Note 136

FERRARI Racing Engines, 1948 – 2012

Ferrari have built more racing engines than anyone else. It was thought that visitors would be interested in charts showing the underlying performance parameters over 65 years of all the units, not just the ones selected for the Car-of-the-Year and described in detail in the main text. These parameters have been derived from the basic data in the 2012 Edition of ***Ferrari; All the cars*** by L. Acerbi (published in England by Haynes).

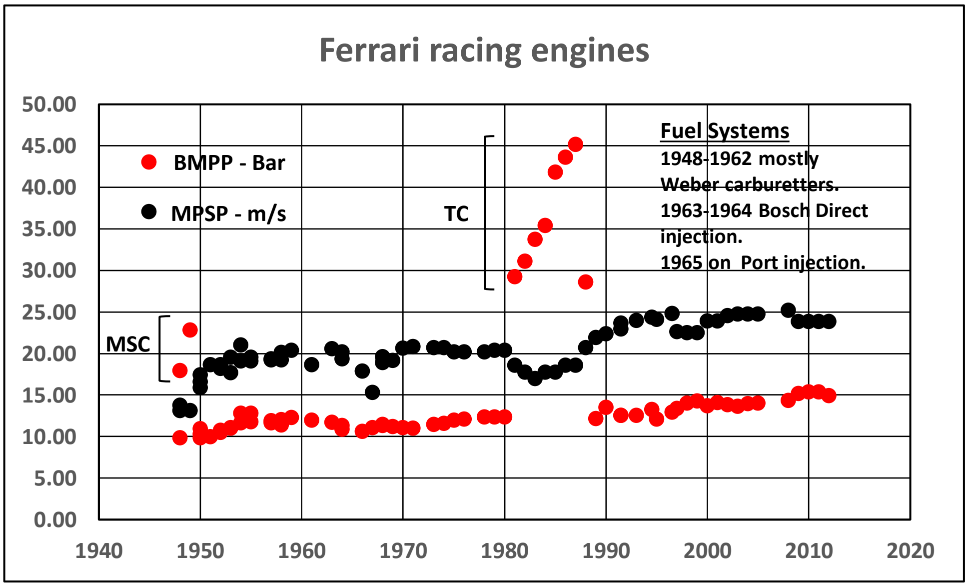
The data may not be entirely the same as already written in the main text or in Appendix 1, but it is retained for its own consistency.

While many designers have worked for Ferrari the standard of the detail drawings needed for manufacture and the testing methods will have been the same throughout. The Ferrari data therefore provides an opportunity to calculate a very long series of parameters with a minimum of stray variables. In particular the mechanical limits described in Note 13 (**MPSP**, **BNP** and **MPDP**) have been examined.

It has not been possible to carry the charts past 2012.

All powers in CV have been converted into (B)HP.

Brake Mean Effective Pressure at Peak Power (**BMPP**) and Mean Piston Speed at Peak Power (**MPSP**)
_Fig. 1 provides these parameters v. date.



Comments on BMPP.

- The higher values in 1948-49 are for the two 125 types of Mechanically-Supercharged (MSC) 1.5L V12 engines raced then:- SOHC, single Roots blower; and the later redesign with DOHC and two-stage supercharging.
- The 1981 -1988 points are for the 126 series Turbo-Charged (TC) 1.5L V6s, rising to the rule-limited inlet pressure of 4 Bar absolute in 1987, then dropping to the rule of 2.5 Bar imposed in 1988.

Comments on MPSP.

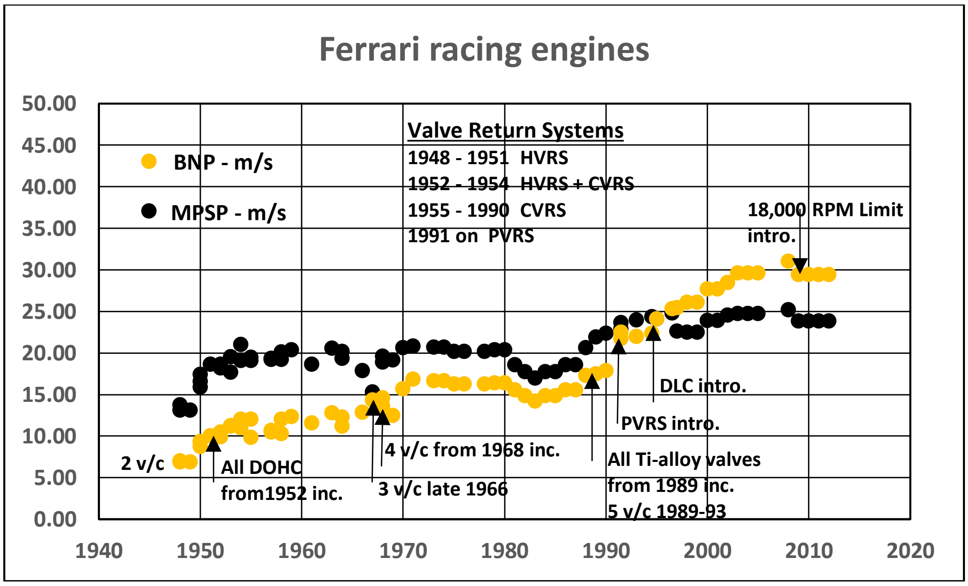
- The original type 125 engines were characterised by exceptionally-low MSP. The parameter was quickly raised to about 20 m/s (about 4,000 Ft/Min) which was the well-known limit in the UK for many years post-WW2.
- The low figures for 1966-67 were production-based F2 engines.

- The droop during the TC years was due to the higher piston temperatures, although they were cooled.
- By 2000 the new limit of MPSP was 25 m/s, a result of better materials and reduced-mass pistons (Piston Height (PH)/Bore (B) steadily reduced – see the illustrations in Note 13 Part I and also Note 13 Part I Sub-note A).

Bore Speed (**BNP**), surrogate for Mean Valve Speed (MVSP)

The usefulness of BNP as a surrogate for MVS is explained in Note 13 Part III. It is needed in the absence from the source of Valve Lift and Inlet Opening Duration.

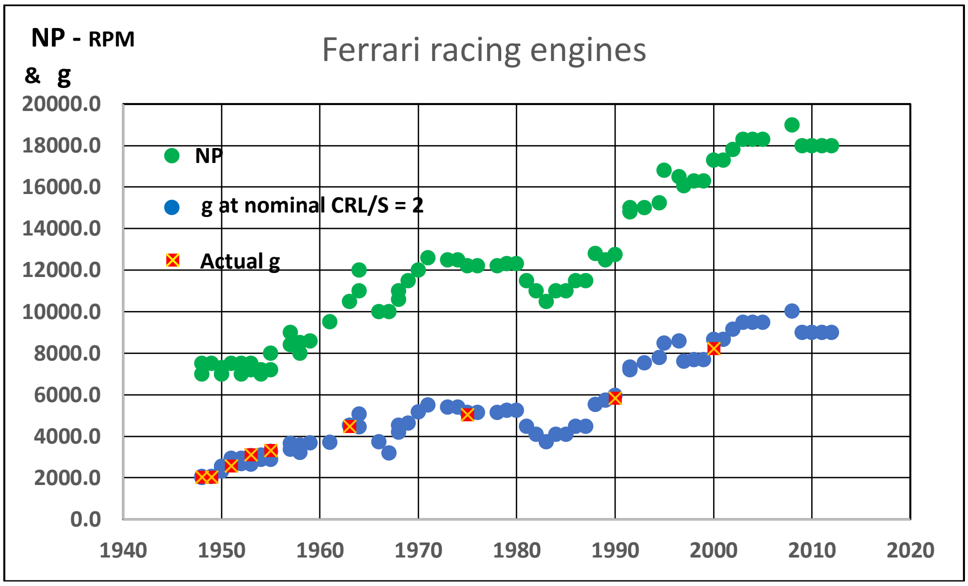
Fig.2 below shows the variation of BNP, marked for the introduction of major improvements to permit increases in Bore/Stroke (B/S) ratio for higher RPM and therefore Higher Power at a given MPSP. Not shown, because the date in the late-'60s is uncertain, was the important adoption of interference fit of dual coil springs to damp surge. This chart is a useful complement to Note 15 (which defines and illustrates the Valve Return Systems **HVRS, CVRS and PVRS**).



Maximum Piston Deceleration (**MPDP**)

Fig. 3 on P.3 below provides NP and MPDP, the latter calculated for a nominal CRL/S ratio of 2, since the Connecting-rod Length (CRL) is not given in the source. Where the actual value is known (CRL/S is listed below on P.4) the correct MPDP is added. The biggest difference is only -5% for the 2000 type 049.

Continued on P.3



Comments on NP

- The early SOHC Ferraris were limited in NP by Siamesed inlet ports giving poor breathing (see Note 47).
- The FIA limited RPM to a maximum of 19,000 in 2007 and further to 18,000 in 2009. Apart from cost considerations this was partially to help achieve the longer engine lives demanded.

Comments on MPDP

- At least below 10,000 RPM the avoidance of piston-ring flutter, which leads to broken rings, excessive blow-by of combustion gases and loss of oil overboard – even fires when the oil is ignited by the exhaust – depends on not exceeding the factor

  Ring Axial Width (w) x MPDP = 4,000 mm.g for cast-iron rings;
  (the factor is inversely variable with ring density).

  This is discussed in Note 13 Part II. This Note also shows in Postscript 2 that engines *could* run at RPM with a factor exceeding the figure above when (to put it simply) there was "not time for the rings to flutter". However, in Note 13 Part I Sub-note A it was reported that a ring of only 0.475 mm (0.019''!) had been produced for the 2003 Cosworth type TJ which enabled it to reach around 4,600 mm.g. If this ring was available to the Ferrari 2000 type 049 reaching actual MPDP = 8,217g the factor would have been just under the flutter onset quoted above (3,900 mm.g).

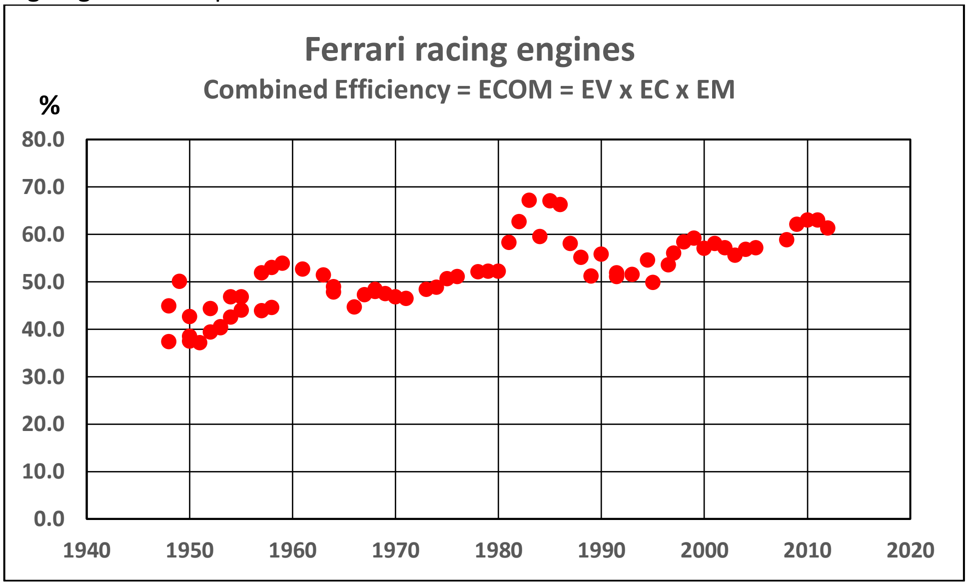
  Other methods of avoiding piston-ring flutter, other than by thinner rings, were developed by Honda over 2000 – 2008. These are described in CORRECTIONS & ADDITIONS P.10 30 October 2015. Ultimately they used Ti-alloy rings, the density being only 60% of steel. It is not known whether Ferrari used such methods in later years.

  [With the narrowly-prescriptive FIA rules from 2014 the ring flutter problem has gone away. At an overspeed RPM seen on TV of 12,500 and a Stroke of 53 mm the max. MPD is only 5554g so that an easily-made ring of 0.72 mm (0.028'') can cope.]

Continued on P.4

Combined Efficiency (ECOM = EV x EC x EM)

The definition of ECOM is given in Analysis UPDATE Part 2 at PP 9/10. Fig.4 shows it for 65 years of Ferrari racing engine development.



Comments on ECOM.

- The source did not provide Inlet Valve Pressure, so this has been provided (where required) from elsewhere.
- The high values for the two early MSC engines are presumably due to high mechanical efficiency from the exceptionally-low MPSP.
- TurboCharging provides the above-trend gain in the '80s..

Ferrari engine sections

References and links to Ferrari engine sections and drawings in this website are given below.

Date	Type	Link	CRL/S
1948	125/GPC	Represented by:	
		ILLUSTRATIONS for Appendix 5 Part 1 P.10	2.1
1949	125/GPC/49	1st Pressure-Charged Era (1PC) Part 2 P.7	2.1
1951	375	1st Pressure-Charged Era (1PC) Part 2 PP10/11	1.91
1953	500	2nd Naturally-Aspirated era (2NA) Part 1 P.3	1.82
		also:- CORRECTIONS & ADDITIONS P.15 18 Nov. 2015	
1956	D50	Represented by:-	
		2nd Naturally-Aspirated Era (2NA) Part 1 P.11	1.85
1963	156/120^0	Represented by:-	
		CORRECTIONS & ADDITIONS P.4 Sept. 2015	2.14
1964	158	"Reverse engineered" in	
		2nd Naturally-Aspirated Era (2NA) Part 3 P.19	
1975	312B	Represented by:-	
		2nd Naturally-Aspirated Era (2NA) Part 4 P.8	2.26
1990	037	Note 122	2.23
2000	049	3rd Naturally-Aspirated Era (3NA) Eg 85 P.6	2.68

Data Tables

The basic data and the analyses are available in Appendix 11 Ferrari.