

The Sporting Limits



Grand Prix racing has always been run to rules set, in the first place by the French and then by International, motor-sporting authorities. Where these rules controlled engine design a Summary is given on TABLE 1. This also lists race distances since these affect the stresses which can be accepted. Distances have been reduced drastically over the years, the 2000 standard being only $\frac{1}{4}$ of 1906.

As can be seen from TABLE 1, many approaches have been tried in engine regulations, not only to produce fair competition but also occasionally to improve efficiency. Several times attempts have been made to slow GP cars down and once to speed them up (the 1966 formula). Sometimes the object was to limit the expense.

The period 1906 – 1913 was one of experimentation with rule types but in 1914 the simplest was adopted, that of a fixed Swept Volume (V). Despite its physical incentive to produce expensive multi-cylinder engines (which will be explained later in this review) this type of rule has remained the most popular, used for 63 out of 78 years (81%). Designers soon outflanked it by using Pressure-Charging (PC), effective for the “GP Car-of the Year” in 1924 and not taken into account by the rules until 1938. Then various ways were adopted to limit PC effect, usually by specifying a smaller V for PC units than for Normally-Aspirated (NA) engines. In the most recent mixed PC and NA formulae, there were limits on PC inlet pressures and on total fuel quantity for the race. Currently PC is banned. Also, bearing in mind the physical incentive mentioned above, cylinder numbers (CN) were then limited to 10 (after 2000; from 1966 the limit had been 12).

Gas Turbines (GT) were permitted to compete against the usual reciprocating engines over 1966 – 1971, with restrictions on internal flow area intended to create power equality with the then-current NA $V = 3$ Litre piston engines. Only Lotus built such a car for 1971, using a Pratt & Whitney turbine adapted from an aircraft unit (which, at different flow areas, had also powered cars raced at Indianapolis in 1967 and 1968 and had only failed to win those two 500 mile high-speed oval track races because of minor faults). The Lotus did not win a GP. The Doppler effect on a high-revving piston engine exhaust, preferably *not* muffled by a Turbo-Charger, is one of the principal “circus” attractions of a motor-race and, of course, was absent from the GT and may have affected its banning from 1971! Grand Prix engine exhausts have always been free, without silencing.

Wankel engines were also allowed 1966 – 1970, with an equivalent-power capacity ratio, but none was ever built for GP racing.

GRAND PRIX ENGINE DEVELOPMENT, 1906-2000

MAJOR RULES CONTROLLING ENGINE DESIGN

Key to TABLE 1.

Maxima applying to the following parameters:-

V = Total Swept Volume (Litres).

W = Car Weight (kg).

FQ = Fuel Quantity:- Litres per 100 km before 1931 (but see Note 4);

After 1983, Total Litres.

FT = Fuel Type (see detailed Notes).

PC = Pressure-Charged at IVP = Absolute Pressure before Inlet Valve (Bar), when limited.

Engines otherwise Normally Aspirated (NA).

PA = Total Piston Area (square cm).

CN = Cylinder Number.

0 = No engine control rules.

YEAR	x	V		W	FQ	FT	IVP	PA	CN	0
1906	1239			1000	n.1					
1907	768				30					
1908	768							755		
No GP 09/11										
1912	1539									0
1913	911				20					
1914	752	4.5		n.2						
WW1										
1921	518	3								
1922-25	798-999	2								
1926-27	509-600	1.5								
1928	600			750	n.3					
1929	605			n.4	14Kg	P				
1930	600			n.5	."	P/B	70/30			
1931-33	10H&5H & 500									0
1934-37	500			750						
		NA	PC							
1938-39	500	4.5	3							
WW2										
1948-51	290-604	4.5	1.5							
1952-53	377-508	2	0.5	n.6						
1954-57	314-508	2.5	0.75							
1958-60	3-500/2H	."				AG	100/	130	n.7	
1961-65	."	1.5NA				P	102	RON	n.8	
1966-83	300/2H	3	1.5			."	n.9	1972	12	
1984-85	."	."			220	."			."	
1986	."	1.5PC			195	."			."	
1987	."	3.5	1.5		195	."	4	n.10	."	
1988	."	."		PC	150	."	2.5		."	
1989-94	."	3.5NA		n.11		P	n.12		."	
1995-2000	."	3NA		n.13		."			."	

NOTES:-

x = Race Distance (km). Up to 1934 are for French GP. H = Hours alternative if this occurred before minimum distance.

n.1:-Same as Gordon Bennett Cup rule, 1902-05, which allowed +7kg if a magneto was fitted.

n.2:-One source states that Superchargers and Alcohol Fuel were banned in 1914 rules.

n.3:-Only Italian GP was run to these rules; other GP races were *Formule Libre* (i.e.any car).

n.4:-P = "Pump" petrol, i.e., as sold to public. Combined Petrol & Oil limit was 14kg/100km. Only French & Spanish GPs were run to these rules; other GP races were *Formule Libre*.

n.5:-P/B = 70% Pump petrol/30% Benzole. Only Belgian GP was run to these rules; other GP races were *Formule Libre*.

n.6:-Formula 2 was adopted for major GPs, after Alfa-Romeo withdrew at end 1951.

n.7:-AG. Regulation fuel was Petrol to AvGas100Octane/130 Performance No. spec. The two figures, 100/130, indicate the anti-detonation qualities with Lean/Rich mixture when Pressure-Charged, 130PN being equivalent to "110 Octane".

n.8:-102 Octane to Research Method (RON) spec. This was intended to be the 5 Star pump petrol of the period @101 +1 for tolerance (although it has been retained in the rules after the withdrawal from sale of that grade ca. 1975).

n.9:-"Oval" (or "Racetrack")-shape cylinders were banned in 1987 (after Honda introduced these to motor-cycle racing in 1979).

n.10:-Water-spray cooling of charge intercoolers was banned.

n.11:-Two-Stroke engines were banned and so remain.

n.12:-From mid-1992 the fuel rules were tightened to exclude "power-boosting additives".They were revised further in 1993-94 for the same reason.

n.13:-The 3 Litre NA formula continued until the end of 2005.

Car Weight Definitions

Prior to 1934-39: with oil + 4 wheels; without water, fuel tyres, crew (4).

1934-39: oil & wheels also excluded (in 1938-39 minimum car weights were specified (4)).

When minimum car weights were required from 1961 on, the complete car without fuel but including oil and coolant was specified – the latter clarified in 1982 as the quantities aboard at the race finish.

From 1995 the driver's weight at a nominal 75kg was included in a higher minimum rule.

Refuelling during a race

Banned 1984-1993 inclusive. Re-permitted 1994 and onward.