The Engineering Society For Advancing Mobility Land Sea Air and Space®
SAE INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

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(R) PREIGNITION RATING OF SPARK PLUGS

1. SCOPE:

This SAE Recommended Practice describes the equipment and procedures used in obtaining preignition ratings of spark plugs.

1.1 The spark plug preignition ratings obtained with the equipment and procedure specified herein are useful for comparative purposes and are not to be considered as absolute values since different numerical values may be obtained in different laboratories.

2. REFERENCES:

2.1 Applicable Documents:

SAE HS840, Manual for the SAE 17.6 Cubic Inch Spark Plug Rating Engine, including Maintenance and Overhaul

3. EQUIPMENT:

SAE 17.6 engine[1] with the cylinder barrel having knurled and chemically treated surface and compression piston rings chromium plated.

4. SPEED:

The nominal speed is to be 2700 rpm, but is not to be over 2765 rpm when firing, nor below 2670 rpm when motoring.

5. COMPRESSION RATIO:

5.6:1.

[1]See SAE HS840, Manual for the SAE 17.6 Cubic Inch Spark Plug Rating Engine, including Maintenance and Overhaul currently--1989 under rev.

6. SPARK ADVANCE:

30 degrees Before Top Dead Center (BTDC) for nonaviation plugs, 40 degrees BTDC for aviation plugs or nonaviation plugs that cannot be rated at 30 degrees BTDC.

7. IGNITION SOURCE:

Magneto or approved alternate.

8. SPARK PLUG INSTALLATION:

The thread in the spark plug hole opening should conform in size and length to the standards established by SAE for the rating engine.

8.1 SAE recommended torque values should be used when installing plugs in the engine.

8.1.1 Reducer bushings or adaptors should not be used.

9. FUEL:

98% - one degree Benzene, 2% - Specification MIL-L-6082D Grade 1100 SAE60 NONADDITIVE aviation oil, with 3 cc/gal (0.8 ml/L) T.E.L. added.

10. FUEL INJECTION TIMING:

The fuel injection pump port shall begin to close 60 degrees ± 5 of crankshaft angle After Top Dead Center (ATDC) on the intake stroke.

11. FUEL CIRCULATION RATE:

1/2 gal/min ± 1/4 (2 L/min ± 1).

12. FUEL INJECTION PUMP:

The gallery pressure of the fuel injection pump is to be 15 psi ± 2 (100 kPa ± 10).

13. FUEL PRESSURES-INJECTION:

750 psi (5170 kPa) minimum.

14. MIXTURE STRENGTH:

The mixture strength is that which gives maximum thermal plug temperature.

15. INLET AIR TEMPERATURE:

225°F ± 5 (107°C ± 3).

16. INLET AIR HUMIDITY:

75 g ± 25 of moisture/lb (0.453 kg) of dry air.

17. COOLANT:

The coolant should be water plus 1 g/gal (3 L) of an inhibitor. The total dissolved and suspended solids should not exceed 120 ppm.

18. JACKET INLET TEMPERATURE:

a. With pressure cooling control: 225°F ± 5 (107°C ± 3)
b. With insert head engine: 190°F ± 2 (88°C ± 1)

19. COOLANT FLOW:

5 gal/min ± 1/2 (20 L/min ± 2).

20. CRANKCASE OIL:

Oil is to be nonadditive SAE 120 aviation oil.

21. OIL PRESSURE:

a. In main bearings, 95 psi ± 5 (650 kPa ± 40)
b. In valve gear, 15 psi (100 kPa) minimum at operating temperature

22. OIL TEMPERATURE:

190°F ± 10 (88°C ± 5).

23. OIL QUANTITY:

Oil level is maintained at the center of the oil level sight glass.

24. OPERATING CONDITIONS:

The plug rating is that indicated Mean Effective Pressure (IMEP) value obtained on the engine at a point when the supercharge pressure is 1 in Hg (3.37 kPa) below the preignition point.

24.1 Preignition Point:

The following steps are recommended to attain the preignition point.

24.1.1 The supercharge pressure is increased in 4 in Hg (13.5 kPa) increments until preignition occurs as indicated by a rapid rise in thermal plug temperature. At each setting, the mixture strength is adjusted such that a maximum thermal plug temperature is obtained and held for 3 min.

24.1.2 When preignition occurs, the fuel supply is instantly cut off and the supercharge pressure is decreased 2 in Hg (6.7 kPa) at which point the fuel is turned on and again adjusted for maximum thermal plug temperature. This condition should be held for 3 min or until preignition again occurs.

24.1.3 If preignition occurs after Step 24.1.2, the supercharge pressure should be reduced by 1 in Hg (3.37 kPa) again adjusting for optimum thermal temperature until stable engine operation for 3 min is obtained or preignition occurs. If preignition occurs, refer to Step 24.1.5.

24.1.4 If, after Step 24.1.2 stable engine operation is obtained, the supercharge pressure should be increased by 1 in Hg (3.37 kPa), again adjusting for optimum thermal plug temperature until stable engine operation for 3 min is obtained or preignition occurs. If preignition occurs, refer to Step 24.1.5.

24.1.5 Friction torque should be measured at supercharge pressure 1 in Hg (3.37 kPa) below the preignition point (or previous stabilized setting prior to preignition), and within 30 s after the engine ceases to fire.

24.1.6 Rating data may be verified using a plug that has a rating point at least 50 IMEP above the plugs that have been rated.

25. CALCULATION OF IMEP:

$$\text{Indicated HP} = \text{Friction HP} + \text{Brake HP} \qquad \text{(Eq.1)}$$

$$IHP = \frac{2700}{5252} T_F + \frac{2700}{5252} T_B$$

$$IHP = 0.51 (T_F + T_B) = \frac{Plan}{33\ 000}$$

$$0.51 (T_F + T_B) = (0.04)(0.01)P = IMEP$$

$$IMEP = 8.65 (T_F + T_B)$$

T_F - Friction Torque
T_B - Brake Torque

IMEP - Indicated Mean Effective Pressure

The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.