24	9:52:18	19/3/2006
2,388	418	96	97	21.49	30	30	23.08	232.98	5.37718	34	23.83	10.24	9:52:48	19/3/2006
2,388	418	97	97	21.49	30	30	23.06	232.98	5.37252	34	23.83	10.24	9:53:17	19/3/2006
2,388	418	98	97	21.49	30	30	23.19	232.98	5.40281	34	23.83	10.24	9:53:47	19/3/2006
2,388	418	97	97	21.4	30	30	23.15	232.98	5.39349	34	23.83	10.24	9:54:16	19/3/2006
2,388	418	96	97	21.4	30	30	23.15	232.98	5.39349	34	23.83	10.24	9:54:46	19/3/2006
2,388	418	96	97	21.4	30	30	23.07	232.98	5.37485	34	23.83	10.24	9:55:15	19/3/2006
2,387	418	96	97	21.4	30	30	23.05	232.98	5.37019	34	23.83	10.24	9:55:45	19/3/2006
2,387	417	97	97	21.4	30	30	23.11	232.98	5.38417	34	23.83	10.24	9:56:14	19/3/2006
2,388	415	98	97	21.58	30	30	23.14	232.98	5.39116	34	23.83	10.24	9:56:44	19/3/2006
2,388	416	97	98	21.58	30	30	23.09	232.98	5.37951	34	23.83	10.24	9:57:14	19/3/2006
2,385	415	96	98	21.58	30	30	23.08	232.98	5.37718	34	23.83	10.24	9:57:43	19/3/2006
2,388	418	95	98	21.58	30	30	23.15	232.98	5.39349	34	23.83	10.24	9:58:13	19/3/2006
2,382	420	97	98	21.58	30	30	23.51	232.98	5.47736	34	23.83	10.24	9:58:42	19/3/2006
2,385	421	97	98	21.66	30	30	23.37	232.98	5.44474	34	23.83	10.24	9:59:12	19/3/2006
2,384	423	98	98	21.66	30	30	23.6	232.98	5.49833	34	23.83	10.24	9:59:41	19/3/2006
2,384	424	98	98	21.66	30	30	23.43	232.98	5.45872	34	23.83	10.24	10:00:11	19/3/2006
2,377	424	97	98	21.66	30	30	23.43	232.98	5.45872	34	23.83	10.24	10:00:40	19/3/2006
2,377	424	98	98	21.66	30	30	23.47	232.96	5.46757	34	23.83	10.24	10:01:10	19/3/2006
2,380	424	98	98	21.89	30	30	23.44	232.98	5.46105	34	23.83	10.24	10:01:40	19/3/2006
2,382	423	98	99	21.89	30	30	23.48	232.98	5.47037	34	23.83	10.24	10:02:09	19/3/2006
2,380	422	99	98	21.89	30	30	23.55	232.98	5.48668	34	23.83	10.24	10:02:39	19/3/2006
2,386	423	100	99	21.89	30	30	23.5	232.98	5.47503	34	23.83	10.24	10:03:08	19/3/2006
2,378	421	100	100	21.89	30	30	23.55	232.96	5.48621	34	23.83	10.24	10:03:38	19/3/2006
2,383	423	99	99	21.66	30	30	23.51	232.98	5.47736	34	23.83	10.24	10:04:07	19/3/2006
2,380	423	99	98	21.66	30	30	23.6	232.98	5.49833	34	23.83	10.24	10:04:37	19/3/2006
2,379	421	99	99	21.66	30	30	23.45	232.98	5.46338	34	23.83	10.24	10:05:06	19/3/2006
2,378	421	97	98	21.66	30	30	23.44	232.96	5.46058	34	23.83	10.24	10:05:36	19/3/2006
2,378	424	96	98	21.66	30	30	23.51	232.98	5.47736	34	23.83	10.24	10:06:05	19/3/2006
2,380	424	98	98	21.74	30	30	23.56	232.98	5.48901	34	23.83	10.24	10:06:35	19/3/2006
2,380	424	98	97	7050	30	30	23.39	232.98	5.4494	34	23.83	10.24	10:07:05	19/3/2006
2,380	424	98	98	7050	30	30	23.32	232.98	5.43309	34	23.83	10.24	10:07:34	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OiIT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,378	424	95	98	21.98	30	30	23.56	232.94	5.48807	34	23.83	10.24	10:09:32	19/3/2006
2,380	424	96	97	21.98	30	30	23.62	232.98	5.50299	34	23.83	10.24	10:10:02	19/3/2006
2,385	424	97	98	21.98	30	30	23.3	232.94	5.4275	34	23.83	10.24	10:10:31	19/3/2006
2,378	423	99	98	21.98	30	30	23.62	232.98	5.50299	34	23.83	10.24	10:11:01	19/3/2006
2,385	421	99	98	21.79	30	30	23.59	232.98	5.496	34	23.83	10.24	10:11:31	19/3/2006
2,385	421	98	97	21.79	30	30	23.47	232.98	5.46804	34	23.83	10.24	10:12:00	19/3/2006
2,385	421	98	97	21.79	30	30	23.47	232.98	5.46804	34	23.83	10.24	10:12:30	19/3/2006
2,381	424	97	98	21.79	30	30	23.4	232.98	5.45173	34	23.83	10.24	10:12:59	19/3/2006
2,380	422	97	97	21.79	30	30	23.35	232.9	5.43822	34	23.83	10.24	10:13:29	19/3/2006
2,382	422	96	97	21.79	30	30	23.53	232.96	5.48155	34	23.83	10.24	10:13:58	19/3/2006
2,381	422	96	97	21.66	30	30	23.55	232.98	5.48668	34	23.83	10.24	10:14:28	19/3/2006
2,382	421	98	97	21.66	30	30	23.51	232.98	5.47736	34	23.83	10.24	10:14:57	19/3/2006
2,385	421	98	97	21.66	30	30	23.57	232.98	5.49134	34	23.83	10.24	10:15:27	19/3/2006
2,384	421	98	97	21.66	30	30	23.44	232.98	5.46105	34	23.83	10.24	10:15:57	19/3/2006
2,386	421	97	97	21.66	29	30	23.44	232.98	5.46105	34	23.83	10.24	10:16:26	19/3/2006
2,383	423	97	97	21.66	30	30	23.48	232.98	5.47037	34	23.83	10.24	10:16:56	19/3/2006
2,384	421	98	97	21.66	30	30	23.44	232.98	5.46105	34	23.83	10.24	10:17:25	19/3/2006
2,385	421	96	97	21.66	30	30	23.61	232.98	5.50066	34	23.83	10.24	10:17:55	19/3/2006
2,384	422	96	97	21.66	30	30	23.48	232.96	5.4699	34	23.83	10.24	10:18:24	19/3/2006
2,385	423	97	97	21.58	30	30	23.42	232.98	5.45639	34	23.83	10.24	10:18:54	19/3/2006
2,387	423	96	97	21.58	30	30	23.57	232.96	5.49087	34	23.83	10.24	10:19:24	19/3/2006
2,386	422	98	97	21.58	30	30	23.5	232.96	5.47456	34	23.83	10.24	10:19:53	19/3/2006
2,384	423	98	97	21.58	30	30	23.39	232.98	5.4494	34	23.83	10.24	10:20:23	19/3/2006
2,385	421	98	97	21.58	30	30	23.35	232.98	5.44008	34	23.83	10.24	10:20:52	19/3/2006
2,384	421	96	97	21.58	30	30	23.42	232.98	5.45639	34	23.83	10.24	10:21:22	19/3/2006
2,386	423	96	97	21.49	29	30	23.44	232.98	5.46105	34	23.83	10.24	10:21:51	19/3/2006
2,387	424	96	97	21.49	29	30	23.6	232.98	5.49833	34	23.83	10.24	10:22:21	19/3/2006
2,386	424	95	97	21.49	29	30	23.42	232.98	5.45639	34	23.83	10.24	10:22:50	19/3/2006
2,387	424	96	97	21.49	30	30	23.39	232.94	5.44847	34	23.83	10.24	10:23:20	19/3/2006
2,387	424	96	97	21.49	29	30	23.51	232.98	5.47736	34	23.83	10.24	10:23:50	19/3/2006
2,388	424	97	97	909.7	30	30	23.52	232.96	5.47922	34	23.83	10.24	10:24:19	19/3/2006
2,385	424	98	97	909.7	30	30	23.39	232.94	5.44847	34	23.83	10.24	10:24:49	19/3/2006
2,388	422	98	97	909.7	30	30	23.58	232.98	5.49367	34	23.83	10.24	10:25:18	19/3/2006
2,383	422	97	97	909.7	29	30	23.44	232.96	5.46058	34	23.83	10.24	10:25:48	19/3/2006
2,383	421	97	97	909.7	29	30	23.66	232.98	5.51231	34	23.83	10.24	10:26:17	19/3/2006
2,382	424	97	97	21.59	30	30	23.47	232.98	5.46804	34	23.83	10.24	10:26:47	19/3/2006
2,385	424	96	97	21.59	29	30	23.36	232.98	5.44241	34	23.83	10.24	10:27:16	19/3/2006
2,384	421	96	97	21.59	29	30	23.54	232.98	5.48435	34	23.83	10.24	10:27:46	19/3/2006
2,387	422	95	97	21.59	29	30	23.44	232.94	5.46011	34	23.83	10.24	10:28:16	19/3/2006
2,386	421	98	97	21.59	29	30	23.57	232.98	5.49134	34	23.83	10.24	10:28:45	19/3/2006
2,388	421	98	97	21.58	30	30	23.45	232.96	5.46291	34	23.83	10.24	10:29:15	19/3/2006
2,381	421	97	97	21.58	30	30	23.41	232.98	5.45406	34	23.83	10.24	10:29:44	19/3/2006
2,385	422	97	97	21.58	29	30	23.5	232.98	5.47503	34	23.83	10.24	10:30:14	19/3/2006
2,383	421	98	97	21.58	30	30	23.6	232.96	5.49786	34	23.83	10.24	10:30:43	19/3/2006
2,386	421	98	97	21.58	29	30	23.62	232.98	5.50299	34	23.83	10.24	10:31:13	19/3/2006

ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2.386	421	98	97	21.56	30	30	23.45	232.96	5.46291	34	23.83	10.24	10:33:11	19/3/2006
2.386	421	97	97	21.56	30	30	23.46	232.98	5.46571	34	23.83	10.24	10:33:41	19/3/2006
2.379	420	98	98	21.56	30	30	23.54	232.98	5.48435	34	23.83	10.24	10:34:10	19/3/2006
2.383	419	99	98	21.49	30	30	23.48	232.94	5.46943	34	23.83	10.24	10:34:40	19/3/2006
2.384	420	99	98	21.49	30	30	23.26	232.98	5.41911	34	23.83	10.24	10:35:10	19/3/2006
2.388	421	98	97	21.49	29	30	23.44	232.96	5.46058	34	23.83	10.24	10:35:39	19/3/2006
2.386	421	96	97	21.49	29	30	23.45	232.98	5.46338	34	23.83	10.24	10:36:09	19/3/2006
2.383	421	97	97	21.49	29	30	23.42	232.98	5.45639	34	23.83	10.24	10:36:38	19/3/2006
2.383	421	98	97	21.46	30	30	23.42	232.98	5.45639	34	23.83	10.24	10:37:08	19/3/2006
2.380	421	98	98	21.46	30	30	23.33	232.96	5.43496	34	23.83	10.24	10:37:37	19/3/2006
2.382	421	97	97	21.46	30	30	23.51	232.98	5.47736	34	23.83	10.24	10:38:07	19/3/2006
2.381	421	97	98	21.46	30	30	23.62	232.94	5.50204	34	23.83	10.24	10:38:36	19/3/2006
2.380	421	99	98	21.46	30	30	23.49	232.96	5.47223	34	23.83	10.24	10:39:06	19/3/2006
2.380	421	99	98	21.46	30	30	23.53	232.98	5.48202	34	23.83	10.24	10:39:36	19/3/2006
2.384	421	99	98	124.2	30	30	23.59	232.96	5.49553	34	23.83	10.24	10:40:05	19/3/2006
2.379	421	98	98	124.2	30	30	23.48	232.9	5.46849	34	23.83	10.24	10:40:35	19/3/2006
2.378	424	97	97	124.2	29	30	23.47	232.98	5.46804	34	23.83	10.24	10:41:04	19/3/2006
2.379	424	98	98	124.2	30	30	23.46	232.86	5.4629	34	23.83	10.24	10:41:34	19/3/2006
2.383	423	99	98	124.2	30	30	23.52	232.98	5.47969	34	23.83	10.24	10:42:03	19/3/2006
2.382	421	98	98	21.46	29	30	23.53	232.98	5.48202	34	23.83	10.24	10:42:33	19/3/2006
2.387	419	98	98	21.46	30	30	23.46	232.98	5.46571	34	23.83	10.24	10:43:03	19/3/2006
2.382	420	98	97	21.46	30	30	23.59	232.98	5.496	34	23.83	10.24	10:43:32	19/3/2006
2.382	421	96	97	21.46	29	30	23.41	232.98	5.45406	34	23.83	10.24	10:44:02	19/3/2006
2.387	422	98	97	21.49	29	30	23.59	232.98	5.496	34	23.83	10.24	10:44:31	19/3/2006
2.384	423	97	97	21.49	29	30	23.35	232.98	5.44008	34	23.83	10.24	10:45:01	19/3/2006
2.387	421	98	97	21.49	29	30	23.51	232.96	5.47689	34	23.83	10.24	10:45:30	19/3/2006
2.381	421	97	97	21.49	29	30	23.56	232.98	5.48901	34	23.83	10.24	10:46:00	19/3/2006
2.378	421	98	97	21.49	29	30	23.35	232.96	5.43962	34	23.83	10.24	10:46:30	19/3/2006
2.381	421	98	97	21.49	29	30	23.53	232.98	5.48202	34	23.83	10.24	10:46:59	19/3/2006
2.386	421	98	97	21.51	29	30	23.35	232.96	5.43962	34	23.83	10.24	10:47:29	19/3/2006
2.383	420	97	97	21.51	29	30	23.43	232.98	5.45872	34	23.83	10.24	10:47:58	19/3/2006
2.384	419	97	97	21.51	30	30	23.61	232.92	5.49924	34	23.83	10.24	10:48:28	19/3/2006
2.382	418	98	97	21.51	29	30	23.47	232.92	5.46663	34	23.83	10.24	10:48:57	19/3/2006
2.387	418	98	97	21.51	29	30	23.41	232.98	5.45406	34	23.83	10.24	10:49:27	19/3/2006
2.386	419	98	97	21.51	29	30	23.54	232.98	5.48435	34	23.83	10.24	10:49:56	19/3/2006
2.384	421	98	97	21.51	29	30	23.48	232.92	5.46896	34	23.83	10.24	10:50:26	19/3/2006
2.381	421	98	97	21.51	29	30	23.51	232.98	5.47736	34	23.83	10.24	10:50:56	19/3/2006
2.384	421	98	97	21.51	29	30	23.38	232.98	5.44707	34	23.83	10.24	10:51:25	19/3/2006
2.382	421	98	97	21.49	29	30	23.5	232.98	5.47503	34	23.83	10.24	10:51:55	19/3/2006
2.380	421	98	97	14100	30	30	23.44	232.98	5.46105	34	23.83	10.24	10:52:24	19/3/2006
2.381	421	98	97	361.5	29	30	23.47	232.96	5.46757	34	23.83	10.24	10:52:54	19/3/2006
2.382	420	98	97	361.5	29	30	23.54	232.96	5.48388	34	23.83	10.24	10:53:23	19/3/2006
2.385	420	98	98	361.5	30	30	23.64	232.96	5.50717	34	23.83	10.24	10:53:53	19/3/2006
2.388	419	99	98	361.5	30	30	23.41	232.98	5.45406	34	23.83	10.24	10:54:22	19/3/2006
2.386	419	99	98	361.5	30	30	23.41	232.98	5.45406	34	23.83	10.24	10:54:52	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,381	420	98	98	21.41	29	30	23.47	232.96	5.46757	34	23.83	10.24	10:56:50	19/3/2006
2,380	418	98	98	21.44	30	30	23.61	232.98	5.50066	34	23.83	10.24	10:57:20	19/3/2006
2,379	418	99	98	21.44	30	30	23.48	232.94	5.46943	34	23.83	10.24	10:57:49	19/3/2006
2,380	418	99	98	21.44	30	30	23.42	232.94	5.45545	34	23.83	10.24	10:58:19	19/3/2006
2,379	418	99	98	21.44	30	30	23.35	232.96	5.43962	34	23.83	10.24	10:58:48	19/3/2006
2,378	420	99	98	21.44	30	30	23.53	232.84	5.47873	34	23.83	10.24	10:59:18	19/3/2006
2,384	419	99	99	21.44	30	30	23.6	232.96	5.49786	34	23.83	10.24	10:59:48	19/3/2006
2,378	418	99	99	21.51	30	30	23.44	232.96	5.46058	34	23.83	10.24	11:00:17	19/3/2006
2,381	418	99	99	139.6	30	30	23.47	232.98	5.46804	34	23.83	10.24	11:00:47	19/3/2006
2,382	418	99	98	139.6	30	30	23.5	232.9	5.47315	34	23.83	10.24	11:01:16	19/3/2006
2,381	419	100	98	139.6	30	30	23.54	232.98	5.48435	34	23.83	10.24	11:01:46	19/3/2006
2,382	421	100	98	139.6	30	30	23.39	232.98	5.4494	34	23.83	10.24	11:02:15	19/3/2006
2,383	421	100	99	139.6	30	30	23.4	232.96	5.45126	34	23.83	10.24	11:02:45	19/3/2006
2,380	421	100	99	21.46	30	30	23.56	232.98	5.48901	34	23.83	10.24	11:03:14	19/3/2006
2,378	421	99	99	21.46	30	30	23.48	232.92	5.46896	34	23.83	10.24	11:03:44	19/3/2006
2,381	418	101	100	21.46	30	30	23.42	232.98	5.45639	34	23.83	10.24	11:04:13	19/3/2006
2,378	419	101	100	21.46	30	30	23.56	232.9	5.48712	34	23.83	10.24	11:04:43	19/3/2006
2,381	421	101	101	21.46	30	30	23.53	232.76	5.47684	34	23.83	10.24	11:05:13	19/3/2006
2,380	421	102	101	21.23	30	30	23.53	232.94	5.48108	34	23.83	10.24	11:05:42	19/3/2006
2,379	421	102	101	21.23	30	30	23.47	232.84	5.46475	34	23.83	10.24	11:06:12	19/3/2006
2,377	421	102	102	21.23	30	30	23.42	232.74	5.45077	34	23.83	10.24	11:06:41	19/3/2006
2,380	423	103	102	21.23	30	30	23.52	232.72	5.47357	34	23.83	10.24	11:07:11	19/3/2006
2,379	423	103	102	21.23	30	30	23.5	232.84	5.47174	34	23.83	10.24	11:07:40	19/3/2006
2,380	424	103	103	21.32	30	30	23.42	232.8	5.45218	34	23.83	10.24	11:08:10	19/3/2006
2,376	424	102	102	21.32	30	30	23.59	232.72	5.48986	34	23.83	10.24	11:08:40	19/3/2006
2,379	424	104	102	21.32	30	30	23.51	232.72	5.47125	34	23.83	10.24	11:09:09	19/3/2006
2,377	424	104	103	21.32	31	30	23.6	232.82	5.49455	34	23.83	10.24	11:09:39	19/3/2006
2,377	424	104	102	21.32	31	30	23.47	232.88	5.46569	34	23.83	10.24	11:10:08	19/3/2006
2,377	424	104	102	21.27	31	31	23.66	232.78	5.50757	34	23.83	10.24	11:10:38	19/3/2006
2,378	424	103	102	21.27	31	31	23.54	232.76	5.47917	34	23.83	10.24	11:11:07	19/3/2006
2,376	425	103	103	21.27	31	31	23.54	232.6	5.4754	34	23.83	10.24	11:11:37	19/3/2006
2,377	427	104	103	21.27	30	31	23.03	232.34	5.35079	34	23.83	10.24	11:12:06	19/3/2006
2,378	427	104	103	21.27	30	31	23.66	232.88	5.50994	34	23.83	10.24	11:12:36	19/3/2006
2,380	427	104	102	21.4	30	31	23.63	232.86	5.50248	34	23.83	10.24	11:13:06	19/3/2006
2,378	427	104	102	21.4	31	31	23.49	232.94	5.47176	34	23.83	10.24	11:13:35	19/3/2006
2,376	427	104	103	21.4	31	31	23.57	232.66	5.4838	34	23.83	10.24	11:14:05	19/3/2006
2,376	426	104	103	21.4	31	31	23.75	232.54	5.52283	34	23.83	10.24	11:14:34	19/3/2006
2,377	426	104	103	21.4	31	31	23.6	232.36	5.4837	34	23.83	10.24	11:15:04	19/3/2006
2,378	425	104	103	21.49	31	31	23.4	232.44	5.4391	34	23.83	10.24	11:15:33	19/3/2006
2,377	425	104	103	21.49	30	31	23.73	232.8	5.52434	34	23.83	10.24	11:16:03	19/3/2006
2,378	426	104	103	21.49	31	31	23.62	232.58	5.49354	34	23.83	10.24	11:16:32	19/3/2006
2,377	426	105	103	21.49	31	31	23.81	232.76	5.54202	34	23.83	10.24	11:17:02	19/3/2006
2,376	424	104	103	21.49	30	31	23.41	232.2	5.4358	34	23.83	10.24	11:17:32	19/3/2006
2,377	425	104	102	21.35	30	31	23.24	232.68	5.40748	34	23.83	10.24	11:18:01	19/3/2006
2,377	425	104	102	21.35	31	31	23.37	232.84	5.44147	34	23.83	10.24	11:18:31	19/3/2006



ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	λmbT	PAir	PGas	H-Meter	Date
2,376	424	105	103	21.35	31	31	23.53	232.78	5.47731	34	23.83	10.24	11:20:29	19/3/2006
2,379	424	104	103	21.43	30	31	23.25	232.3	5.40098	34	23.83	10.24	11:20:58	19/3/2006
2,377	424	104	102	21.43	31	31	23.68	232.66	5.50939	34	23.83	10.24	11:21:28	19/3/2006
2,377	424	104	102	21.43	31	31	23.33	232.68	5.42842	34	23.83	10.24	11:21:58	19/3/2006
2,377	424	104	103	21.43	31	31	23.71	232.5	5.51258	34	23.83	10.24	11:22:27	19/3/2006
2,378	424	104	103	21.43	31	31	23.47	232.48	5.45631	34	23.83	10.24	11:22:57	19/3/2006
2,380	424	104	102	21.28	31	31	23.55	232.76	5.4815	34	23.83	10.24	11:23:26	19/3/2006
2,381	424	104	102	21.28	31	31	23.22	232.62	5.40144	34	23.83	10.24	11:23:56	19/3/2006
2,378	424	104	103	43.52	31	31	23.68	232.66	5.50939	34	23.83	10.24	11:24:25	19/3/2006
2,379	424	105	103	43.52	31	31	23.71	232.62	5.51542	34	23.83	10.24	11:24:55	19/3/2006
2,377	424	104	103	43.52	31	31	23.47	232.54	5.45771	34	23.83	10.24	11:25:24	19/3/2006
2,376	424	103	102	43.52	31	31	23.45	232.76	5.45822	34	23.83	10.24	11:25:54	19/3/2006
2,377	424	102	101	43.52	31	31	23.22	232.72	5.40376	34	23.83	10.24	11:26:24	19/3/2006
2,378	424	101	100	43.52	31	31	23.51	232.76	5.47219	34	23.83	10.24	11:26:53	19/3/2006
2,382	422	102	100	21.35	30	30	23.39	232.84	5.44613	34	23.83	10.24	11:27:23	19/3/2006
2,381	421	103	100	21.35	30	30	23.48	232.9	5.46849	34	23.83	10.24	11:27:52	19/3/2006
2,381	421	103	101	21.35	31	30	23.54	232.88	5.482	34	23.83	10.24	11:28:22	19/3/2006
2,381	421	103	100	21.35	30	30	23.51	232.94	5.47642	34	23.83	10.24	11:28:51	19/3/2006
2,378	421	102	100	21.35	30	30	23.4	232.96	5.45126	34	23.83	10.24	11:29:21	19/3/2006
2,383	421	102	100	21.16	30	30	23.41	232.86	5.45125	34	23.83	10.24	11:29:50	19/3/2006
2,383	421	102	100	21.16	30	30	23.45	232.84	5.4601	34	23.83	10.24	11:30:20	19/3/2006
2,384	419	103	100	21.16	30	30	23.43	232.98	5.45872	34	23.83	10.24	11:30:49	19/3/2006
2,379	420	102	100	21.16	30	30	23.65	232.9	5.50809	34	23.83	10.24	11:31:19	19/3/2006
2,381	420	102	99	21.16	30	30	23.51	232.96	5.47689	34	23.83	10.24	11:31:49	19/3/2006
2,384	421	102	99	21.33	30	30	23.48	232.98	5.47037	34	23.83	10.24	11:32:18	19/3/2006
2,380	420	102	99	640.9	30	30	23.47	232.9	5.46616	34	23.83	10.24	11:32:48	19/3/2006
2,380	419	101	98	640.9	30	30	23.56	232.96	5.48854	34	23.83	10.24	11:33:17	19/3/2006
2,383	419	100	98	640.9	30	30	23.56	232.94	5.48807	34	23.83	10.24	11:33:47	19/3/2006
2,380	418	100	98	43.72	30	30	23.41	232.94	5.45313	34	23.83	10.24	11:34:16	19/3/2006
2,384	418	102	98	99.65	30	30	23.63	232.94	5.50437	34	23.83	10.24	11:34:46	19/3/2006
2,380	419	102	99	99.65	30	30	23.56	232.9	5.48712	34	23.83	10.24	11:35:15	19/3/2006
2,380	418	102	98	99.65	30	30	23.39	232.94	5.44847	34	23.83	10.24	11:35:45	19/3/2006
2,377	418	101	98	99.65	30	30	23.39	232.74	5.44379	34	23.83	10.24	11:36:15	19/3/2006
2,380	421	101	98	99.65	30	30	23.64	232.94	5.5067	34	23.83	10.24	11:36:44	19/3/2006
2,387	420	101	98	21.17	30	30	23.63	232.98	5.50532	34	23.83	10.24	11:37:14	19/3/2006
2,386	419	101	98	21.17	30	30	23.48	232.98	5.47037	34	23.83	10.24	11:37:43	19/3/2006
2,387	418	101	98	21.17	30	30	23.39	232.96	5.44893	34	23.83	10.24	11:38:13	19/3/2006
2,383	418	100	98	21.17	30	30	23.4	232.98	5.45173	34	23.83	10.24	11:38:42	19/3/2006
2,382	418	101	99	21.17	30	30	23.39	232.92	5.448	34	23.83	10.24	11:39:12	19/3/2006
2,386	420	102	100	21.16	30	30	23.37	232.94	5.44381	34	23.83	10.24	11:39:41	19/3/2006
2,382	421	102	99	125.3	30	30	23.41	232.98	5.45406	34	23.83	10.24	11:40:11	19/3/2006
2,388	420	102	99	626.7	30	30	23.36	232.98	5.44241	34	23.83	10.24	11:40:40	19/3/2006
2,381	421	102	100	626.7	30	30	23.41	232.86	5.45125	34	23.83	10.24	11:41:10	19/3/2006
2,383	421	101	100	626.7	30	30	23.41	232.98	5.45406	34	23.83	10.24	11:41:39	19/3/2006
2,379	421	101	100	626.7	30	30	23.44	232.84	5.45777	34	23.83	10.24	11:42:09	19/3/2006

ตาราง ข-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,386	418	101	98	21.3	29	30	23.51	232.98	5.47736	34	23.83	10.24	11:44:07	19/3/2006
2,388	418	101	98	21.3	29	30	23.35	232.98	5.44008	34	23.83	10.24	11:44:37	19/3/2006
2,387	418	101	99	21.3	30	30	23.38	232.98	5.44707	34	23.83	10.24	11:45:06	19/3/2006
2,388	418	101	98	21.16	30	30	23.39	232.98	5.4494	34	23.83	10.24	11:45:36	19/3/2006
2,386	418	101	99	21.16	30	30	23.3	232.94	5.4275	34	23.83	10.24	11:46:05	19/3/2006
2,386	418	101	100	21.16	30	30	23.44	232.98	5.46105	34	23.83	10.24	11:46:35	19/3/2006
2,384	420	102	100	21.16	30	30	23.31	232.92	5.42937	34	23.83	10.24	11:47:05	19/3/2006
2,388	419	102	100	21.16	30	30	23.3	232.98	5.42843	34	23.83	10.24	11:47:34	19/3/2006
2,388	418	102	99	20.98	30	30	23.51	232.98	5.47736	34	23.83	10.24	11:48:04	19/3/2006
2,388	418	102	98	20.98	30	30	23.49	232.98	5.4727	34	23.83	10.24	11:48:33	19/3/2006
2,388	418	101	98	20.98	30	30	23.21	232.98	5.40747	34	23.83	10.24	11:49:03	19/3/2006
2,388	418	101	98	20.98	30	30	23.45	232.98	5.46338	34	23.83	10.24	11:49:32	19/3/2006
2,388	418	100	97	20.98	29	30	23.4	232.98	5.45173	34	23.83	10.24	11:50:02	19/3/2006
2,388	418	100	98	20.95	29	30	23.39	232.96	5.44893	34	23.83	10.24	11:50:32	19/3/2006
2,387	418	100	98	20.95	29	30	23.42	232.98	5.45639	34	23.83	10.24	11:51:01	19/3/2006
2,388	418	101	98	20.95	29	30	23.4	232.98	5.45173	34	23.83	10.24	11:51:31	19/3/2006
2,388	418	101	98	20.95	30	30	23.39	232.98	5.4494	34	23.83	10.24	11:52:00	19/3/2006
2,387	419	101	98	20.95	30	30	23.47	232.98	5.46804	34	23.83	10.24	11:52:30	19/3/2006
2,385	418	101	98	21.09	30	30	23.39	232.94	5.44847	34	23.83	10.24	11:52:59	19/3/2006
2,387	418	99	97	1085	29	30	23.57	232.98	5.49134	34	23.83	10.24	11:53:29	19/3/2006
2,386	420	99	97	1085	29	30	23.47	232.98	5.46804	34	23.83	10.24	11:53:58	19/3/2006
2,386	421	99	98	1085	29	30	23.62	232.98	5.50299	34	23.83	10.24	11:54:28	19/3/2006
2,386	421	99	98	1085	29	30	23.48	232.98	5.47037	34	23.83	10.24	11:54:57	19/3/2006
2,387	421	100	98	1085	29	30	23.41	232.98	5.45406	34	23.83	10.24	11:55:27	19/3/2006
2,387	421	101	98	21.25	30	30	23.49	232.98	5.4727	34	23.83	10.24	11:55:56	19/3/2006
2,387	420	100	98	21.25	30	30	23.53	232.98	5.48202	34	23.83	10.24	11:56:26	19/3/2006
2,381	418	99	98	21.25	29	30	23.41	232.98	5.45406	34	23.83	10.24	11:56:56	19/3/2006
2,381	419	99	98	21.25	29	30	23.38	232.98	5.44707	34	23.83	10.24	11:57:25	19/3/2006
2,382	420	99	98	21.25	29	30	23.44	232.98	5.46105	34	23.83	10.24	11:57:55	19/3/2006
2,383	421	99	98	21.25	30	30	23.4	232.98	5.45173	34	23.83	10.24	11:58:24	19/3/2006
2,385	420	99	98	21.25	29	30	23.36	232.94	5.44148	34	23.83	10.24	11:58:54	19/3/2006
2,380	421	101	100	21.25	30	30	23.6	232.94	5.49738	34	23.83	10.24	11:59:23	19/3/2006
2,380	421	101	100	21.25	30	30	23.41	232.98	5.45406	34	23.83	10.24	11:59:53	19/3/2006
2,378	421	101	99	21.25	30	30	23.14	232.92	5.38977	34	23.83	10.24	12:00:23	19/3/2006
2,381	421	101	100	21.41	30	30	23.47	232.9	5.46616	34	23.83	10.24	12:00:52	19/3/2006
2,380	421	101	100	21.41	30	30	23.7	232.88	5.51926	34	23.83	10.24	12:01:22	19/3/2006
2,381	421	101	100	21.41	30	30	23.63	232.9	5.50343	34	23.83	10.24	12:01:51	19/3/2006
2,381	421	100	100	21.41	30	30	23.46	232.9	5.46383	34	23.83	10.24	12:02:21	19/3/2006
2,387	421	101	100	21.41	30	30	23.49	232.86	5.46988	34	23.83	10.24	12:02:50	19/3/2006
2,384	421	102	101	21.16	30	30	23.38	232.72	5.44099	34	23.83	10.24	12:03:20	19/3/2006
2,378	421	102	101	324.1	30	30	23.49	232.86	5.46988	34	23.83	10.24	12:03:49	19/3/2006
2,378	421	102	100	324.1	30	30	23.47	232.78	5.46335	34	23.83	10.24	12:04:19	19/3/2006
2,382	421	102	101	324.1	30	30	23.45	232.94	5.46244	34	23.83	10.24	12:04:48	19/3/2006
2,383	421	101	101	324.1	30	30	23.41	232.9	5.45219	34	23.83	10.24	12:05:18	19/3/2006
2,382	420	101	101	324.1	30	30	23.38	232.88	5.44473	34	23.83	10.24	12:05:48	19/3/2006

ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,383	420	102	100	366.2	30	30	23.53	232.96	5.48155	34	23.83	10.24	12:07:46	19/3/2006
2,381	420	102	100	366.2	30	30	23.36	232.96	5.44195	34	23.83	10.24	12:08:15	19/3/2006
2,386	418	101	100	366.2	30	30	23.44	232.98	5.46105	34	23.83	10.24	12:08:45	19/3/2006
2,387	418	102	100	21.03	30	30	23.35	232.98	5.44008	34	23.83	10.24	12:09:14	19/3/2006
2,387	418	101	100	21.03	30	30	23.29	232.98	5.4261	34	23.83	10.24	12:09:44	19/3/2006
2,387	418	101	100	21.03	30	30	23.52	232.96	5.47922	34	23.83	10.24	12:10:14	19/3/2006
2,384	419	102	100	21.03	30	30	23.42	232.92	5.45499	34	23.83	10.24	12:10:43	19/3/2006
2,382	419	102	100	21.03	30	30	23.41	232.98	5.45406	34	23.83	10.24	12:11:13	19/3/2006
2,381	418	102	100	21.12	30	30	23.48	232.94	5.46943	34	23.83	10.24	12:11:42	19/3/2006
2,380	418	102	100	21.12	30	30	23.53	232.98	5.48202	34	23.83	10.24	12:12:12	19/3/2006
2,383	418	101	100	21.12	30	30	23.65	232.94	5.50903	34	23.83	10.24	12:12:41	19/3/2006
2,382	418	101	100	21.12	29	30	23.53	232.98	5.48202	34	23.83	10.24	12:13:11	19/3/2006
2,378	418	101	100	21.12	29	30	23.39	232.9	5.44753	34	23.83	10.24	12:13:40	19/3/2006
2,381	418	102	100	21.17	29	30	23.38	232.98	5.44707	34	23.83	10.24	12:14:10	19/3/2006
2,382	418	102	100	21.17	30	30	23.42	232.98	5.45639	34	23.83	10.24	12:14:40	19/3/2006
2,380	418	102	100	21.17	29	30	23.37	232.86	5.44194	34	23.83	10.24	12:15:09	19/3/2006
2,380	418	102	100	21.17	30	30	23.39	232.96	5.44893	34	23.83	10.24	12:15:39	19/3/2006
2,379	418	101	100	21.17	29	30	23.49	232.88	5.47035	34	23.83	10.24	12:16:08	19/3/2006
2,380	418	101	100	21.25	29	30	23.43	232.82	5.45497	34	23.83	10.24	12:16:38	19/3/2006
2,379	418	102	100	21.25	29	30	23.39	232.82	5.44566	34	23.83	10.24	12:17:07	19/3/2006
2,377	418	101	100	21.25	29	30	23.33	232.86	5.43262	34	23.83	10.24	12:17:37	19/3/2006
2,377	418	102	100	21.25	29	30	23.44	232.86	5.45824	34	23.83	10.24	12:18:07	19/3/2006
2,380	418	102	100	21.25	29	30	23.33	232.98	5.43542	34	23.83	10.24	12:18:36	19/3/2006
2,380	418	101	100	21.25	29	30	23.34	232.92	5.43635	34	23.83	10.24	12:19:06	19/3/2006
2,381	418	101	99	21.25	29	30	23.32	232.98	5.43309	34	23.83	10.24	12:19:35	19/3/2006
2,384	418	101	100	21.25	29	30	23.41	232.92	5.45266	34	23.83	10.24	12:20:05	19/3/2006
2,380	418	101	100	21.25	29	30	23.47	232.98	5.46804	34	23.83	10.24	12:20:34	19/3/2006
2,382	418	101	100	21.25	29	29	23.39	232.98	5.4494	34	23.83	10.24	12:21:04	19/3/2006
2,379	418	102	100	21.25	29	29	23.42	232.98	5.45639	34	23.83	10.24	12:21:34	19/3/2006
2,380	418	102	100	14100	29	29	23.38	232.94	5.44614	34	23.83	10.24	12:22:03	19/3/2006
2,377	418	102	101	14100	29	29	23.41	232.72	5.44798	34	23.83	10.24	12:22:33	19/3/2006
2,379	418	102	100	14100	29	29	23.44	232.8	5.45683	34	23.83	10.24	12:23:02	19/3/2006
2,377	418	102	100	14100	29	29	23.38	232.92	5.44567	34	23.83	10.24	12:23:32	19/3/2006
2,380	418	102	100	14100	29	30	23.39	232.96	5.44893	34	23.83	10.24	12:24:01	19/3/2006
2,382	418	101	101	21.19	29	30	23.49	232.96	5.47223	34	23.83	10.24	12:24:31	19/3/2006
2,379	418	101	101	21.19	30	30	23.22	232.92	5.4084	34	23.83	10.24	12:25:00	19/3/2006
2,380	418	102	102	66.35	30	30	23.42	232.9	5.45452	34	23.83	10.24	12:25:30	19/3/2006
2,382	418	103	102	66.35	30	30	23.47	232.92	5.46663	34	23.83	10.24	12:26:00	19/3/2006
2,384	419	103	102	66.35	30	30	23.45	232.96	5.46291	34	23.83	10.24	12:26:29	19/3/2006
2,381	419	102	102	66.35	30	30	23.38	232.86	5.44427	34	23.83	10.24	12:26:59	19/3/2006
2,383	418	102	101	66.35	30	30	23.58	232.96	5.4932	34	23.83	10.24	12:27:28	19/3/2006
2,384	418	103	102	20.98	30	30	23.44	232.92	5.45964	34	23.83	10.24	12:27:58	19/3/2006
2,379	420	102	102	20.98	30	30	23.46	232.94	5.46477	34	23.83	10.24	12:28:27	19/3/2006
2,380	420	103	102	20.98	30	30	23.36	232.94	5.44148	34	23.83	10.24	12:28:57	19/3/2006
2,384	421	103	102	20.98	30	30	23.36	232.98	5.44241	34	23.83	10.24	12:29:26	19/3/2006

ตาราง จ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,391	411	103	103	381.1	30	30	20.98	233.39	4.89652	34	23.83	10.24	12:31:25	19/3/2006
2,400	401	103	102	381.1	30	30	20.99	233.2	4.89487	34	23.83	10.24	12:31:54	19/3/2006
2,400	400	103	102	381.1	30	30	21.07	233.12	4.91184	34	23.83	10.24	12:32:24	19/3/2006
2,399	399	104	102	381.1	30	30	21.02	233.18	4.90144	34	23.83	10.24	12:32:53	19/3/2006
2,399	399	104	101	381.1	30	30	21.06	233.16	4.91035	34	23.83	11.36	12:33:22	19/3/2006
2,399	399	104	101	18.5	30	30	21.14	233.14	4.92858	34	23.83	11.36	12:33:52	19/3/2006
2,400	398	104	101	18.5	30	30	21.18	233.18	4.93875	34	23.83	11.36	12:34:22	19/3/2006
2,400	398	104	101	18.5	30	30	21.04	233.2	4.90653	34	23.83	11.36	12:34:51	19/3/2006
2,400	397	103	100	18.5	30	30	21.12	233.41	4.92962	34	23.83	11.36	12:35:21	19/3/2006
2,400	397	102	101	18.5	30	30	21.14	233.51	4.9364	34	23.83	11.36	12:35:50	19/3/2006
2,400	397	104	101	18.5	30	30	21.13	233.43	4.93238	34	23.83	11.36	12:36:20	19/3/2006
2,400	397	104	101	18.17	30	30	21	233.37	4.90077	34	23.83	11.36	12:36:49	19/3/2006
2,398	397	103	101	18.17	30	30	21.08	233.35	4.91902	34	23.83	11.36	12:37:19	19/3/2006
2,398	397	103	101	18.17	30	30	21.08	233.37	4.91944	34	23.83	11.36	12:37:48	19/3/2006
2,400	397	103	101	18.17	30	30	21.07	233.55	4.9209	34	23.83	11.36	12:38:18	19/3/2006
2,400	397	102	101	18.17	30	30	21.17	233.53	4.94383	34	23.83	11.36	12:38:47	19/3/2006
2,399	397	102	102	18.17	30	30	21.05	233.43	4.9137	34	23.83	11.36	12:39:17	19/3/2006
2,399	397	104	102	18.42	30	30	21.11	233.39	4.92686	34	23.83	11.36	12:39:47	19/3/2006
2,399	397	104	102	18.42	30	30	21.02	233.45	4.90712	34	23.83	11.36	12:40:16	19/3/2006
2,395	397	103	100	18.42	30	30	21.04	233.71	4.91726	34	23.83	11.36	12:40:46	19/3/2006
2,400	397	102	100	18.42	30	30	21.17	233.83	4.95018	34	23.83	11.36	12:41:15	19/3/2006
2,398	397	101	98	18.42	30	30	21.11	233.95	4.93868	34	23.83	11.36	12:41:45	19/3/2006
2,400	397	100	98	18.42	30	30	21.17	233.91	4.95187	34	23.83	11.36	12:42:14	19/3/2006
2,399	397	100	98	18.41	29	30	21.17	233.89	4.95145	34	23.83	11.36	12:42:44	19/3/2006
2,400	397	100	98	18.41	29	30	21.05	233.73	4.92002	34	23.83	11.36	12:43:13	19/3/2006
2,399	397	101	98	18.41	29	30	21.15	233.67	4.94212	34	23.83	11.36	12:43:43	19/3/2006
2,399	397	101	99	18.41	29	30	21.01	233.59	4.90773	34	23.83	11.36	12:44:13	19/3/2006
2,399	398	101	99	18.41	29	30	21.13	233.69	4.93787	34	23.83	11.36	12:44:42	19/3/2006
2,400	396	100	98	18.41	29	30	21.14	233.57	4.93767	34	23.83	11.36	12:45:12	19/3/2006
2,399	396	101	99	18.64	29	30	21.02	233.57	4.90964	34	23.83	11.36	12:45:41	19/3/2006
2,400	396	100	98	18.64	29	30	21.11	233.53	4.92982	34	23.83	11.36	12:46:11	19/3/2006
2,400	395	100	98	59	29	30	21.11	233.59	4.93108	34	23.83	11.36	12:46:40	19/3/2006
2,399	396	101	98	59	29	30	21.03	233.49	4.91029	34	23.83	11.36	12:47:10	19/3/2006
2,399	395	101	98	93.69	29	30	21.15	233.51	4.93874	34	23.83	11.36	12:47:39	19/3/2006
2,399	395	101	97	93.69	29	30	21.09	233.51	4.92473	34	23.83	11.36	12:48:09	19/3/2006
2,399	395	100	98	93.69	29	30	21.1	233.37	4.92411	34	23.83	11.36	12:48:38	19/3/2006
2,399	395	100	98	93.69	29	30	21.14	233.49	4.93598	34	23.83	11.36	12:49:08	19/3/2006
2,400	395	99	97	28.92	29	30	21.14	233.57	4.93767	34	23.83	11.36	12:49:38	19/3/2006
2,400	396	98	97	28.92	29	30	21.07	233.43	4.91837	34	23.83	11.36	12:50:07	19/3/2006
2,399	396	98	97	59.49	29	30	21.08	233.37	4.91944	34	23.83	11.36	12:50:37	19/3/2006
2,399	397	98	97	59.49	29	29	21.17	233.55	4.94425	34	23.83	11.36	12:51:06	19/3/2006
2,400	396	99	97	59.49	29	29	21.1	233.39	4.92453	34	23.83	11.36	12:51:36	19/3/2006
2,400	395	98	97	59.49	29	29	21.04	233.39	4.91053	34	23.83	11.36	12:52:05	19/3/2006

ตาราง ฉ-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,400	395	98	96	18.52	29	29	21.07	233.26	4.91479	34	23.83	11.36	12:54:03	19/3/2006
2,400	395	98	95	18.52	29	29	21.08	233.22	4.91628	34	23.83	11.36	12:54:33	19/3/2006
2,400	394	96	96	18.52	29	29	21.1	233.08	4.91799	34	23.83	11.36	12:55:02	19/3/2006
2,400	395	98	96	18.52	29	29	21.11	233.24	4.9237	34	23.83	11.36	12:55:32	19/3/2006
2,398	395	98	96	18.52	29	29	21.09	233.18	4.91777	34	23.83	11.36	12:56:01	19/3/2006
2,400	395	98	97	18.4	29	29	21.07	233.08	4.911	34	23.83	11.36	12:56:31	19/3/2006
2,400	395	98	97	18.4	29	29	21	233.12	4.89552	34	23.83	11.36	12:57:01	19/3/2006
2,398	395	98	97	52.81	29	29	21.1	233.04	4.91714	34	23.83	11.36	12:57:30	19/3/2006
2,400	394	98	97	52.81	29	29	21.01	233.14	4.89827	34	23.83	11.36	12:58:00	19/3/2006
2,400	394	97	97	52.81	29	29	21.08	233.08	4.91333	34	23.83	11.36	12:58:29	19/3/2006
2,400	395	97	97	52.81	29	29	21.11	232.98	4.91821	34	23.83	11.36	12:58:59	19/3/2006
2,400	394	96	97	52.81	29	29	21.08	233.06	4.9129	34	23.83	11.36	12:59:28	19/3/2006
2,399	394	96	97	52.81	29	29	21.1	233.06	4.91757	34	23.83	11.36	12:59:58	19/3/2006
2,400	395	98	97	18.58	29	29	21.14	233.08	4.92731	34	23.83	11.36	13:00:27	19/3/2006
2,399	395	98	97	18.58	29	29	21.08	233.12	4.91417	34	23.83	11.36	13:00:57	19/3/2006
2,399	395	97	96	104.1	29	29	21.07	233.12	4.91184	34	23.83	11.36	13:01:26	19/3/2006
2,396	395	96	96	104.1	29	29	21.11	233.1	4.92074	34	23.83	11.36	13:01:56	19/3/2006
2,399	394	97	96	104.1	29	29	21.1	233.04	4.91714	34	23.83	11.36	13:02:25	19/3/2006
2,399	393	96	95	104.1	29	29	18.65	233.87	4.36168	34	23.83	11.36	13:02:55	19/3/2006
2,388	381	96	96	104.1	29	29	18.73	233.97	4.38226	34	23.83	11.36	13:03:25	19/3/2006
2,388	380	96	95	104.1	29	29	18.84	233.93	4.40724	34	23.83	11.36	13:03:54	19/3/2006
2,388	377	96	95	17.65	29	29	18.84	233.97	4.40799	34	23.83	11.36	13:04:23	19/3/2006
2,388	377	95	95	17.65	29	29	18.83	233.97	4.40566	34	23.53	11.84	13:04:53	19/3/2006
2,388	377	97	95	17.65	29	29	18.8	233.97	4.39864	34	23.53	11.84	13:05:23	19/3/2006
2,388	377	97	95	17.65	29	29	18.87	233.93	4.41426	34	23.53	11.84	13:05:52	19/3/2006
2,388	377	97	96	17.65	29	29	18.84	233.97	4.40799	34	23.53	11.84	13:06:22	19/3/2006
2,388	376	96	95	17.65	29	29	18.86	233.97	4.41267	34	23.53	11.84	13:06:51	19/3/2006
2,388	376	96	95	15.49	29	29	18.84	233.89	4.40649	34	23.53	11.84	13:07:21	19/3/2006
2,388	375	96	95	15.49	29	29	18.75	233.99	4.38731	34	23.53	11.84	13:07:50	19/3/2006
2,388	375	95	95	15.49	29	29	18.77	233.97	4.39162	34	23.53	11.84	13:08:20	19/3/2006
2,388	376	96	95	15.49	29	30	18.78	233.97	4.39396	34	23.53	11.84	13:08:49	19/3/2006
2,388	375	96	95	15.49	29	30	18.82	233.97	4.40332	34	23.53	11.84	13:09:19	19/3/2006
2,388	374	96	95	15.49	29	30	18.78	233.95	4.39358	34	23.53	11.84	13:09:49	19/3/2006
2,388	374	96	95	15.49	29	30	18.64	233.97	4.3612	34	23.53	11.84	13:10:18	19/3/2006
2,389	374	97	95	15.49	29	30	18.84	233.93	4.40724	34	23.53	11.84	13:10:48	19/3/2006
2,388	374	97	95	15.1	29	30	18.7	233.97	4.37524	34	23.53	11.84	13:11:17	19/3/2006
2,388	375	97	96	15.1	29	30	18.77	233.95	4.39124	34	23.53	11.84	13:11:47	19/3/2006
2,388	375	97	96	15.1	29	30	18.87	233.97	4.41501	34	23.53	11.84	13:12:16	19/3/2006
2,388	376	97	96	15.1	29	30	18.7	233.97	4.37524	34	23.53	11.84	13:12:46	19/3/2006
2,388	376	97	97	15.1	29	30	18.75	233.93	4.38619	34	23.53	11.84	13:13:15	19/3/2006
2,388	377	98	98	15.1	29	30	18.76	233.91	4.38815	34	23.53	11.84	13:13:45	19/3/2006
2,388	377	97	97	15.1	29	30	18.84	233.95	4.40762	34	23.53	11.84	13:14:14	19/3/2006
2,388	377	97	97	15.22	29	30	18.76	233.97	4.38928	34	23.53	11.84	13:14:44	19/3/2006

ตาราง ด-1 แสดงตัวอย่างของข้อมูลการทดสอบความทานวันที่ 19 มี.ค. 2549 (ต่อ)

rpm	ExhT	OilT	WT	FC	AirT	GasT	Curr	Volt	P (Kw)	AmbT	PAir	PGas	H-Meter	Date
2,388	377	98	98	15.22	30	30	18.82	233.97	4.40332	34	23.53	11.84	13:16:42	20/3/2006
2,388	377	99	98	15.22	30	30	18.86	233.91	4.41154	34	23.53	11.84	13:17:12	20/3/2006
2,388	377	99	98	15.22	30	30	18.76	233.97	4.38928	34	23.53	11.84	13:17:41	20/3/2006
2,388	377	98	97	15.1	30	30	18.84	233.97	4.40799	34	23.53	11.84	13:18:11	20/3/2006
2,388	377	98	97	15.1	30	30	18.81	234.01	4.40173	34	23.53	11.84	13:18:40	20/3/2006
2,388	377	97	97	15.1	30	30	18.7	233.71	4.37038	34	23.53	11.84	13:19:10	20/3/2006

ภาคผนวก ซ

ข้อมูลผลการวิเคราะห์น้ำมันหล่อลื่น

รูปที่ ข-1 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นใหม่ ยี่ห้อ ช้าง มาตรฐาน SAE 40 API CF (54326)

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Cust. Code : 18004	Site Name : Biogas Project	Condition :
Cust. Name : ICE R&D LAB	Location :	Oil :    Wear :    Contaminant :
Address : Faculty of Engineering Chulalongkorn University Bangkok	Unit Number : New Oil CHANG SAE40 API CF	
Test code : 803	Unit type : NEW OIL	
Lube System Capacity :	Unit make :	
	Oil grade : CHANG SAE40 API CF	

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Recommendations

Data is provided below

Lab ID : 54326		Alarm Limit Range
Date sampled : 26-Feb-08		Limit Name :
Hours on Oil : Not Available		New Oil for Baseline
Hours on Unit : Not Available		Purpose
Bottle ID : 815201		
Standard History :	Oil    Wear    Cont.	

Substrate Test	Method	Unit	RDE fine	RFS coarse	
Iron			0.6		
Chromium			0.0		
Lead			0.6		
Copper			0.1		
Tin			0.2		
Aluminium			0.9		
Nickel			0.1		
Silver			0.0		
Molybdenum			66.8		
Titanium			0.0		
Silicon			15.9		
Boron	Method	Unit	Additive		
Sodium			0		
Magnesium			2		
Calcium			11		
Barium			2539		
Phosphorus			0		
Zinc			784		
			863		
Physical Test	Method	Unit	Viscosity		
Viscosity @ 40 °C					
Viscosity @ 100 °C			14.6		
Viscosity Index					
Oxidation	Method	Unit	FTIR		
Nitration			6.7		
Sulfation			5.5		
Fuel			13.9		
Water			0.00		
Glycol			0.027		
Soot			0		
			0.00		
	Method	Unit	Other Test		
TAN					
TBN			10.3		
Flash Point					

Note: Alarm Limits are variable and dependent upon dataset size and to be used as general guideline


No. Sign or :    or :    (first level warning limit)    or :    (second level warning limit)

First level warning limit is Upper level and/or Lower level  
 Second level warning limit is Upper level and/or Lower level  
 No warranty is expressed or implied by this report

Accuracy of interpretation and recommendation can be based on representative sample and information supplied



รูปที่ ข-2 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นจากเครื่องยนต์ที่ใช้น้ำมันดีเซลร่วมกับก๊าซชีวภาพ NEW OIL ชั่วโมง 0 (55009)



**LubeCheck™ - Oil Analysis for Predictive Maintenance**

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Cust. Code : 18004  
Cust. Name : ICE R&D LAB

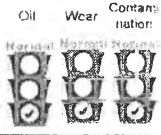
Address : Faculty of Engineering  
Chulabngkorn University  
Bangkok

Test code : 803  
Lube System Capacity : 2.75 Liters

Site Name : Biogas Project  
Location : Pump From Dip-Stick Port

Unit Number : KUBOTA RT 120 011182  
Unit type : Engine Diesel  
Unit make : KUBOTA  
Unit model : RT 120  
Oil grade : CHANG SAE40 API CF

Condition  
or  
Oil  
Wear  
Contamination:



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**Recommendations**

Note some test values are near to the Alarm Limits, or slightly over the Alarm Limits, but are not considered serious at this time. All other wear tests and oil condition tests appear satisfactory, and the oil was still serviceable at the time of sampling. Continue routine sampling interval.

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Lab ID	Date sampled	Hours on Oil	Hours on Unit	Rottle ID	55060			55010			55009			Alarm Limit Range
					Oil	Wear	Cont.	Oil	Wear	Cont.	Oil	Wear	Cont.	
	15-Mar-06	10	70	831077	N	N	N	N	N	N	N	C		
	14-Mar-06	0	50	815209	N	N	N	N	N	N	C			
	14-Mar-06	40	90	815208	N	N	N	N	N	N	C			
Limit Name : Engine Diesel General SAE 40														
Condition History														
Spectro Test														
	Method	Unit	RDE fine	RPS coarse	RDE fine	RPS coarse	RDE fine	RPS coarse						
Iron			16.1		4.8		6.0							
Chromium			5.8		2.0		39.5							
Lead			0.7		0.7		1.1							
Copper			0.8		0.2		4.2							
Tin			0.0		0.0		0.0							
Aluminium			3.5		1.8		16.6							
Nickel			0.0		0.0		0.2							
Silver			0.0		0.0		0.0							
Molybdenum			05.4		08.7		65.4							
Titanium			0.0		0.0		0.0							
Silicon			15.5		15.1		19.3							
Additive														
	Method	Unit	Additive			Additive			Additive					
Boron			0		0		0							
Sodium			2		1		3							
Magnesium			12		10		12							
Calcium			2642		2482		2651							
Barium			0		0		0							
Phosphorus			732		708		656							
Zinc			885		836		813							
Physical Test														
	Method	Unit	Viscosity			Viscosity			Viscosity					
Viscosity @ 40 °C			14.8			14.6			14.0					
Viscosity @ 100 °C														
Viscosity Index														
FTIR														
	Method	Unit	FTIR			FTIR			FTIR					
Oxidation			8.9			6.3			7.4					
Nitration			5.7			5.4			5.1					
Sulfation			14.0			13.6			15.0					
Fuel			0.00			0.10			0.15					
Water			0.024			0.045			0.055					
Glycol			0			0			0					
Soot			0.05			0.00			0.12					
Other Test														
	Method	Unit	Other Test			Other Test			Other Test					
TAN														
TBN			0.1			7.3			6.9					
Flash Point														

Note: Alarm Limits are variable and dependent upon dataset size and in reused as general guideline

No Sign: **N** ; **C** : Caution ; **W** : Warning ; **A** : Alarm (First level warning limit) ; **AL** : Alarm (Second level warning limit)

Oil Condition: **N** (Normal) ; **C** (Caution) ; **W** (Warning) ; **A** (Alarm)

Wear: **N** (Normal) ; **C** (Caution) ; **W** (Warning) ; **A** (Alarm)


Contamination: **N** (Normal) ; **C** (Caution) ; **W** (Warning) ; **A** (Alarm)

Accuracy of interpretation and recommendation are based on representative samples and information supplied. No warranty is expressed or implied in this report.

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รูปที่ ข-3 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นจากเครื่องยนต์ที่ใช้น้ำมันดีเซลร่วมกับก๊าซชีวภาพ หลังผ่านการทดสอบความทนทาน 10 ชั่วโมง (55060)



**LubeCheck™ - Oil Analysis for Predictive Maintenance**

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Cust. Code : 18004  
Cust. Name : ICE R&D LAB

Address : Faculty of Engineering  
Chulalongkorn University  
Bangkok

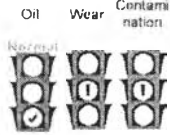
Test code : 803  
Lube System Capacity : 2.75 Liters

Site Name : Biogas Project  
Location : Pump From Dip Stick Port

Unit Number : KUBOTA RT 120 011192  
Unit type : Engine Diesel  
Unit make : KUBOTA  
Unit model : RT 120

Oil grade : CHANG SAE40 API CF

Condition of  
Oil Wear Contamination



---

**Recommendations**

Minor amount of dirt and abrasive wear noted  
All other wear tests and oil condition tests appear satisfactory, and the oil was still serviceable at the time of sampling.  
Continue routine sampling interval.

Lab ID	Date sampled	Hours on Oil	Hours on Unit	Bottle ID	Condition History	Alarm Limit Range											
						55187			55066			55080			Limit Name : Engine Diesel General SAE 40		
						Oil	Wear	Cont.	Oil	Wear	Cont.	Oil	Wear	Cont.			
						(N)	(C)	(E)	(N)	(C)	(E)	(N)	(N)	(N)			
						RDE fine	RFS coarse		RDE fine	RFS coarse		RDE fine	RFS coarse				
						3.6			19.3			18.1					
Spectro Test	Method	Unit															
Iron	mg/L	ppm															
Chromium	mg/L	ppm															
Lead	mg/L	ppm															
Copper	mg/L	ppm															
Tin	mg/L	ppm															
Aluminium	mg/L	ppm															
Nickel	mg/L	ppm															
Silver	mg/L	ppm															
Molybdenum	mg/L	ppm															
Titanium	mg/L	ppm															
Silicon	mg/L	ppm															
	Method	Unit															
Boron	mg/L	ppm															
Sodium	mg/L	ppm															
Magnesium	mg/L	ppm															
Calcium	mg/L	ppm															
Barium	mg/L	ppm															
Phosphorus	mg/L	ppm															
Zinc	mg/L	ppm															
	Method	Unit															
Physical Test						Viscosity				Viscosity				Viscosity			
Viscosity @ 40 °C	mm²/s	cSt															
Viscosity @ 100 °C	mm²/s	cSt				14.8				14.8				14.5			
Viscosity Index																	
	Method	Unit															
Oxidation	mg/100ml	ppm				6.4				7.2				6.9			
Nitration	mg/100ml	ppm				6.5				5.9				5.7			
Sulfation	mg/100ml	ppm				15.8				14.6				14.2			
Fuel	mg/100ml	ppm				0.10				0.10				0.10			
Water	mg/100ml	ppm				0.038				0.030				0.024			
Glycol	mg/100ml	ppm				0				0				0			
Soot	mg/100ml	ppm				0.07				0.01				0.00			
	Method	Unit															
TAN	mg/100ml	ppm				0.8				7.2				6.1			
TBN	mg/100ml	ppm															
Flush Point	mg/100ml	ppm															

Note: Alarm limits are variable and dependent upon dataset size and to be used as general guideline.

No Sign or **N** : normal or **C** : (first level warning limit) or **E** : (second level warning limit)


Oil Quality: **Good** (acceptable) or **Low** (Alarm limit)

Accuracy of interpretation and recommendation are based on representative sample and information supplied. No warranty is expressed or implied for this report.

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รูปที่ ข-4 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นจากเครื่องยนต์ที่ใช้น้ำมันดีเซลร่วมกับก๊าซชีวภาพ หลังผ่านการทดสอบความทนทาน 25 ชั่วโมง (55066)



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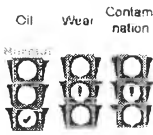
Page 1 of 3

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Cust Code : 18004  
Cust Name : ICE R&D LAB  
Address : Faculty of Engineering  
Chulalongkorn University  
Bangkok  
Test code : 803  
Lube System Capacity : 2.75 Liter

Site Name : Biogas Project  
Location : Pump Room Dip-Stick Port  
Unit Number : KUBOTA RT 120 011192  
Unit type : Engine Diesel  
Unit make : KUBOTA  
Unit model : RT 120  
Oil grade : CHANG SAE40 API CF

Condition of Contamination  
Oil Wear Contamination



---

**Recommendations**

Minor amount of dirt and abrasive wear noted.  
All other wear tests and oil condition tests appear satisfactory, and the oil was still serviceable at the time of sampling.  
Continue routine sampling interval.

---


Lab ID	Date sampled	Hours on Oil	Hours on Unit	Bottle ID	55188			55187			55088			Alarm Limit Range
					Oil	Wear	Cont.	Oil	Wear	Cont.	Oil	Wear	Cont.	
	19-Mar-06	135	831030		17-Mar-06	110	831075		16-Mar-06	25	805		Limit Name : Engine Diesel General SAE 40	
<b>Condition History</b>					Oil	Wear	Cont.	Oil	Wear	Cont.	Oil	Wear	Cont.	
<b>Spectro Test</b>					Method	Unit	RDE fine	RFS coarse	RDE fine	RFS coarse	RDE fine	RFS coarse		
Iron							30.8		33.6		19.3			
Chromium							15.7		15.6		6.7			
Lead							0.5		0.7		0.1			
Copper							1.7		1.9		1.1			
Tin							0.0		0.0		0.0			
Aluminum							11.1		10.8		4.8			
Nickel							0.0		0.0		0.2			
Silver							0.0		0.0		0.0			
Molybdenum							75.0		72.7		06.6			
Titanium							0.0		0.0		0.0			
Silicon							17.0		17.5		15.4			
<b>Additive</b>					Method	Unit	Additive	Additive	Additive	Additive	Additive	Additive		
Boron							0		0		0			
Sodium							2		2		2			
Magnesium							14		13		11			
Calcium							3154		3034		2619			
Barium							0		0		0			
Phosphorus							793		744		652			
Zinc							064		653		793			
<b>Physical Test</b>					Method	Unit	Viscosity	Viscosity	Viscosity	Viscosity	Viscosity			
Viscosity @ 40 °C							15.6		14.8		14.8			
Viscosity @ 100 °C														
Viscosity Index														
<b>FTIR</b>					Method	Unit	FTIR	FTIR	FTIR	FTIR	FTIR			
Oxidation							9.0		8.4		7.2			
Nitration							6.5		6.5		5.9			
Sulfation							16.3		15.8		14.6			
Fuel							0.10		0.10		0.10			
Water							0.006		0.038		0.006			
Glycol							0		0		0			
Soot							0.08		0.07		0.01			
<b>Other Test</b>					Method	Unit	Other Test	Other Test	Other Test	Other Test	Other Test			
TAN							0.4		0.6		0.2			
TBN														
Flash Point														

Note: Alarm Limits are variable and dependent upon dilution size and to be used as general guideline.  
 No Sign. = N, Alarm Limit = A, Critical = C, (First level warning limit), (Second level warning limit)  
 First level warning limit is Upper level alarm, Second level warning limit is Upper level alarm, Lower level warning limit is Lower level alarm.  
 Accuracy of oil prediction and recommendations are based on representative sample and information supplied.  
 No warranty is expressed or implied for this report.

File: 550660661.rpt, Path: \\F:\Data\55066\550660661.rpt, Date: 19-Mar-06, Time: 10:00:00, User: fcs@f-cus.com



รูปที่ ข-5 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นจากเครื่องยนต์ที่ใช้น้ำมันดีเซลร่วมกับก๊าซชีวภาพ หลังผ่านการทดสอบความทนทาน 50 ชั่วโมง (55187)



**LubeCheck™ - Oil Analysis for Predictive Maintenance**


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Cust. Code : 18004  
Cust. Name : ICE R&D LAB  
Address : Faculty of Engineering  
Chulalongkorn University  
Bangkok

Site Name : Biogas Project  
Location : Pump From Dip-Stick Port  
Unit Number : KUBOTA RT 120 011192  
Unit type : Engine Diesel  
Unit make : KUBOTA  
Unit model : RT 120  
Oil grade : CHANG SAE 40 API CF

Condition of Contamination  
Oil Wear Contamination  
Normal



---

Test code : 803  
Lube System Capacity : 275 Liters

**Recommendations**

Minor amount of dirt and abrasive wear noted  
All other wear tests and oil condition tests appear satisfactory, and the oil was still serviceable at the time of sampling  
Continue routine sampling interval

---

Lab ID	Test Method	Result	55189 19-Mar-06	55188 19-Mar-06	55187 17-Mar-06	Alarm Limit Range
Date sampled			19-Mar-06	19-Mar-06	17-Mar-06	Limit Name : Engine Diesel General SAE 40
Hours on Oil			80	75	50	
Hours on Unit			140	136	110	
Bottle ID			831081	831080	831079	
Condition History			Oil (N) Wear (C) Cont. (A)	Oil (N) Wear (C) Cont. (A)	Oil (N) Wear (C) Cont. (A)	
Spectro Test	Method Unit	RDE fine RFS coarse	RDE fine RFS coarse	RDE fine RFS coarse	RDE fine RFS coarse	Upper Lower
Iron	0.0005 mg/g	36.3 2	30.8 2	33.6 2		
Chromium	0.0005 mg/g	18.7 A	15.7 A	15.6 C		
Lead	0.0005 mg/g	0.8	0.5	0.7		
Copper	0.0005 mg/g	1.9	1.7	1.9		
Tin	0.0005 mg/g	0.0	0.0	0.0		
Aluminium	0.0005 mg/g	13.3 A	11.1 A	10.6 A		
Nickel	0.0005 mg/g	0.3	0.2	0.2		
Silver	0.0005 mg/g	0.0	0.0	0.0		
Molybdenum	0.0005 mg/g	80.0	75.8	72.7		
Titanium	0.0005 mg/g	0.0	0.0	0.0		
Silicon	0.0005 mg/g	19.0 C	17.9 C			
Boron	0.0005 mg/g	0	0	0		
Sodium	0.0005 mg/g	2	2	2		
Magnesium	0.0005 mg/g	15	14	13		
Calcium	0.0005 mg/g	3269	3154	3034		
Barium	0.0005 mg/g	0	0	0		
Phosphorus	0.0005 mg/g	875	793	744		
Zinc	0.0005 mg/g	903	864	853		
Physical Test	Method Unit	Viscosity	Viscosity	Viscosity		
Viscosity @ 40°C	0.441 cSt					
Viscosity @ 100°C	0.445 cSt	149	150	148	143 - 117	
Viscosity Index	0.200					
Oxidation	0.002 mg/g	9.2	9.0	8.4		
Nitration	0.002 mg/g	0.7	0.6	0.5		
Sulfation	0.002 mg/g	17.0	16.3	15.8		
Fuel	0.002 mg/g	0.10	0.10	0.10		
Water	0.002 mg/g	0.034	0.035	0.038		
Glycol	0.002 mg/g	0	0	0		
Soot	0.002 mg/g	0.10	0.08	0.07		
TAN	0.004 mg/g					
TBN	0.004 mg/g	66	64	56		
Flash Point	0.004 mg/g					

Note: Alarm Limits are variable and dependent upon dataset size and to be used as general guideline

No Sign. or N : Normal, C : (first level warning limit), A or A : (second level warning limit)


Upper & Lower Alarm Limits

Accuracy of interpretation and recommendation are based on representative sample and information supplied. No warranty is expressed or implied for this result.

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Email: info@fuslubec.com

รูปที่ ข-6 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นจากเครื่องยนต์ที่ใช้น้ำมันดีเซลร่วมกับก๊าซชีวภาพ หลังผ่านการทดสอบความทนทาน 75 ชั่วโมง (55188)



### LubeCheck™ - Oil Analysis for Predictive Maintenance

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Cust. Code : 18004  
Cust. Name : ICE R&D LAB  
Address : Faculty of Engineering  
Chulalongkorn University  
Bangkok


Site Name : Biogas Project  
Location : Pump From Dip-Stick Port  
Unit Number : KUBOTA RT 120 011192  
Unit type : Engine Diesel  
Unit make : KUBOTA  
Unit model : RT 12D  
Oil grade : CHANG SAE40 API CF

Condition of  
Oil Wear Contamination


Normal



Normal



Normal



---

Recommendations

Note some test values are near to the Alarm Limits, or slightly over the Alarm Limits, but are not considered serious at this time. All other wear tests and oil condition tests appear satisfactory, and the oil was still serviceable at the time of sampling. Continue routine sampling interval.

Lab ID	Oil Code	Sample No.	55180	55189	55188	Alarm Limit Range
Date sampled			20-Mar-06	19-Mar-06	19-Mar-06	Limit Name :
Hours on Oil			0	60	75	Engine Diesel General SAE 40
Hours on Unit			140	140	135	
Bottle ID			831082	831081	831080	
Condition History			Oil Wear Cont. (N) (N) (N)	Oil Wear Cont. (N) (N) (N)	Oil Wear Cont. (N) (N) (N)	
Spectro Test	Method	Unit	RDE fine RFS coarse	RDE fine RFS coarse	RDE fine RFS coarse	
Iron	0.0001	mg/l	43	16.3	30.8	
Chromium	0.0001	mg/l	1.0	16.7	15.7	
Lead	0.0001	mg/l	0.0	0.8	0.6	
Copper	0.0001	mg/l	0.1	1.0	1.7	
Tin	0.0001	mg/l	0.0	0.0	0.0	
Aluminium	0.0001	mg/l	1.2	12.3	11.1	
Nickel	0.0001	mg/l	0.0	0.3	0.2	
Silver	0.0001	mg/l	0.0	0.0	0.0	
Molybdenum	0.0001	mg/l	72.7	80.0	74.8	
Titanium	0.0001	mg/l	0.0	0.0	0.0	
Silicon	0.0001	mg/l	16.2	19.0	17.3	
	Method	Unit	Additive	Additive	Additive	
Boron	0.0001	mg/l	0	0	0	
Sodium	0.0001	mg/l	1	2	2	
Magnesium	0.0001	mg/l	12	15	14	
Calcium	0.0001	mg/l	2816	2229	3154	
Barium	0.0001	mg/l	6	6	6	
Phosphorus	0.0001	mg/l	873	876	293	
Zinc	0.0001	mg/l	663	533	564	
Physical Test	Method	Unit	Viscosity	Viscosity	Viscosity	
Viscosity @ 40 °C	0.0001	mm²/s				
Viscosity @ 100 °C	0.0001	mm²/s	14.7	14.9	15.0	
Viscosity Index	0.0001					
	Method	Unit	FTIR	FTIR	FTIR	
Oxidation	0.0001	mg/l	6.2	9.2	9.0	
Nitration	0.0001	mg/l	5.3	6.7	6.6	
Sulfation	0.0001	mg/l	13.6	17.0	16.3	
Fuel	0.0001	mg/l	0.10	0.10	0.10	
Water	0.0001	mg/l	0.042	0.034	0.035	
Glycol	0.0001	mg/l	0	0	0	
Soot	0.0001	mg/l	0.00	0.10	0.06	
	Method	Unit	Other Test	Other Test	Other Test	
TAN	0.0001	mg KOH/g				
TBN	0.0001	mg KOH/g	7.4	6.6	6.4	
Flash Point	0.0001	°C				

Note: Alarm Limits are variable and dependent upon dataset size and to be used as general guideline.

No Sign or (N) : Healthy ; or (C) : (first level warning limit) ; A or (A) : (second level warning limit)


1 : Exceeds ; 2 : Approaches limit ; 3 : Exceeds limit ; Lower : Approaches Limit ; First level warning limit in Upper level and/or Lower level ; Second level warning limit in Upper level and/or Lower level

Accuracy of test, prediction and recommendations are based on representative sample and information supplied. No warranty is expressed or implied for this report.

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รูปที่ ข-7 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นจากเครื่องยนต์ที่ใช้น้ำมันดีเซลร่วมกับก๊าซชีวภาพ หลังผ่านการทดสอบความทนทาน 80 ชั่วโมง (55189)



**LubeCheck™ - Oil Analysis for Predictive Maintenance**


Page 1 of 3

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**Cust. Code** : 18004  
**Cust. Name** : ICE R&D LAB  
**Address** : Faculty of Engineering  
 Chulalongkorn University  
 Bangkok  
**Test code** : 803  
**Lube System Capacity** : 2.75 Liters

**Site Name** : Biogas Project  
**Location** : Pump From Dip-Stick Post  
**Unit Number** : KUBOTA RT 120 D11182  
**Unit type** : Engine Diesel  
**Unit make** : KUBOTA  
**Unit model** : RT 120  
**Oil grade** : CHANG SAE40 API CF

**Condition of**  
 Oil    Wear    Contamination



---

**Recommendations**

Minor amount of dirt and abrasive wear noted.  
 All other wear tests and oil condition tests appear satisfactory, and the oil was still serviceable at the time of sampling.  
 Continue routine sampling interval.

Lab ID	Date sampled	Hours on Oil	Duties on Unit	Duties ID	Test Method	Result	55525 21-Mar-09			55190 29-Mar-09			55189 19-Mar-09			Alarm Limit Range Limit Name : Engine Diesel General SAE 40		
							Oil	Wear	Cont.	Oil	Wear	Cont.	Oil	Wear	Cont.			
							831083	831082	831081									
							N	W	C	N	W	C	N	W	C			
<b>Spectra Test</b>							<b>RDE fine</b>			<b>RDE fine</b>			<b>RDE fine</b>					
Iron	0.005	mg/L	23.1				4.3			26.3								
Chromium	0.005	mg/L	13.2	A			1.6			16.7								
Lead	0.005	mg/L	0.0				0.0			0.6								
Copper	0.005	mg/L	0.0				0.1			1.0								
Tin	0.005	mg/L	0.0				0.0			0.0								
Aluminium	0.005	mg/L	0.0				1.2			13.3								
Nickel	0.005	mg/L	0.0				0.0			0.3								
Silver	0.005	mg/L	0.0				0.0			0.0								
Molybdenum	0.005	mg/L	0.0				0.0			0.0								
Titanium	0.005	mg/L	0.0				0.0			0.0								
Silicon	0.005	mg/L	13.7				16.2			19.0								
							<b>Additive</b>			<b>Additive</b>			<b>Additive</b>					
Boron	0.005	mg/L	0				0			0								
Sodium	0.005	mg/L	1				1			2								
Magnesium	0.005	mg/L	12				12			15								
Calcium	0.005	mg/L	2799				2618			3250								
Barium	0.005	mg/L	0				0			0								
Phosphorus	0.005	mg/L	715				673			875								
Zinc	0.005	mg/L	614				503			603								
<b>Physical Test</b>							<b>Viscosity</b>			<b>Viscosity</b>			<b>Viscosity</b>					
Viscosity @ 40 °C	0.005	mm²/s	14.9				14.7			14.9								
Viscosity @ 100 °C	0.005	mm²/s																
Viscosity Index	0.005																	
							<b>FTIR</b>			<b>FTIR</b>			<b>FTIR</b>					
Oxidation	0.005	mg/g	3.6				6.2			6.2								
Nitration	0.005	mg/g	6.6				5.3			6.7								
Sulfation	0.005	mg/g	16.0				13.6			17.0								
Fuel	0.005	mg/g	0.10				0.10			0.10								
Water	0.005	mg/g	0.037				0.042			0.034								
Glycol	0.005	mg/g	0				0			0								
Soot	0.005	mg/g	0.03				0.02			0.10								
							<b>Other Test</b>			<b>Other Test</b>			<b>Other Test</b>					
TAN	0.005	mg/g	0.8				0.8			0.8								
TBN	0.005	mg/g	7.4				7.4			6.6								
Flash Point	0.005	mg/g																

Note: Alarm Limits are variable and dependent upon oil-label size and to be used as general guideline.  
 For steps see [N] (Normal) or [C] (Critical) (first level warning limit), [A] or [B] (second level warning limit), [P] (Pass level warning limit) or [U] (Upper level warning limit).  
 [M] (Major) [S] (Severe) [L] (Low) [H] (High) [O] (Off)  
 Amount of interpretation and recommendations are based on representative sample and laboratory application. No warranty is given for a report.

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รูปที่ ข-10 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นจากเครื่องยนต์ที่ใช้น้ำมันดีเซลร่วมกับ ก๊าซชีวภาพหลังผ่านการทดสอบความทนทาน 205 (55756) ชั่วโมง



## LubeCheck - Oil Analysis for Predictive Maintenance


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**Cust. Code :** 18004  
**Cust. Name :** ICE R&D LAB  
**Address :** Faculty of Engineering  
 Chulalongkorn University  
 Bangkok  
**Test code :** 803  
**Lube System Capacity :** 2.75 Liters

**Site Name :** Biogas Project  
**Location :** Pump From Dip-Stick Port  
**Unit Number :** KUBOTA RT 120 011192  
**Unit type :** Engine Diesel  
**Unit make :** KUBOTA  
**Unit model :** RT 120  
**Oil grade :** CHANG SAE 40 API CF

Condition  
of  
Oil  
Wear  
Contam-  
nation



---

**Recommendations**

Dirt (silicon) is present and resulting in abrasive wear.  
 Recommend check to determine how dirt is entering the system and correct the problem to prevent further dirt entry.  
 Continue routine sampling interval.

Lab ID	Date sampled	Hours on Oil	Hours on Unit	Bottle ID	Condition History	55756			55696			55695			Alarm Limit Range					
						Oil	Wear	Cont.	Oil	Wear	Cont.	Oil	Wear	Cont.	Limit Name : Engine Diesel General SAE 40					
						(N)	(N)	(N)	(N)	(N)	(N)	(N)	(N)	(N)	(N)	(N)	(N)	(N)		
						RDE fine	RFS coarse	RDE fine	RFS coarse	RDE fine	RFS coarse	RDE fine	RFS coarse							
<b>Spectro Test</b>						Method	Unit	Additive			Additive			Additive						
Iron	D-43170	mg/g	60	A				4.1					53.0							
Chromium	18251	mg/g	3-4	A				1.9					46.2							
Lead	18251	mg/g	1.2					0.0					1.3							
Copper	18251	mg/g	1.6					0.1					2.3							
Tin	18251	mg/g	0.8					0.0					6.4							
Aluminium	18251	mg/g	25.2	A				1.7					24.9							
Nickel	18251	mg/g	0.6					0.0					0.5							
Silver	18251	mg/g	0.1					0.0					0.0							
Molybdenum	18251	mg/g	70.7					49.9					73.6							
Titanium	18251	mg/g	0.0					0.0					0.0							
Silicon	18251	mg/g	20.4					7.8					23.7							
<b>Physical Test</b>						Method	Unit	Viscosity			Viscosity			Viscosity						
Viscosity @ 40 °C	18251	mm²/s						14.9					15.1	11.0 - 12.5						
Viscosity @ 100 °C	18251	mm²/s																		
Viscosity Index	18251																			
<b>Other Test</b>						Method	Unit	FTIR			FTIR			FTIR						
Oxidation	18251	mg/g	8.5					6.3					9.2							
Nitration	18251	mg/g	6.0					5.6					6.7							
Sulfation	18251	mg/g	13.3					13.4					10.3							
Fuel	18251	mg/g	0.10					0.10					0.10							
Water	18251	mg/g	0.034					0.054					0.033							
Glycol	18251	mg/g	0					0					0							
Soot	18251	mg/g	0.13					0.00					0.18							
<b>Other Test</b>						Method	Unit	TAN			TBN			Flash Point						
TAN	18251	mg/g	7.1										6.4							
TBN	18251	mg/g											7.0							
Flash Point	18251	°C																		

Note: Alarm limits are variable and dependent upon dataset size and to be used as general guideline.

No. Sign: Normal, Warning, Alarm (first level warning limit), Alarm (second level warning limit)

Alarm Level: Green (Normal), Yellow (Warning), Red (Alarm)


Severity of abnormality and recommendations are based on representative sample and information supplied.

No warranty is expressed or implied for the result.

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รูปที่ ข-11 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นจากเครื่องยนต์ที่ใช้น้ำมันดีเซลร่วมกับ  
 ก๊าซชีวภาพหลังผ่านการทดสอบความทนทาน 230(55805) ชั่วโมง



**LubeCheck™ - Oil Analysis for Predictive Maintenance**


Page 1 of 3

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**Cust. Code :** 18004  
**Cust. Name :** ICE R&D LAB  
**Address :** Faculty of Engineering  
 Chulalongkorn University  
 Bangkok  
**Test code :** 803  
**Lube System Capacity :** 2.75 Liters

**Site Name :** Biogas Project  
**Location :** Pump From Dip-Stick Port  
**Unit Number :** KUBOTA RT 120 011192  
**Unit type :** Engine Diesel  
**Unit make :** KUBOTA  
**Unit model :** RT 120  
**Oil grade :** CHANG SAE 40 API CF

**Condition of**  
**Oil** **Wear** **Contamination**



---

**Recommendations**

Dirt (silicon) is present and resulting in abrasive wear.  
 Recommend check to determine how dirt is entering the system and correct the problem to prevent further dirt entry.  
 Continue routine sampling interval.

---


Lab ID	Date sampled	Hours on Oil	Hours on Unit	Bottle ID	Alarm Limit Range								
					Limit Name : Engine Diesel General SAE 40								
55805	20-Mar-05	55	390	831069									
55756	28-Mar-05	25	265	831068									
55696	29-Mar-05	0	240	831087									
Condition History					Oil	Wear	Cont.	Oil	Wear	Cont.	Oil	Wear	Cont.
					(N)	(N)	(C)	(N)	(N)	(N)	(N)	(N)	(N)
Spectro Test		Method	Unit	RDE fine	RFS coarse	RDE fine	RFS coarse	RDE fine	RFS coarse	Decision			
Iron	0.0000	mg/L	49.0	33.0	33.0	33.0	33.0	33.0	33.0	Decision	Warning	Warning	Warning
Chromium	0.0000	mg/L	36.4	34.4	34.4	34.4	34.4	34.4	34.4	Decision	Warning	Warning	Warning
Lead	0.0000	mg/L	0.0	1.2	1.2	1.2	1.2	1.2	1.2	Decision	Warning	Warning	Warning
Copper	0.0000	mg/L	1.1	1.6	1.6	1.6	1.6	1.6	1.6	Decision	Warning	Warning	Warning
Tin	0.0000	mg/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Decision	Warning	Warning	Warning
Aluminum	0.0000	mg/L	21.1	25.2	25.2	25.2	25.2	25.2	25.2	Decision	Warning	Warning	Warning
Nickel	0.0000	mg/L	0.1	0.6	0.6	0.6	0.6	0.6	0.6	Decision	Warning	Warning	Warning
Silver	0.0000	mg/L	0.0	0.1	0.1	0.1	0.1	0.1	0.1	Decision	Warning	Warning	Warning
Molybdenum	0.0000	mg/L	0.3	0.7	0.7	0.7	0.7	0.7	0.7	Decision	Warning	Warning	Warning
Titanium	0.0000	mg/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Decision	Warning	Warning	Warning
Silicon	0.0000	mg/L	15.0	26.4	26.4	26.4	26.4	26.4	26.4	Decision	Warning	Warning	Warning
Additive		Method	Unit	Additive	Additive	Additive	Decision						
Boron	0.0000	mg/L	0	0	0	0	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Sodium	0.0000	mg/L	2	2	2	2	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Magnesium	0.0000	mg/L	11	14	14	14	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Calcium	0.0000	mg/L	28.0	27.0	27.0	27.0	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Barium	0.0000	mg/L	0	0	0	0	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Phosphorus	0.0000	mg/L	7.0	7.0	7.0	7.0	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Zinc	0.0000	mg/L	7.0	5.1	5.1	5.1	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Physical Test		Method	Unit	Viscosity	Viscosity	Viscosity	Decision						
Viscosity @ 40 °C	0.0000	mm²/s	14.8	14.0	14.0	14.0	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Viscosity @ 100 °C	0.0000	mm²/s					Decision	Warning	Warning	Warning	Warning	Warning	Warning
Viscosity Index	0.0000						Decision	Warning	Warning	Warning	Warning	Warning	Warning
Oxidation		Method	Unit	FTIR	FTIR	FTIR	Decision						
Oxidation	0.0000	mg/kg	7.5	6.5	6.5	6.5	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Nitration	0.0000	mg/kg	6.4	6.6	6.6	6.6	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Sulfation	0.0000	mg/kg	10.6	10.3	10.3	10.3	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Fuel	0.0000	mg/kg	0.10	0.10	0.10	0.10	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Water	0.0000	mg/kg	0.031	0.034	0.034	0.034	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Glycol	0.0000	mg/kg	0	0	0	0	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Soot	0.0000	mg/kg	0.03	0.13	0.13	0.13	Decision	Warning	Warning	Warning	Warning	Warning	Warning
Other Test		Method	Unit	Other Test	Other Test	Other Test	Decision						
TAN	0.0000	mg/kg	6.4	7.1	7.1	7.1	Decision	Warning	Warning	Warning	Warning	Warning	Warning
TBN	0.0000	mg/kg					Decision	Warning	Warning	Warning	Warning	Warning	Warning
Flash Point	0.0000	°C					Decision	Warning	Warning	Warning	Warning	Warning	Warning

Note: Alarm Limits are variable and dependent upon dataset size and to be used as general guideline.  
 No. of tests: N (Normal), W (Warning), C (Critical), A (Alarm).  
 Alarm limits: Upper Alarm Limit (U), Lower Alarm Limit (L).  
 Accuracy of interpretation and recommendation are based on representative sample and information supplied.  
 No warranty is expressed or implied for this report.

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รูปที่ ข-12 แสดงใบรายงานผลการทดสอบน้ำมันหล่อลื่นจากเครื่องยนต์ที่ใช้น้ำมันดีเซลร่วมกับ ก๊าซชีวภาพหลังผ่านการทดสอบความหนาน 255(55954), 280(55955) ชั่วโมง



### LubeCheck™ - Oil Analysis for Predictive Maintenance

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**Cust. Code :** 1R004  
**Cust. Name :** ICE R&D LAB

**Address :** Faculty of Engineering  
Chulalongkorn University  
Bangkok




**Test code :** 803  
**Lube System Capacity :** 2.75 Liters

**Site Name :** Biogas Project  
**Location :** Pump From Dip Stick Port

**Unit Number :** KUBOTA RT 120 011192  
**Unit type :** Engine Diesel  
**Unit make :** KUBOTA  
**Unit model :** RT 120

**Oil grade :** CHANG SAE 40 AP/ CF

Condition of

Oil	Wear	Contamination
		

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**Recommendations**

Dirt (silicon) is present and resulting in abraive wear.  
Recommend check to determine how dirt is entering the system and correct the problem to prevent further dirt entry.  
Continue routine sampling interval.

---

Lab ID	Date sampled	Hours on Oil	Hours on Unit	AntiLeak ID	55955			55954			55805			Alarm Limit Range
					Oil	Wear	Cont.	Oil	Wear	Cont.	Oil	Wear	Cont.	
					02-Apr-06			31-Mar-06			30-Mar-06			Limit Name : Engine Diesel General SAE 40
					100			75			50			
					340			310			200			
					831091			831090			831089			
Condition History					Oil	Wear	Cont.	Oil	Wear	Cont.	Oil	Wear	Cont.	
					(N)	(C)	(C)	(N)	(C)	(C)	(N)	(C)	(C)	
<b>Spectro Test</b>					Method	Unit	RDE fine	RFS coarse	RDE fine	RFS coarse	RDE fine	RFS coarse		
Iron							69.8		110.0		48.0			
Chromium							33.9		60.7		39.4			
Lead							0.0		0.2		0.0			
Copper							1.7		3.0		1.1			
Tin							0.0		0.0		0.0			
Aluminium							30.6		49.0		21.1			
Nickel							0.0		0.4		0.1			
Silver							0.0		0.0		0.0			
Molybdenum							15.1		25.2		01.0			
Titanium							0.0		0.0		0.0			
Silicon							21.6		21.3		19.0			
<b>Additive</b>					Method	Unit	Additive			Additive				
Boron							1		0		0			
Sodium							2		2		2			
Magnesium							17		16		11			
Calcium							3391		3358		2936			
Barium							0		0		0			
Phosphorus							366		636		726			
Zinc							916		850		790			
<b>Physical Test</b>					Method	Unit	Viscosity			Viscosity				
Viscosity @ 40 °C							15.3			15.2				
Viscosity @ 100 °C										14.6				
Viscosity Index														
<b>FTIR</b>					Method	Unit	FTIR			FTIR				
Oxidation							7.7		0.5		7.5			
Nitration							6.5		7.0		6.4			
Sulfation							17.3		18.8		15.6			
Fuel							0.10		0.10		0.10			
Water							0.032		0.035		0.031			
Glycol							0		0		0			
Soot							0.35		0.40		0.09			
<b>Other Test</b>					Method	Unit	Other Test			Other Test				
TAN							6.0			5.0				
TBN										6.4				
Flash Point														

Note: Alarm Limits are variable and dependent upon dataset size and to be used as general guideline

Alarm to [N] : Normal ; [C] : Caution ; [E] : Error (first level warning limit) ; [A] : Alarm (second level warning limit)

[U] : Upper ; [L] : Lower ; [W] : Warning ; [E] : Error

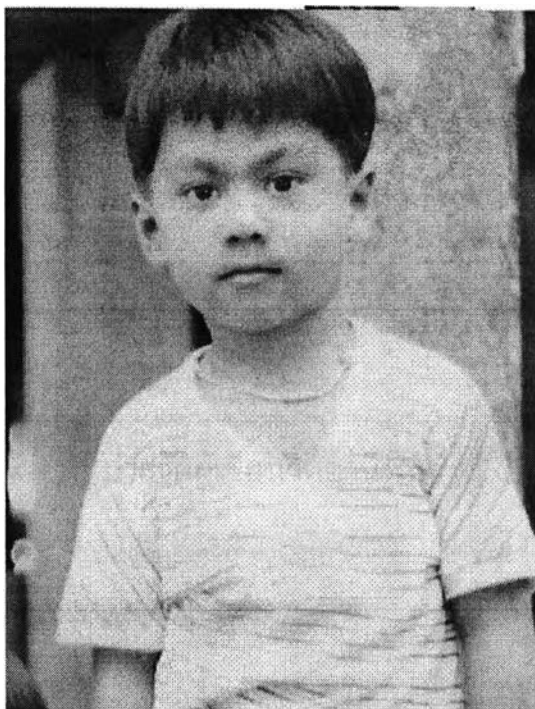
First level warning limit in upper level and/or Lower level  
Second level warning limit in upper level and/or Lower level  
No warning is displayed if limit is not set

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## ประวัติผู้เขียนวิทยานิพนธ์



นายกรีชชัย คชพลายุกต์ เกิดเมื่อวันที่ 6 เดือน กุมภาพันธ์ พุทธศักราช 2523 ที่ อำเภอ บางสะพาน จังหวัดประจวบคีรีขันธ์ สำเร็จการศึกษาปริญญาวิทยาศาสตรบัณฑิต ภาควิชา วิศวกรรมเครื่องกล คณะวิศวกรรมศาสตร์ มหาวิทยาลัยธรรมศาสตร์เมื่อปีการศึกษา 2545 เข้า ศึกษาต่อในหลักสูตรวิทยาศาสตรมหาบัณฑิต ภาควิชาวิศวกรรมเครื่องกล คณะ วิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัยเมื่อปีการศึกษา 2545