

## GRAND PRIX ENGINE DEVELOPMENT, 1906 – 2000



### INTRODUCTION

#### The stimulus for Grand Prix racing

Grand Prix racing in the review period, 1906 – 2000, was the pre-eminent automobile competition. Its stimulus was a mixture of:-

- Sport;
- Indirect Profit from Advertising of the Technical Merit of car manufacturers;
- and, more recently, Direct Profit to the race series organisers and the competing teams.

This review describes the technology of the engines from 1906 up to 2000, noting that the funds for their development were provided mainly to attain Advertising objectives – corporate brand enhancement or, in some years, National prestige. The latter included personal surrogate efforts for the United Kingdom by the original BRM consortium and then Alfred Owen (BRM owner post-1952) and Tony Vandervell (Thinwall and Vanwall). Leonard Lee combined UK prestige with brand Advertising for Coventry Climax engines. Probably Enzo Ferrari, after he founded his own company, was unique in spending the money he made from road cars to fund his racing cars purely for love of the Sport. Perhaps Ettore Bugatti was also primarily interested in the Sport but also made a profit from selling some 400 Type 35 variants. The first firm ever to make a steady profit from Grand Prix engine-building must have been Cosworth, founded in 1958 on the genius of Keith Duckworth in partnership with Michael Costin. Their example and profit was followed eventually by their ex-employees Mario Illien and the late Paul Morgan who founded Ilmor jointly in 1984.

With expanded TV coverage the incentive to spend money on Advertisement by both motor and non-motor industries, via sponsorship of racing teams or by buying broadcasting time interpolated into race coverage, boosted the development funds available many-fold over the last 3 decades of the review period. The ultimate payers are, of course, the enormous world-wide TV audience as they buy the products advertised.

#### The motivation of the technical staff

Whatever the motives of the “Movers and Shakers” of the Grand Prix world, it is probable that most of the people engaged in the technical activity were and are doing it for the competitive challenge to their skills at the highest engineering level. Even now, with the increased funding mentioned above, the financial rewards relative to the effort and ingenuity demanded, compared to the career risks involved in having competence tested publically so often, are not enough to attract those unmotivated by that consideration.

#### The first Grand Prix

The first closed-circuit “Grand Prix” was that run by the Automobile Club of France (ACF) in June 1906. This took the place of the 1900 – 1905 Gordon Bennett Cup International series of races because that only allowed one team from each Nation to compete and the then-strong French car industry wished to enter more teams.

This Grand Prix was run 21 years after Gottlieb Daimler’s Maybach-designed 1-cylinder 0.5 HP engine first powered a stabilised cycle (1885) and 11 years after the first internal-combustion motor race in 1895 was won (in effect) by a 2-cylinder 4 HP Panhard-Levassor whose engine was also a Daimler-Maybach design.

#### The development of “Grandes Epreuves”

Other countries gradually introduced their own National motor races of similar calibre to the French GP, agreeing to common technical rules for a season or longer. Although many minor races took the “Grand Prix” label over the years this review is concerned with the major or

“classic” events which used to be known as “Les Grandes Epreuves”. It confines itself to the most successful car in each year – the “Grand Prix Car-of-the-Year”, henceforth abbreviated to “CoY”. The method of selection of the CoY is explained in the sidebar under the heading “[The General Design of Racing Piston Engines](#)”.

### The Championships

In 1950 a World Drivers’ Championship was inaugurated for Grand Prix racing (“Formula 1”), based on a scale of points awarded over a season’s races. This was supplemented in 1958 by a Constructors’ Championship. The schedule of point-scoring events was expanded steadily in the search for more Direct Profit from 6 in 1950 to 11 in 1970 and to 17 in 2000.

### Scope of the Review

This review covers 78 years of actual Grand Prix racing in the 95 calendar years 1906 – 2000. The interruptions were due:- in 1909 – 1911 to economic recession aggravated by French chagrin at losing two previous races to foreign cars; in 1915 – 1920 and 1940 - 1947 to the two World Wars and their aftermaths.

With the 7 occasions in which the Constructors’ title was won by a car powered by a different engine from that which powered the Champion Driver, which engine is also counted in the review, this gives a total of 85 engine examples. These are discussed generally and individually as the machines which passed best the test of “Speed-with-Reliability”.

The designers’ objectives for their engines:-

To “Breathe, Burn and Turn” more efficiently overall than the competition –  
and *keep on Turning* for the length of the race!

### Engine-design identification

In the later review period 3 CoY engines were launched financially by companies who did not design them but naturally wished their names to appear on the end-product for their advertising benefit. These 3 were:-

Ford (Cosworth DFV);  
TAG (Porsche P01);  
Mercedes-Benz (Ilmor FO110).

This review uses the design company’s name in referring to the engines.

### Systems of Units

Unless otherwise stated all units are SI, that is, linear dimensions are in “mm”\*, all volumetric are “cc” and all weights are “kg” *but* the author preferred to retain Powers as “HP” (see attached **Note A**) and Torques as “lb. wt. ft.”. Crank speeds are “RPM”, linear speeds are metres/second (**m/s**) and pressures in **Bar** ( $10^5$  Newtons per square metre = 14.503 lb.wt per square inch).

Approximate basic figures are given in *italics* (or sometime in Appendix 1 with a stippled background) but this convention is *not* carried through to analyses.

When prices are given the money value of the year is also shown adjusted to average 2013 level using the General Index of Retail Prices.

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\*This sometimes leads to silly-looking figures because the original design was in inches, often to Anglo-Saxon fractions.

### Note A

#### Power (HP and accuracy)

Output in this review is quoted in Horsepower (HP) rather than converted into SI Kilowatts (even although the SI unit is a compliment to the man who conceived the measurement method!). Torque is in lb.wt.ft. not Newton Metres. This choice was made because it is believed that most readers in English, like the author, will be more at home with the historical units.

The engine test methods can be considered as “SAE-standard”, i.e.:-

- Unobstructed and unheated inlet (no air cleaner);
- No dynamo or alternator;

- No engine fan (unless air-cooled);
- No exhaust silencer (no GP car engine has been silenced);
- Ignition and mixture adjusted to optimum at each speed.

Although every care has been taken to obtain correct data no distinction has been drawn generally in the text between British “Brake Horsepower” (BHP) and the 1.4% smaller Continental Horsepower [4,500 metre.kg/min = French *Cheval Vapeur* (CV) = Italian *Cavallino Vapori* (CV) = German *PferdStarke* (PS)]. This is because it is certain that the figures quoted by many makers over the years are nowhere near that accuracy

On the other hand some makers have given trustworthy figures in kW, CV or PS where a reliable conversion to BHP *can* be made and that has been done.

Apart from variation in test-bed equipment and methods (steady settled conditions or “flash”) there are good reasons why accuracy is uncertain:-racing engines are modified continuously and published specifications and powers may not always be consistent; some nominally-identical units are better than others for undiscovered reasons; tests are brief because parts lives are short; few test engines are available; and, to cap it all, the competition must be misled – no-one expects racing data to be given under oath! There are particular examples where there is good evidence that quoted powers were as much as 10% optimistic and these are described in [Note 5](#) (Delage) and [Note 6](#) (Maserati).

Getting correct the broad sweep of power across the years is the effect at which the author has aimed.

#### “Rated” power

A special point about power is that it has sometimes *not* been the “natural peak” value (as defined in [Note 11](#)) but some lower figure because engine speed has been limited mechanically or thermally, i.e. the engine has been “Rated” so as to achieve a desired life. Precise details of such Rated powers are rarely available.

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