The Engineering Resource For Advancing Mobility®

A Product of the
Cooperative Engineering Program

SAE J604 JAN86

Engine Terminology and Nomenclature — General

SAE Recommended Practice
Reaffirmed January 1986

Submitted for Recognition as an American National Standard

ISSN 0148-7191

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

Not applicable.

APPLICATION:

This Recommended Practice is applicable to all types of reciprocating engines including two-stroke cycle and free piston engines, and was prepared to facilitate clear understanding and promote uniformity in nomenclature.

Modifying adjectives in some cases were omitted for simplicity. However, it is good practice to use adjectives when they add to clarity and understanding.

COMMITTEE COMPOSITION:

DEVELOPED BY THE SAE ENGINE COMMITTEE:

A. W. Carey, Jr., Cummins Eng. Co., Inc., Columbus, IN - Chairman
L. J. Billington, Caterpillar Tractor Co., Peoria, IL - Vice Chairman
J. K. Amdall, Caterpillar Tractor Co., Peoria, IL - Div. Director
S. Jakub, S. R. Jakub Associates, West Hartford, CT - Div. Director
J. Stellar, Hayden, Inc., Corona, CA - Div. Director
J. R. Grady, Borg-Warner Automotive Inc., Troy, MI - Sponsor
N. Alvis, Woodward Governor Co., Ft. Collins, CO
K. Chiku, Toyota Motor Corp., Gardena, CA
W. B. Clemmens, Environmental Protection Agency, Ann Arbor, MI
G. J. Decker, Deere & Co., Waterloo, IA
D. Downs, Ricardo Consulting Engineers plc, Sussex, England
A. S. Foster, Chrysler Corporation, Detroit, MI
R. J. Green, Amer. Motors Corp., Detroit, MI
D. J. Muhlenkamp, Toyota Motor Sales, USA Inc., Torrance, CA
N. D. Postma, Ford Motor Co., Dearborn, MI
R. W. Stachowicz, Dresser Industries, Inc., Waukesha, WI
R. H. Syson, Wedtech Corp., Bronx, NY
P. G. Van de Walker, Onan Corp., Minneapolis, MN
C. D. Wink, Waynesboro, PA

SAE The Engineering Resource For Advancing Mobility®

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

HIGHWAY VEHICLE PRACTICE

Submitted for recognition as an American National Standard

SAE J604

Issued May 1958
Reaffirmed Jan. 1986

Reaffirms J604d

ENGINE TERMINOLOGY AND NOMENCLATURE--GENERAL

1. This SAE Recommended Practice is applicable to all types of reciprocating engines including two-stroke cycle and free piston engines, and was prepared to facilitate clear understanding and promote uniformity in nomenclature.

   Modifying adjectives in some cases were omitted for simplicity. However, it is good practice to use adjectives when they add to clarity and understanding.

2. GEOMETRY TERMINOLOGY:

2.1 Compression Ratio = $\frac{\text{Maximum cylinder volume}}{\text{Minimum cylinder volume}}$

2.2 Valve or Port Areas: Full open areas measured immediately adjacent to the cylinder.

Example: For poppet valves

Area = (π) x (head outer diameter) x (full lift)

Example: For rectangular port in the cylinder wall

Area = (height at cylinder surface) x (width, developed at cylinder surface)

2.3 Valve or Port Timing: Geometric crankshaft positions at which ports or valves open or close.

2.4 Top Center: The geometric crankshaft position at which piston motion reverses direction and the cylinder volume is at, or near, a minimum.

2.5 Bottom Center: The geometric crankshaft position at which piston motion reverses direction and the cylinder volume is at, or near, a maximum.

2.6 Combustion Chamber Surface-to-Volume Ratio[1]: Area of chamber divided by volume at top center. Fig. 1 illustrates the surface area and the volume of a typical combustion chamber. Figs. 2-4 and the following list define the chamber area in detail:

Include:

1. Head cavity area.
2. Head flat or quench area within head gasket outline.
3. Cylinder block top surface area within head gasket outline.
4. Side area of head gasket outline.
5. Valve side areas, including cylindrical side of valve head and that part of the face projecting into the chamber.
6. Valve head surface area.
7. Piston top surface area.
8. Piston top ring land area.
9. Area of top surface of piston ring exposed between top land diameter and cylinder bore diameter.
10. Cylinder bore surface area above top ring.
11. Spark plug cavity area.

Exclude:

1. Area behind top ring.
2. Gasket area inside first bead.
3. Chamfer less than 0.040 in (1 mm).

3. PERFORMANCE TERMINOLOGY:

3.1 Delivery Ratio[2,3] = $\frac{\text{Mass of delivered air}}{\text{Displaced volume x Ambient density}}$

3.2 Delivered Air-Fuel Ratio = $\frac{\text{Mass of delivered air}}{\text{Mass of delivered fuel}}$

3.3 Trapped Air-Fuel Ratio = $\frac{\text{Mass of delivered air retained}}{\text{Mass of delivered fuel retained}}$

[1]A major source of unburned hydrocarbons in the exhaust gas of spark ignition engines is the quenching of the flame by the relatively cold combustion chamber walls. A useful way to compare different engine designs as to their potential for low exhaust emission values is to compare their combustion chamber surface-to-volume ratios.

[2]If scavenging is done with air-fuel mixture (example given, carburetor engine) "mixture" is to be substituted for "air" and "Mixture density at ambient pressure and temperature" is to be substituted for "Ambient density."

[3]When ambient density is unknown, the density of dry air at SAE standard reference atmospheric conditions (0.0719 lbm/ft^3) (1.1517 kg/m^3) is to be used.

3.4 Trapping Efficiency[2] = $\frac{\text{Mass of delivered air retained}}{\text{Mass of delivered air}}$

3.5 Scavenging Efficiency[2] = $\frac{\text{Mass of delivered air retained}}{\text{Mass of trapped cylinder charge}}$

3.6 Purity = $\frac{\text{Mass of air in trapped cylinder charge}}{\text{Mass of trapped cylinder charge}}$

3.7 Relative Charge[3] = $\frac{\text{Mass of trapped cylinder charge}}{\text{Displaced volume x Ambient density}}$

3.8 Charging Efficiency[2,3] = $\frac{\text{Mass of delivered air retained}}{\text{Displaced volume x Ambient density}}$

3.9 Excess Air Factor = $\frac{\text{Trapped air-fuel ratio}}{\text{Stoichiometric ratio}}$

4. NOMENCLATURE - MULTIPLE EXPANSION PISTON ENGINES:

4.1 Compound Engine: An engine in which the output power is delivered by both reciprocating and rotating expanders.

4.2 Reheater: A combustor or heat exchanger wherein heat is added to the working fluid between stages of expansion.

4.3 Afterburner: A combustor in which heat is added to the working fluid after the last expansion stage.

5. VALVE TIMING AND VALVE OVERLAP (POPPET VALVES): Valve timing events are the valve opening and closing points in the operating cycle, while valve overlap describes that part of the cycle in which both the intake and exhaust valves are open. These are illustrated in Fig. 5 and further defined as follows:

5.1 Timing Events are stated in crankshaft degrees from piston top dead center, rounded to the nearest whole degree. They are based on reference valve lift points at a timing point baseline reference as follows:[4]

(a) Hydraulic Lifters - Timing point baseline is at 0.006 in (0.15 mm) valve lift.

(b) Mechanical Lifters - Timing point baseline is at a valve lift of 0.006 in (0.15 mm) plus the specified lash for each valve.

[4]For the purpose of defining valve events, overlap, and crossover points, the valve lift curves are obtained by multiplication of the cam lift values by the nominal valve mechanism lift ratio (for example, rocker arm ratio). In the case of mechanical lifters, the specified lash is subtracted from each valve lift value.

5.2 Valve Overlap Area is specified as two separate overlap areas expressed as deg-in (deg-mm) rounded to the nearest hundredth. Overlap areas are the areas bounded by the exhaust closing valve lift curve, the intake valve life curve and the timing point baseline from TDC to the respective opening or closing event as defined in paragraph 5.1.

5.3 The Crossover Point is defined as the angular crankshaft position at which exhaust closing valve lift and intake opening valve lift are equal.

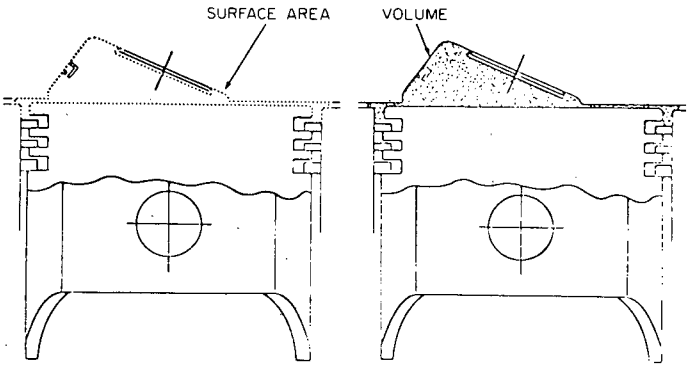

FIG. 1 - TYPICAL COMBUSTION CHAMBER

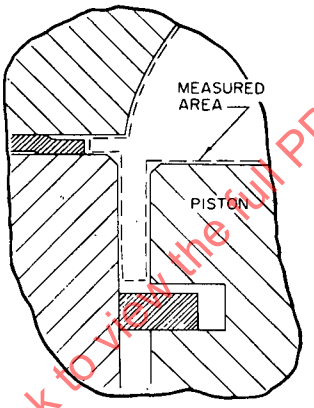

FIG. 2 - HEAD GASKET AND TOP RING LAND AREA

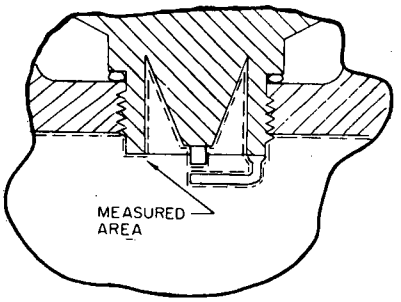

FIG. 3 - SPARK PLUG AREA