PISTON ENGINE PERFORMANCE **4-Stroke** **(File NEWCOPY)**

KEY to ABBREVIATIONS (where these are not defined on the DATABASE)

ROW No.
Identity and Input section

APPROXIMATE INPUT DATA has either Stippled background or is given in *Italics.*
OUTPUT ANALYSIS from such data is therefore also approximate, although not shown as such specifically.

6. &7. Make & Model. These engines have been selected as "Grand Prix Car-of-the Year". In later years, if the Drivers' Championship car differed from the Constructors', both are included, the Constructors' 2nd in that year.
Abreviations used:- Merc = Mercedes (or Mercedes-Benz after 1926); Dues = Duesenberg;
Alfa = Alfa Romeo; Climax = Coventry Climax; Offie/MD = Meyer-Drake (Offenhauser);
S & N = Sizaire & Naudin.

9. Induction System
NA = Normally Aspirated
PC = Pressure Charged
SNA = Sub-Normal Aspiration (with Inlet Restrictor)

10.

Class		Use	Life between Overhauls
RR	Racing	Track	Few Hours
RS	Racing-Sports	Track	Many Hours
S	Sports	Road	Few Years
T	Touring	Road	Many Years
TA		Aero	Many Hours

12. Configuration
Conventional notation i.e. IL = In Line; V = Vee; F = Flat; W, X, H according to shape of cylinder banks; R = Radial; prefixed by Bank Included Angle in Degrees.
All engines are WATER-COOLED, unless specified as AC = AIR-COOLED.

15. Inlet & Exhaust Configuration

C/ = Carburetter	/SS = Same Side Inlet & Exhaust
FI/ = Fuel Injection	/CF = Cross-Flow
	/AIF = Axial Inflow
	/SI = Some ports Siamesed

RSC = Roots-type Supercharger (2RSC = 2-Stage in series)
VSC = Vane-type Supercharger (egs Zoller, Powerplus, Shorrock, Cozette)
CSC = Centrifugal Supercharger (2CSC = 2-Stage in series)
TC = Turbocharger

16. Combustion Chamber & Piston Configurations

	Squish: Without	With	/	Piston-Crown Shape	
Side-Valve	SV/	SVS/	/	Flat-Top	/F
Bath-Tub	BT/	BTS/	/	Low -Hump	/LH
Cylindrical	CY		/	Medium Hump	/MH
Inlet-over-Exhaust	IOE	IOES	/		
Wedge		WS/	/	High Hump	/HH
Bowl-In-Piston		BPS/			
Hemisherical	H/	HS/			
Pent-Roof	PR/	PRS/			

"Negative Squish" /NS
(Where Combustion Chamber is wider than Cylinder Bore)

20. Valve Opening & Return System

	Opening		Return
	Side-Valve	SV	/All Systems are Steel
	PushRod Overhead	PR or PROHV	/Coil Springs (CVRS)
Per	(Single Overhead Camshaft	SOHC	/unless otherwise
Bank	(Double Overhead Camshaft	DOHC or DC	/specified as:-
	Desmodromic	DESMO	/H = Steel Hairpin Spring
			/P = Pneumatic

/T = Titanium-alloy Valves

27 - 30 Valve Timing (Given as far as possible at Valve Off/On cam at cold operating clearance)
Conventional notation Before and After Top & Bottom Dead Centres, Crank Degrees.
Negative for Inlet = Opening after TDC.

38. Piston Height PH
Maximum dimension from crown top to skirt bottom.
39. Piston Skirt Length PSL
Includes only rubbing dimension to skirt bottom.
40. Equivalent PSL EPSL
PSL adjusted for any cut-away portion of skirt to give same rubbing area as simple cylindrical piston of skirt length EPSL.

42. Fuel Type / Reference No. in Appendix 2
Petrol ("Gasoline") = P; Benzole = B; Special ("Un-Real") Petrol = S.
Ethanol = E; Methanol = M; Nitro-Methane = NM
43. Fuel Adjustment to Petrol AA
AA = 1.12, used as a divisor when Alcohol content of fuel is above 25%.
This value was derived from FORD tests on 1963-64 Indy 4.2 Litre engines at constant R = 12.5, backed up by other tests with variable R from which the effect of latter was deducted by use of the Air Standard Eficiency adjustment (DASO 54 & 55).

44. **IVP** = Pressure at Inlet Valve. ATA = Atmospheres Absolute (1 Standard Atmosphere = 14.7 psi).

45. **Manifold Density Ratio** = *Estimated* adjustment of IVP to allow for temperature rise in Pressure-Charging, depending on *efficiency of compression, effect of fuel evaporation* and *any charge aftercooling*.
MDR is relative to Standard Atmosphere (15^0C & 14.7 psi). NA is taken as 1. See Note 10B for method.
46. Code
The Code allows qualitative assessment of designs for features where geometric data is lacking, especially for Inlet & Exhaust Systems.

47. Induction Code

	Grand Prix Car of Year	Other
Normally-Aspirated (NA)	A	D
Mechanically-Driven PC (MSC)	B	E
Turbocharged PC (TC)	C	F
Not to be Included	X	

2nd letter of Code:- **T** = Units with Tortuous Inlets & Simple Exhausts (All B are T)
I = Units with Individual & Tuned Inlets & Exhausts (All C are I)
This is a shorthand way of assessing an engine's Inlet & Exhaust systems, which takes the place of the more detailed code referred to at 46.

Geometric Analysis

55. **PA** = Total Piston Area cm^2
57. **V** = Swept Volume cc
58. **IVA = Total Inlet Valve Head Area = (CN x VNI x Pi x $(IVD)^2$)/400** cm^2
61. **ISA = Total Maximum Inlet Valve Skirt Area = (CN x VNI x Pi x IVD x IVL)/100** cm^2

Performance Analysis

73. **MPS = Mean Piston Speed = (2 x S x N)/60,000** m/s
At N = NP, MPS = MPSP; at N = NT, MPS = MPST.

74. **BMPP** = **Brake Mean Effective Pressure @ Peak (or Rated) Power** Bar

76. **BMTP** = " " " " " " **Torque** Bar

79 & 82. **BMPA**, **BMTA** are values of BMPP, BMTP Adjusted to:- R = 12 (by RA, see Row 77)
and Petrol (by 1/AA, see Row 43)
1 Bar = 10^5 Newtons per Square Metre = 14.503 psi.

94 & 95. **MGVP** = **Mean Gas Velocity @ NP** based on Inlet Valve Head Area, IVA and *assuming* incompressible flow;
(**MSVP** = same based on maximum Skirt area).

97.. **MVSP** = **Mean Valve Speed @ NP, analogous to MPS**

98 & 99. **MPD** = **Maximum Piston Deceleration** (@ TDC) in "g". 1 g = 9.807 m/sec^2 = 32.17 ft/sec^2.

100. **PSF =PISTON STRESS FUNCTION = $(PH)(S)(NP)^2/(B)^{0.5}$** See Note 13 Part I

102 & 103. **KF1, KF2** Values of coefficients used in the ***estimating*** relation for
Friction + Pumping Mean Effective Pressure
= FPMEP = KF1 + KF2 x N x $(MPS)^2$ Bar See Note 99

104. **EIMPA = *Estimated* Indicated Mean Effective Pressure, adjusted to R = 12 and Petrol**
(BMPP + FPMEP) x RA/AA Bar

105. **EEM** = ***Estimated*** **Mechanical Efficiency** = BMPA/EIMPA*

107. **SPPA = $EIMPA/(MDR*(MPSP)^{0.5})$**

109 **SPPB = SPPA - $(R x VIA)/500 + (R x VIA)^2/500,000$**

110. **SPPC = SPPB - 0.35 x Sin(((CRL/S) - 1.875) x (Pi/1.25))** (Sine expressed in radians)

111. **Delta % = $100(SPPC/(3 x (B/PH)^{1/3}) - 1)$**
(Note that B/EPSL should be used in place of B/PH, but full EPSL data is not yet available)

113. **EBMTA** = ***Estimated*** **BMTA = $4.7 + 0.36(BMPA)^{1.27}$** Bar

114. **Delta EBMTA** % = 100((BMTA/EBMTA) - 1)

117. **SCF** is defined in **DST 27 January 2000** (see Note 12). It is a way of ***estimating*** **NP** from a number of geometrical factors
available at the pre-drawing stage of design, based on statistical analysis of actual engines.

126. **RFW = $(CN)^{1/6}$ x (S/B) x (V/1000**) adjusted Litres.

---

* **EEM** does not include the adjustment necessary on **Pressure Charged (PC)** engines for the net effect of:-
(Mechanical Power or Pneumatic Power (via turbine) to drive compressor)
minus
(Pneumatic Power Recovery in cylinders during inlet stroke).

For **Mechanically Supercharged (MSC)** units this adjustment **lowers EM**;
for **TurboCharged (TC)** units it **raises EM** (but this diminishes as IVP is raised, see Note 89).