

A Short Glossary of abbreviations is attached at P.4 as an aid to following the text.

A full Glossary is given as a [Key to Appendix 1](#).



From 1906 to 2000 “GP Car-of-the-Year” (CoY) Peak Power (PP) rose from 90HP to a peak for a single Qualification lap of 1200HP in 1986 with TC. Thereafter rule revisions detailed in [Table 1](#) dropped power substantially, but then further development especially to higher RPM raised power to almost 800HP by the end of this review. The CoY powers across the years are illustrated on Fig. O1, showing the design eras, and the associated engine Basic Dry Weights (W) and Power/Weight ratios (PP/W) are given on Figs. O2 and O3 (details in [Appendix 1](#)).

The year 2000 PP/W was an all-time high in the review period for NA at 7.5 HP/kg (5.6 kW/kg), having been multiplied about 29 times since 1906 (see also [Note 7](#) referring back to an 1889 ratio of 0.025 HP/kg, the date when Daimler built his first specific automobile engine). The improvement of NA 3.5 Litre and 3 Litre engines since 1989 is particularly remarkable – this was a consequence of the greater development funds available, as mentioned in the [Introduction](#) (also see [Note 113](#)).

The way in which engine development has progressed under the most popular rule, of specified Swept Volume (V), is shown as PP/V ratio on Fig. O4. The advantages under that rule of MSC and especially TC are very clear (although the latter examples do not include the weight of the intercooler(s) necessary to enable those engines to run on petrol).

Addition of BMW 2005 P85 (September 2013)

The 2005 BMW prototype engine P85 has been added to the Figures (with firm official data, see [Note 112](#) from (1095*)), although not raced, because it was the last Grand Prix engine to be built before the FIA greatly extended their drive to remove the competitive element from engine technology by ever-more-detailed limits in the rules. Actually, BMW did not carry on with the P85 because of a sudden FIA demand that engine life should be doubled. It therefore represents the end of Grand Prix philosophy as it had been understood since 1906.

The effect of the FIA approach to technology since 2000 is shown by the BMW estimate that an engine to the 2006 V8 2.4L Formula could have been built at a weight of 69 kg where the FIA had imposed a minimum weight of 95 kg, i.e. 38% heavier (1095). A rule for 2006 specifying 4 poppet valves per cylinder had already killed a major and successful Ilmor programme which was developing the Bishop rotary valve (see “[How many valves per cylinder](#)” at P.2).

The FIA 2014 Formula has taken a further step towards a common engine (leaving aside auxiliary systems) by carrying prescribed details down to the diameter of the valve stems.

* DASO1095. *Ten Years of BMW F1 Engines*. Paper by Prof. Dr-Ing. Mario Theissen et al. 2010.

Figures O1 to O4

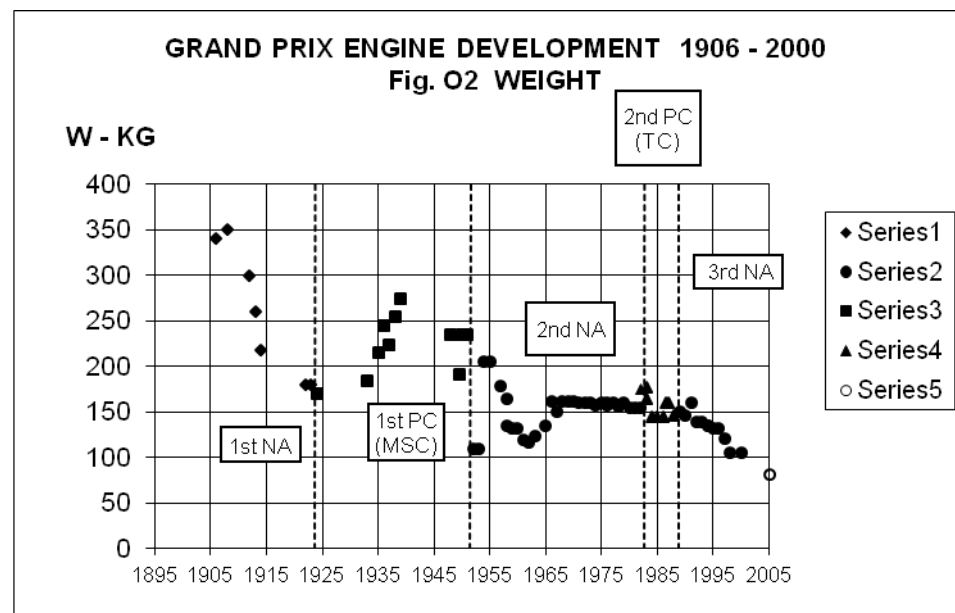
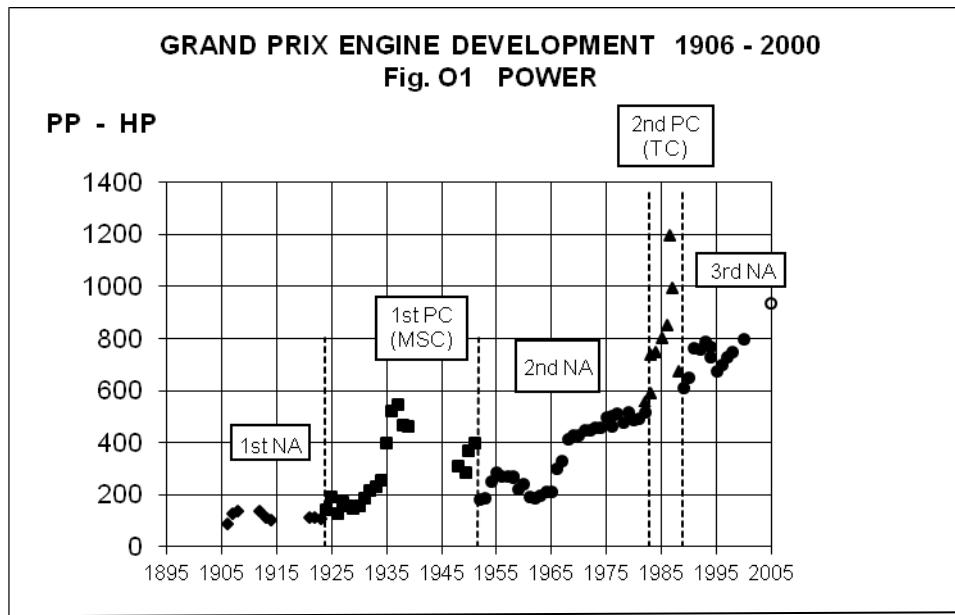
The following key applies to all Figures:-

Grand Prix “Car-of-the-Year” (CoY)

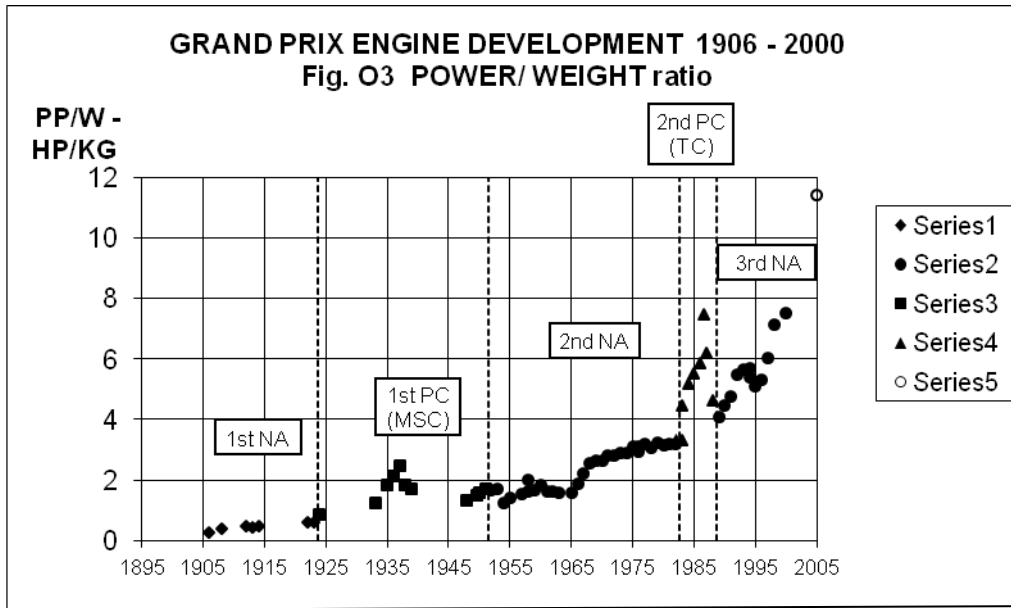
<u>Era</u>	<u>Series</u>	
1 NA	1	Naturally-Aspirated (NA), with Tortuous Inlets & Simple Exhausts (T)
2 & 3 NA	2	NA, with Individual & Tuned Inlets & Exhausts (I)
1 PC	3	Pressure-Charged (PC), by means of Mechanical SuperCharger (MSC)
2 PC	4	PC, by means of TurboCharger (TC)
	5	NA(I), 2005 BMW P85 (not CoY)

Engine Locations:- Front-Mounted until end 1958 (except 1936, Mid-Mounted);
Mid-Mounted in 1959 and onward.

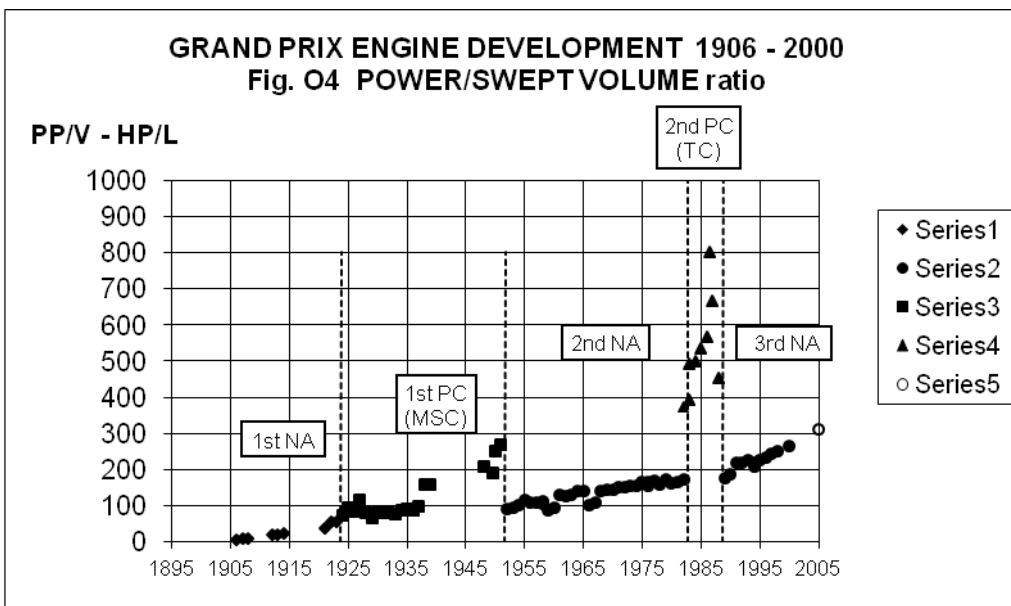
Chassis:- Aerodynamic downforce in 1968 and onward.



Figs.O3 and O4 are shown on P.3.



Note the remarkable PP/W ratio for the 2005 BMW P85, at 11.4 HP/kg.



SHORT GLOSSARY of Abbreviations

This is given here as an aid to following the text. A full Glossary is given with [Appendix 1](#).

	<u>Appendix 1 Line No.</u>
B = Bore mm ; S = Stroke mm ; V = Total Swept Volume cc (or L).	18,19,57.
VIA = Included Angle between Valve stems if OHV (see below) Degrees .	23
R = Compression Ratio (volumetric).	17
PA = Total Piston Area sq. cm .	55
IVD = Inlet Valve Head Diameter mm .	24
IVA = Total Inlet Valve-Head Area sq. cm .	58
CRL = Connecting-Rod Length between centres mm .	37
OHV = Overhead Valves (PR = Push-Rod actuated).	
OHC = Overhead Camshaft (per bank if Vee or Flat configuration); S = Single; D = Double.	
NA = Normally Aspirated.	
PC = Pressure Charged; MSC = Mechanically Supercharged; TC = TurboCharged.	
IVP = Inlet Charge Pressure at inlet valve ATA (Atmospheres Absolute) (1 ATA = 14.696 psi).	44
MDR = Manifold Density Ratio, relative to ambient density at Standard Temperature and Pressure (15°C & 14.696 psi).	45
PP = Peak Power* HP (BHP wherever this is certain, dividing known CV or PS by 1.01387).	49
NP = Crank rotational speed @ PP RPM .	50
* May unknowingly be a Rated Power @ Rated RPM below NP. Where known shown as PR @ NR.	
TP = Peak Torque lb ft	51
NT = Crank rotational speed @ TP RPM .	52
BMPP = Brake Mean Effective Pressure (BMEP) at PP Bar (1 Bar = 10 ⁵ Newtons/sq, cm = 14.503 psi)	74
BMPA = BMPP Adjusted to R = 12 by Air Standard Efficiency ratio and to Petrol if fuel is largely Alcohol by dividing by 1.12 for NA only (when MSC alcohol adjustment is within MDR calculation). Bar	79
BMTP = BMEP at NT Bar	76
BMTA = BMTP adjusted as for BMPP to BMPA Bar .	82
MPSP = Mean Piston Speed @ NP metres/sec = (2 x S x NP)/60,000 (m/s x 196.85 = ft/min).	73
BNP = Bore Speed @ NP m/s = (B x NP)/60,000	96
MVSP = Mean Valve Speed @ NP m/s = (IVL x NP)/(IOD x 83.333) IVL = Inlet Valve Maximum Lift mm IOD = Inlet Valve Open Duration off/on seat Crank Degrees .	97
MGVP = Mean Gas Velocity @ NP m/s = (PA/IVA) x MPSP	94
MPDP = Maximum Piston Deceleration @ NP g .	99
W = Weight (Basic Dry, excluding exhaust system; also excludes intercoolers for TC) (other definitions vary) kg .	124