2nd Naturally-Aspirated Era (2NA): 1952 – 1982: 31 Years.
Part 2. 1958 – 1960; Egs. 36 to 39.

36. 1958 Drivers' Championship (D);
Ferrari 246; 2,417 cc; 270 HP @ 8,300 RPM (See Figs. 36A, 36B, 36C.)

In 1958 a World Constructors' Championship was added to the Drivers' Championship. While Ferrari mounted the Champion Driver, the Champion Constructor was Vanwall. Both cars are included as CoY. Ferrari will be described first as Eg. 36D with Vanwall following as Eg. 37C.

Also in 1958 an important change in the rules came into effect – although it was only promulgated in October 1957, i.e. 3 months before the Argentine Grand Prix, where 6 months notice of rule change had been promised previously – the **limitation to petrol as fuel**. There had been unpopular and mostly disregarded rules in 1929 and 1930 to restrict fuel to petrol or petrol/benzole and alcohol had been banned in 1914 but otherwise the chemistry of fuel had been unspecified. Now this new rule was intended to be for petrol "The same as the ordinary motorist can buy" for maximum advertising advantage to the fuel-supplying companies which subsidised motor-racing. In practice AvGas Grade 100/130 had later to be specified as it was then the only petrol available internationally to a common standard (see Note 58-2). This was a fuel used for General Aviation but certainly *not* what was bought by the "ordinary motorist"!

A simultaneous rule change permitted organisers to run shorter races and the average 1958 event (in a range between 313 and 415 km) was 20% shorter than 1957 (330 to 504 km).

These two changes, to fuel and distance, favoured Ferrari who were making a fresh start on a new type of engine already designed for AvGas and with a smaller-tanked chassis. Once again Enzo Ferrari had shown shrewd strategic judgement regarding rules – or perhaps had influenced them.

The 1958 Ferrari 246F1 65V6 2.4L (type-named "Dino" in memory of Enzo Ferrari's son Alfredo who died aged 24 in 1956) was, in typical company fashion, an enlarged version by a team led by Carlo Chiti of a 1.5L unit designed in mid-1956 for the newly-reformed Formula 2 of 1957. This F2 engine, to run on AvGas, had been designed under the leadership of Vittorio Bellentani with Vittorio Jano as consultant (see Note 59). The basic type drew largely on the Lancia heritage of 60V6s and their D50 90V8, egs. having chain-driven DOHC and "Jano" tappets, but was unconventional in the 65^0 Vee angle, chosen to give more room for the carburetters. To maintain equal firing intervals then required a 6-pin crank, each pin separated by a web (a heavy solution) with these pins spaced at 60^0-5^0 = 55^0 and 60^0+5^0 = 65^0 intervals. While perhaps heavy as a 1.5L the enlargement process should have reduced the type 246 weight per cc.

The 1.5L had B/S = 70/64.5 = 1.09, similar to the mid-1956 reversion on the Ferrari-raced D50 to Lancia's original 76/68.5 = 1.11 but decidedly less than the further development of that V8 engine in 1957, the type 801 with B/S = 80/62 = 1.29. With type 801 data in hand, however, the type 246 V6 enlargement for 1958 was 85/71 = 1.2.

With the lower compression ratio for petrol and VIA = 60^0 the combustion chamber was less "orange-peeled" than earlier engines (R x VIA = 588^0). So far as is known there was no deliberate swirl or squish.

The Ferrari-claimed power, which may have been optimistic, represented BMPP = 12.0 Bar @ MPSP = 19.6 m/s on R = 9.8. MGVP was only 52.5 m/s. ECOM was 52.9%.

In this first dual-Championship season Ferrari won only 2 GPs out of 10 and gained 40 counted Constructors' points. Their Champion driver was Michael Hawthorn by 1 counted point over Stirling Moss on a Cooper and Vanwall, despite his winning 4 races to Hawthorn's 1. The Vanwall team scored 48 counted points out of 6 wins. Cooper, with privately-run mid-engined cars of only 2L, took the first two races of the season – a harbinger of things to come the following year.

Fig. 36A
1958D Ferrari 246
65V6 85/71 = 1.197 2,417 cc
Note the double-bodied magneto for 12 plugs.
DASO 953

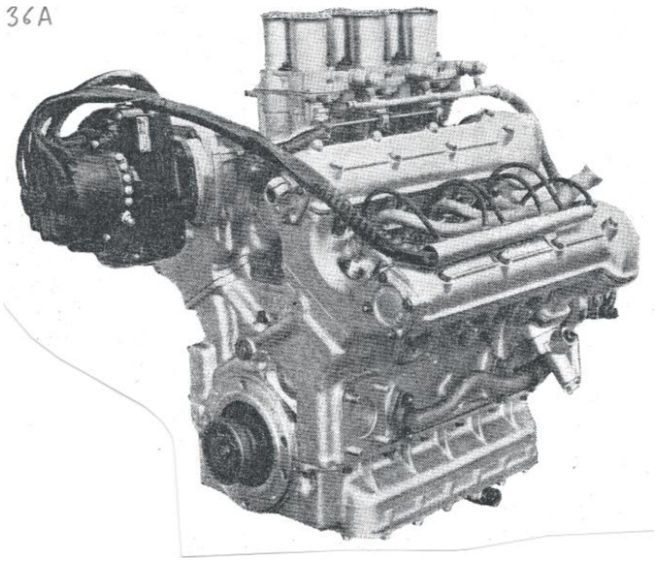


Fig. 36B
1966 FIAT DINO
65V6 86/57 = 1.509 1,987 cc
Representing Ferrari 246.
This low-production FIAT engine was based on the original Formula 2 65V6 Ferrari type 156 of 1957 but it can serve as a general representation of the type 246 also.
The main differences of the FIAT from the Ferrari are:-

- Narrower valve angle (VIA = 47^0 v. 60^0;
- Single ignition instead of double;
- Crankcase carried well below the crank Centre Line instead of just to the CL (see Fig. 36A)
- Wet sump instead of dry sump.

DASO 246 p. 47

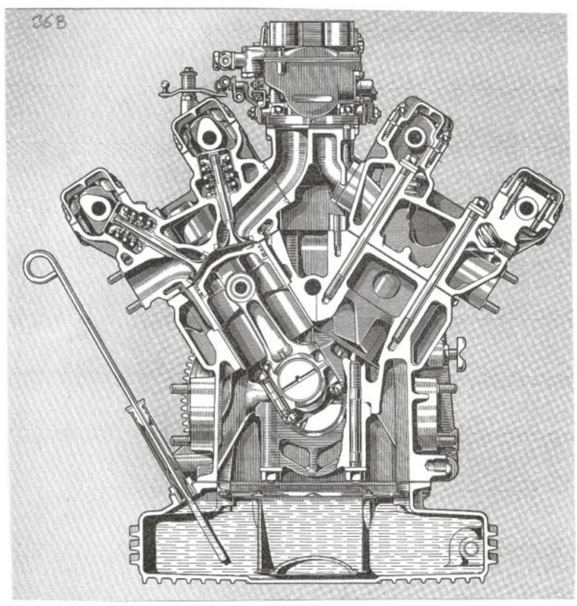
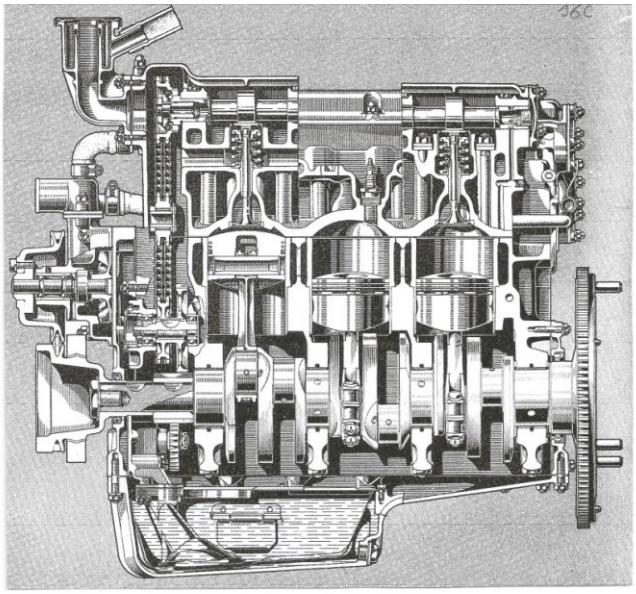


Fig. 36C
1966 FIAT DINO
65V6 86/57 = 1.509 1,987 cc
Representing Ferrari 246.
Note the cast iron cylinder liners supported half-way down the bore in the Al-alloy block; also the 6-pin crankshaft for equal firing intervals.
DASO 246 p. 46



Ferrari 246 in sound and motion:- see Note 115

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37. 1958 Constructors' Championship (C):
Vanwall V254; 2,490 cc; 265 BHP @ 7,400 RPM. (See Figs.37A & 37B and Power Curve)

The Vanwall V254 engine of 1958 did *not* follow (what has been called in this review) the "conventional" GP pattern of the late '60s because, following a conception of Tony Vandervell in 1951, it drew heavily on Norton 1-cylinder 500 cc racing motorcycle practice (he was a Norton Director at the time).

The V254 provenance therefore went back to the 1938 unit of that make, which was its 1st DOHC design (797) (see SO12 in Appendix 1). That was also the date when Joe Craig, Norton's immensely-practical tho' academically-unqualified racing engineer since 1930, had begun a steady increase in B/S ratio (see P.2 of Grand Prix Motorcycle Engine Development, 1949 – 2008).

Specifically the first Vanwall IL4 2L engine, aimed at Formula 2, was designed in 1952 by Frank Fox and his team, including Eric Richter (who had joined from BRM) and Leo Kuzmicki (from Norton), on the basis of the 1952 works Norton top-end (see Note 60) and its B/S ratio of 85.93/86 = 1 (near enough), ***plus*** the data gathered by Norton in 1949 with a water-cooled version of that year's engine designed by Richter while at BRM (B/S = 82/94.3 = 0.87). The normal motorcycle was air-cooled. The Vanwall was water-cooled as a way of sustaining power output although it was also intended to run an alcohol-based fuel with its cooling effect, unlike the 80 Octane petrol then regulation for international motorcycle racing. The car 1st raced as a 2L in May 1954

The bottom-end *was* conventional, adapted from a Rolls-Royce B40 military engine but with Al-alloy substituted for cast-iron and later with a 5th crank bearing. Naturally, Vandervell "Thinwall" copper-lead plain bearings were used, not the roller/ball bearings of the Norton.

The 2-valve Norton head was adopted because of its excellent breathing and burning, Kuzmicki having introduced squish to the motorcycle in 1951 (683) (see also P. 3 of Note 23). The VIA was

64^0 initially which became 60^0 when the swept volume was raised finally in late 1954 to the GP 2.5L limit with B/S = 96/86 = 1.12 (via an intermediate 2.3L with 91/86 = 1.06 in mid-1954). The Norton inlet port feature of axial swirl was retained and also the squish in the cylinder. While there *was* non-orthogonality of the port with the valve head (see Fig. 37A), which would be used deliberately by Keith Duckworth 14 years later in his 4-valve narrow VIA designs to generate "Barrel Turbulence" (aka "Tumble Swirl"), in the Norton there was insufficient port downdraught and too large a valve inclination to provide the necessary acute in-cylinder opposite-wall flow angle to promote that condition (see also Note 26).

Two plugs per cylinder were employed instead of the Norton single.

Like the motorcycle the cam-boxes were pedestal-mounted to allow exposed, air-cooled, hairpin valve springs. These springs needed much development to produce a satisfactory fatigue life and Rolls-Royce helped by introducing shot-peened wire (664). The valve timing was as extreme as the Norton, the 1958 IOD being 340^0 and the OL = 119^0 (68).

Inlet and exhaust systems were tuned similarly to the motorcycle – the primary exhaust pipe at about ¾ metre length was the same – but without the megaphone addition; the clutch-slipping needed on the motorcycle below 5,000 RPM was just not feasible with (initially) around 200 HP. A 5-forward-speed gearbox was used (the bike had 4).

Important details

Two very-important details were:-

- The specially-made steel/N75 laminated compressible gasket rings sealing the liner-head joint;
- The Dykes'-type L-section piston rings used in the top 2 grooves to repress flutter (see Note 13 Part II).

Indirect Fuel Injection

From an early date Bosch piston-pump fuel injection was fitted *but*, unlike the application in-cylinder for the Mercedes-Benz M196 for which it was originally designed, the pump supplied fuel into the inlet tracts controlled by a mechanical linkage. Until mid-1957 the engine was plagued with injection pipe and fuel pump control-rod failures because of its 4-cylinder vibrations with a major period at 7,000 RPM (711).These failures were cured with flexible pipes and a length of this pipe inserted into the control linkage.

1957 results

In the second half of 1957, the last of the free-fuel era and after the vibration failures had been cured, Stirling Moss won 3 races driving the Vanwall even against Juan Fangio who was winning his 5th Championship with Maserati. This 4-cylinder car even defeated 6, 8 and 12 cylinder opposition at the high-speed track of Monza. The low-drag body designed by Frank Costin in 1956 would have been a helpful factor there.

1958 Modifications and Power

The Injection system linkage had to be re-designed in 1958 when developing the engine to run on 100/130 AvGas instead of 36% methanol fuel with 10% nitro-methane. This was because of the much narrower useable Air/Fuel ratio of hydrocarbon fuel. The pump stroke actually had to be reduced at peak RPM to prevent the linear pump delivery overtaking the airflow.

The loss of the alcohol cooling was combated by adding oil jets to spray the underside of the piston. Sodium internal cooling had been added to the inlet valve just before the end of the 1957 season, to complement that already included in the exhaust.

Altogether in the enforced and belated change to AvGas Vanwall managed to restrict the peak Power (PP) loss to 10 HP, from 275 to 265 (68), i.e. 3.6%. Peak Torque (TP) loss was 6.5% and the RPM range between PP and TP was reduced from 22% to 16% - making the car more difficult to drive on twisty circuits.

The 1958 performance represented BMPP = 12.9 Bar @ MPSP = 21.2 m/s on R = 11.5. Chamber (R x VIA) = 690^0, offset by the special attention to swirl and squish. MGVP was 64.9 m/s. ECOM was 54.3%.

MVSP = 3.66, a figure attained by using the HVRS at the limit of its potential. No CoY engine ever used this system again.

1958 results

Vanwall could not be ready with the engine changes until May 1958, missing the Argentine GP in January. Then, despite having had to re-develop their 622 cc cylinders at short notice to burn AvGas, Vanwall defeated the Ferrari 246 with its advantageously-smaller 403 cc cylinders designed for that fuel by 6 wins to 2.

An interesting comment by Moss after the season was that the RPM limit given to him "..*varied according to how Mr Vandervell was feeling*!". Probably also according to race length which, as already mentioned, varied in 1958 from 313-odd km (Monaco, Dutch) to around 410 km (French, Italian, Moroccan).

Tony Vandervell's motivation

The Vanwall was unique (except for BRM under Alfred Owen), being the result of a rich industrialist *spending his own money not to sell more product* – Vandervell "Thinwall" bearings were already well established in road cars and also had a monopoly in 1956 GP engines - *partly* as a hobby but *much more from an intense desire to enhance British engineering prestige*. Yet the motor industry's trade association refused to allow the Constructors' Championship-winning car to be exhibited at their October 1958 Show!

Fig. 37A
1958C Vanwall V254
IL4 96/86 = 1.116 2,490 cc
Note the long-duration cams, the exposed hairpin valve springs
and the exhaust valve guide in direct contact with water.
Although the top pair of piston rings were Dykes' L-section this is not shown on the drawing.
Note the inlet port section-shape which results from angular displacement to give
circumferential swirl to the charge.
The cylinder liners are *sandwiched* between head and crankcase (in a separate block) which has led to top sealing ring troubles in other engines. This may explain why this ring was a complex multi-layer special development by Coopers' Mechanical Joints.
DASO 796

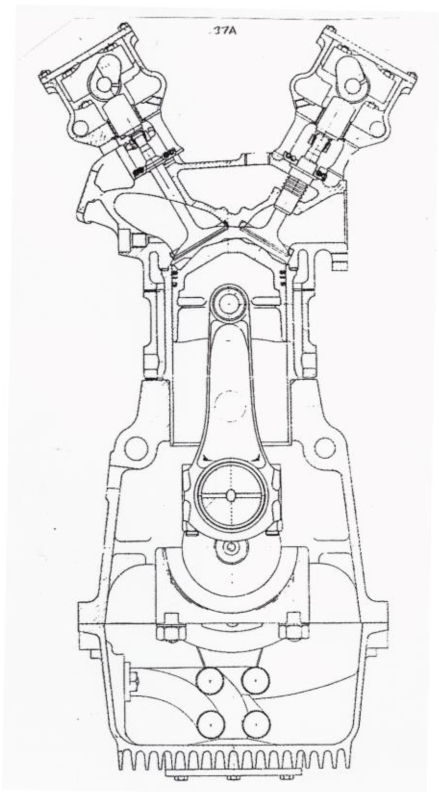
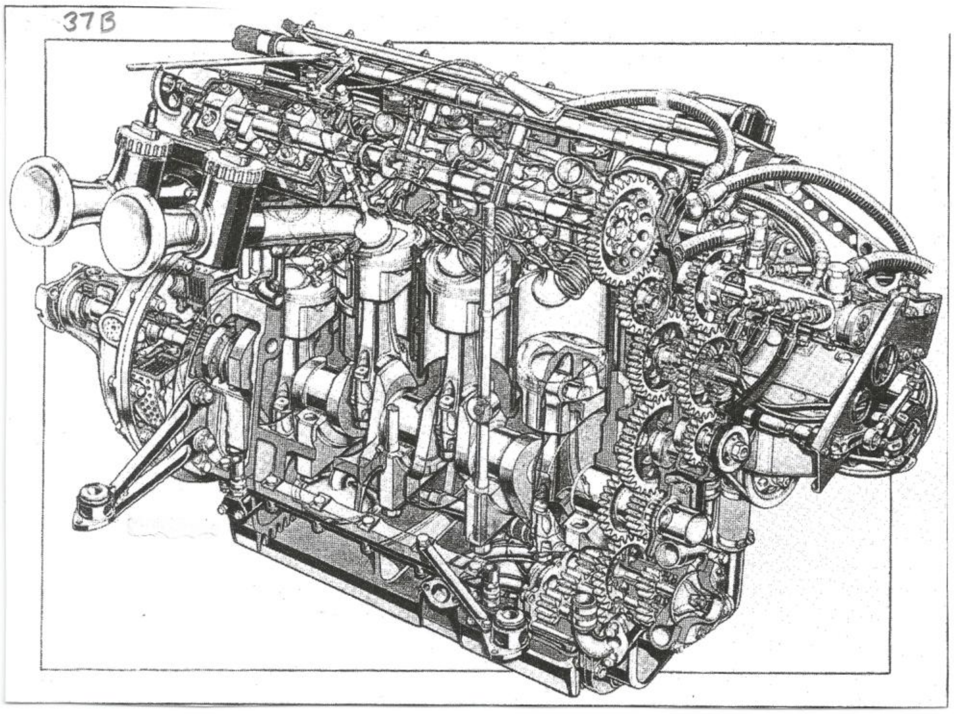


Fig. 37B is shown on P.6
A Vanwall V254 Power Curve is given on P.7

Fig. 37B
1958C Vanwall V254
IL4 96/86 = 1.116 2,490 cc
Note the Amal carburetter bodies used to provide throttles.
Also the slipper pistons carried-over from the Norton 'parent'.
The Bosch injection pump was driven off the front gear train.
DASO 796



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38. 1959 Coventry Climax FPF; 2,496 cc; 220 BHP @ 6,750 RPM.

39. 1960 Coventry Climax FPF; 2,496 cc; 240 BHP @ 6,800 RPM (See Figs. 39A & 39B and Power Curve)

Chassis and engine makers separation

In 1959, for the 1st time in GP history, the chassis and the engine of the "Car-of-the-Year" were built by different companies – Cooper and Coventry Climax, respectively. The Climax engine was *sold* to Coopers – no doubt at a subsidised price i.e. excluding development and tooling costs, which in 1960 was £1,750 (544) (equivalent to nearly £35,000 in mid-2013 money).

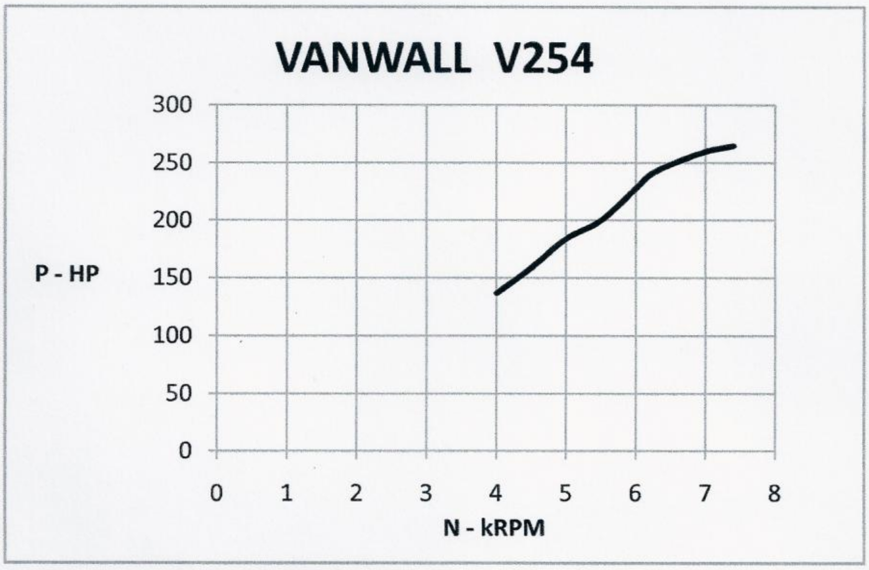
This supply arrangement would become the norm for CoY in the further period of1959 – 2000 inclusive under review, applying to 37/48 examples = 77%. The exceptions making the whole car were Ferrari (10 examples) and BRM once. This was despite the "whole car" interventions without CoY success by Honda, Matra, Renault and Alfa Romeo for some years each. The CoY chassis builders employing proprietary engines were generally specialists in racing cars (the exceptions also producing road cars being Lotus and Matra, the latter being mainly a major aerospace company).The CoY power providers were often engine specialists who sold their products, egs. Coventry Climax, Repco, Cosworth and Ilmor. Sometimes the providers were major road car manufacturers with specialist racing engine departments, egs. BMW, Porsche, Honda and Renault, who sometimes charged the chassis makers and sometimes supplied the engines freely. The major manufacturers group came into the racing arena from 1982 as suppliers as they developed TurboCharged engines which then pried loose the near-iron grip of Cosworth on CoY racing engines. Honda and Renault continued with NA units after 1987.

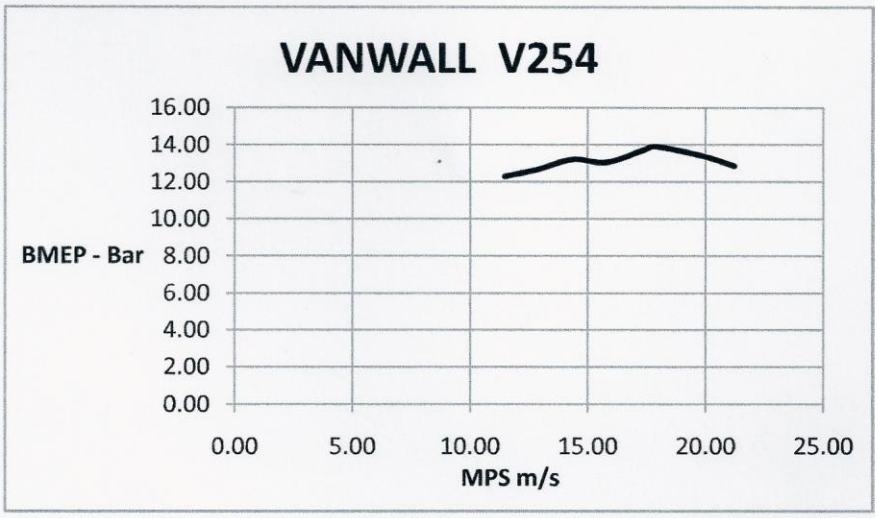
[Continued on P.8]

POWER CURVES

Eg.	37
DASO	68
YEAR	1958
Make	Vanwall
Model	V254
Vcc	2490
Ind. System	NA
Confign.	IL4
Bmm	96
Smm	86

N kRPM	P HP	MPS m/s	BMEP Bar
4	137	11.47	12.31
4.5	159	12.90	12.70
5	184	14.33	13.23
5.5	200	15.77	13.07
6	228	17.20	13.66
6.2	240	17.77	13.91
6.5	249	18.63	13.77
7	260	20.07	13.35
7.4	265	21.21	12.87





The genesis of the FPF

Like the 1958 Ferrari 246, the 1959/1960 Coventry Climax type FPF was enlarged from a 1.5L engine designed originally for the 1957 Formula 2. The basis of that unit was itself one block of the Climax type FPE 90V8 2.5L engine built in 1954 for Formula 1. Walter Hassan has described (33, 515) how Climax were deterred from persevering with the FPE because they thought that its power and “driveability” were insufficient and how they realised later that they had been misled about this. Note 61 gives a comparison with what Climax achieved fairly quickly and what the 1954 competition had available. It is an intriguing thought that the mid-engined Cooper which appeared in the 1955 British GP could have had an FPE instead of the long-out-of-date Bristol BS4 IL6 2L* - the UK attack on the Grand Prix scene could have begun effectively 4 years earlier than the 1959 Cooper-Climax FPF!

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*The intended enlargement of the BS4 to 2.2L for that car was never done (944).

FPE to FPF

The basic FPE and the FPF derivatives (listed in Note 20) can be described as conventional – “good plain cooking” – as might be expected and, indeed, *required* from a company which made its living from selling engines which had then to make a profit or perform impeccably for their purchasers.

Many elements of FPE philosophy were given by Harry Mundy, its designer, in ref.(52) (see Note 34).Like the contemporaneous Lancia D50 the FPE was designed in 1953 with hairpin valve springs and they, too, were discarded later in favour of coils. *Unlike* the D50 it was not intended to form an integral part of the chassis nor was any of the FPFs.

With a free choice FPE B/S = 3’’/2.675’’ (76.2mm/67.945) = 1.12. The derivative 1957 FPF IL4 1.5L was 3.2’’/2.8’’ (81.28/71.12) = 1.14. After stretching through 2L and 2.2L engines the 1959 FPF reached the full Grand Prix formula 2.5L with 3.7’’/3.54;; (93.98/89.916) = 1.05. This was, of course, a result of expediency, all the varieties being at the same cylinder-centre-spacing of 4.175’’ (106mm) to suit the original FPE jigs.

FPF details

The FPE inter-cylinder land had been 4.175’’ – 3’’ = 1.175’’ and this was reduced on the 2.5L FPF to 4.175’’ – 3.7’’ = 0.475’’. To seal the combustion chamber the special Coopers’ joint ring developed for the Vanwall was adopted.

Another consequence of the enlargement was a Connecting-Rod length-between-centres (CRL) of only 1.44 x Stroke (S), compared to a then-conventional 2x. This must have had some adverse effect on power through increased piston side-thrust and hence higher friction (see Note 62). Its effect on piston stress through increased deceleration at TDC, compared to CRL/S = 2, would have been +8%.

To provide sufficient balancing within the confined crankcase and avoid the excessive centre bearing load created in the previous 2.2L version used in 1958, it was necessary to attach crank weights in a sintered-tungsten alloy which was 1.6 x lead density but had the strength of mild steel. Lower main bearing caps were changed to steel with transverse bolts into the sides (a scheme used previously in the Mercedes-Benz M125 – see Fig.23B).

A Dykes’ top piston ring was fitted to avoid flutter.

The cylinder head had radial swirl and no squish; (R x VIA) = $680^{0.}$ It was 2 SP/c; the FPE had 1 SP/c.

From mid-1959 the inlet valve-head area was increased by 13% to give the enhanced power listed in the section heading for 1960.

Hassan was a great believer in a good spread of RPM between Peak Power (PP) and Peak Torque (TP), so as to make the driver’s task easier and also reduce lap times through reduced gear-changing. To this end he restricted IOD to 290^0 with OL = 90^0. The RPM spread on both 2.5L FPFs was therefore about 26% of Peak Power speed (NP). This compared with only 16% on the 1958 Vanwall with its higher output from, *inter alia*, much wider valve timings (as reported in Eg. 37). However, the 1960 Cooper went up to a 5-forward-speed gearbox from 4.

2.5L FPF Performance

The specifics were as follows; early-1959 first figures, mid-1959 & 1960 in []:-
BMPP = 11.7 [12.7] Bar @ MPSP = 20.2 [20.4] m/s on R = 10.3 [11.9];
MGVP = 73.8 [65.6] m/s;
MVSP = 2.90 [2.93] m/s.

The Specific Fuel Consumption (SFC) at 1960 NP was 0.491 lb/BHP.Hr on AvGas 100/130 (33). This corresponds to Brake Thermal Efficiency (BThE) = 28%
and Volumetric Efficiency (EV) = 121% (see Note 37). The inlet and exhaust systems were, of course, individual and tuned, using Weber 58 mm bore carburettors (22.5% larger area than the inlet valve head). This was the first calculated EV > 100%.

ECOM was 50.7% in 1959 and 53% in 1960.

!959 and 1960 Results

The results for the full-size FPF in the Cooper and Lotus chassis' were as follows:-

1959 Cooper T51 5 wins from 8 races = 62.5%;
1960 Cooper T51(1 race) & T53 6 wins from 8 races *contested** = 75%.
1960 Lotus Mk 18 2 wins " " " = 25%
1960 FPF combined 8 wins " " " = 100%**.

*The British teams boycotted the Italian GP run at Monza on the combined track with banking, considering it too bumpy to be safe. It is probably fair to say that their chassis' were *not* fit for that loading.
**The dominance of the Coventry Climax FPF *in mid-engined chassis,* apart from the clean sweep shown, was so great that in the 1960 British GP at Silverstone the winning Cooper and the Lotus' which were 2nd and 3rd all lapped the front-engined V6 Ferraris which were 6th and 7th *twice*!

The 2.5L FPF, perhaps surprisingly for an engine so stretched from its basic 1.5L origin, was very reliable. Jack Brabham, who retained his 1959 Drivers' Championship in 1960 with a sequence of 5 Cooper T53 wins in a row, won 2 of these "*without the engine being touched in between*" (821). In mid-1960 the Cooper team had 10 FPFs available, half of which were 1969 engines (1108)***.
***DASO 1108. McLaren Memories. E.Young. Haynes. 2005.

The advantages of the mid-engined, stable-steering chassis

It is doubtful if the FPF would have powered the CoY in 1959 or 1960 if it had not been mounted in the mid-engined stable-steering Cooper chassis. This had lower frontal area (about 20%) and lower weight (about 10%) advantages over the competing front-engined Ferrari 256. The way in which this layout had developed from the 1948 500 cc car is described in Note 66.

There *had* been something of a rehearsal of mid-engined Cooper versus front-engined Ferrari in 1949 Formula 2 races, in that case to the Italian firm's advantage (see Note 63).

The reduced Grand Prix race distances permitted in 1958 and onwards (see Note 64), with the reduced SFC on AvGas, particularly suited the Coopers "grown-up" from their 1955 1,100 cc Sports-Racing car relative to the "traditional" Ferrari chassis.

Another proof that the "Cooper formula" was the "*Way to go*" came from Colin Chapman of Lotus. He tried with his ingenious front-FPF-engined Mk16 to get down to the Cooper's frontal area and weight and had been unsuccessful. After 1959 he threw in his hand and copied Cooper's mid engine layout with neutral-to-final-oversteer handling and then Moss in Rob Walker's private Lotus Mk 18 brought the 2 1960 victories listed above (see also Note 66).This began Chapman's long and successful Grand Prix career.

FPF Postscript

It was actually possible to enlarge the FPF still further reliably. For a Cooper entry at Indianapolis in 1961 it was taken out to B/S = 3.78''/3.74'' (96.012mm/94.996) = 1.01; 2,751 cc, 66% of the allowed capacity. Power was 270 BHP @ 6.800 RPM on alcohol-base fuel. Brabham finished the 500 miles in 9th place at a speed 96.4% of the 4.2L winner.

Fig. 39A
1960 Coventry Climax FPF 2.5L
IL4 3.7''/3.54'' (93.98mm/89.916) = 1.045 2,495 cc
This section (when enlarged) shows the Dykes top piston ring.
The exhaust valve guide is in contact with water.
Additional cross-bolts assist to tie the main bearing caps to the crankcase.
DASO 131

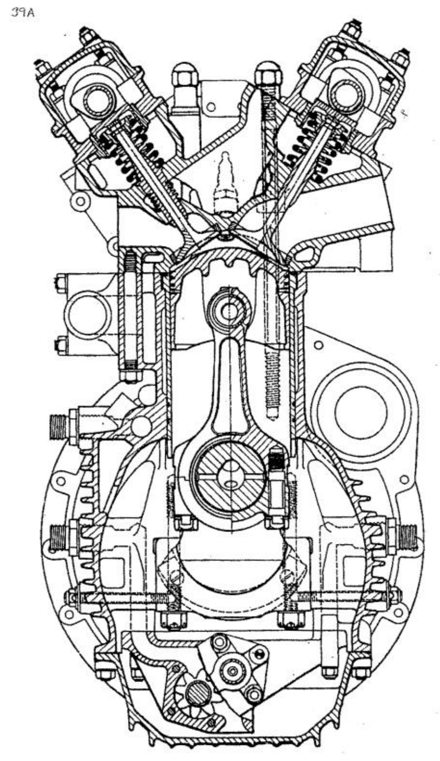
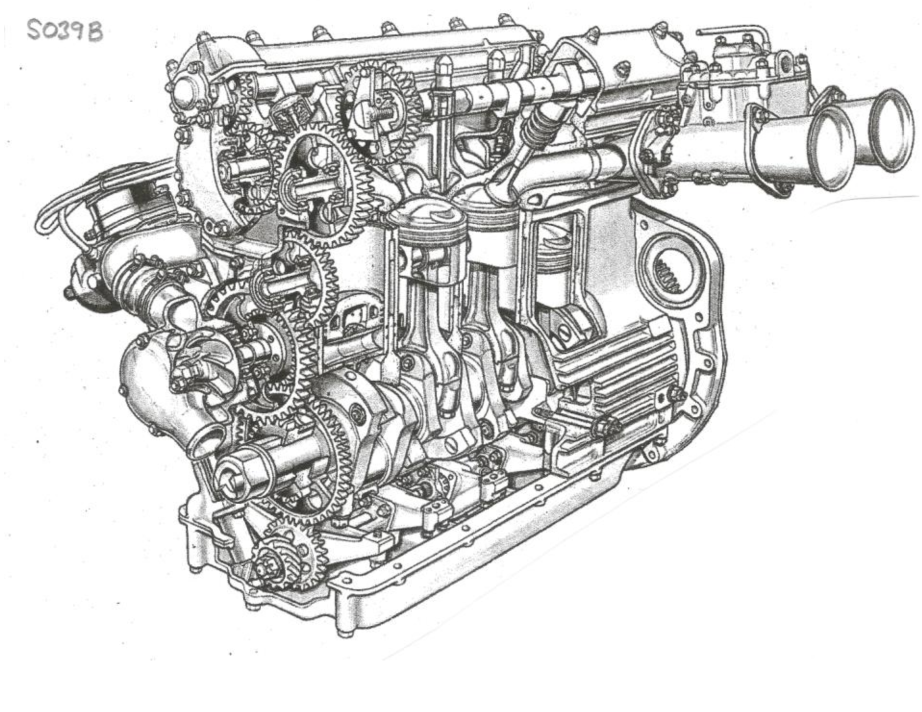
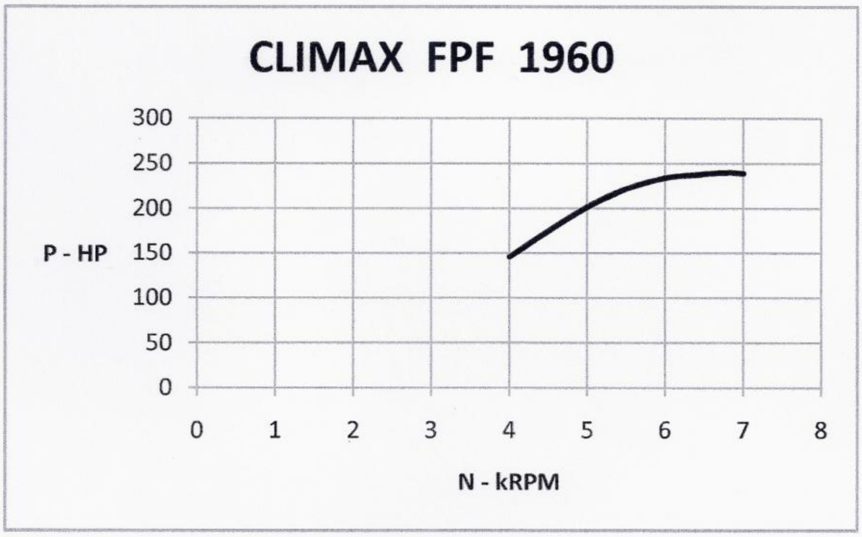


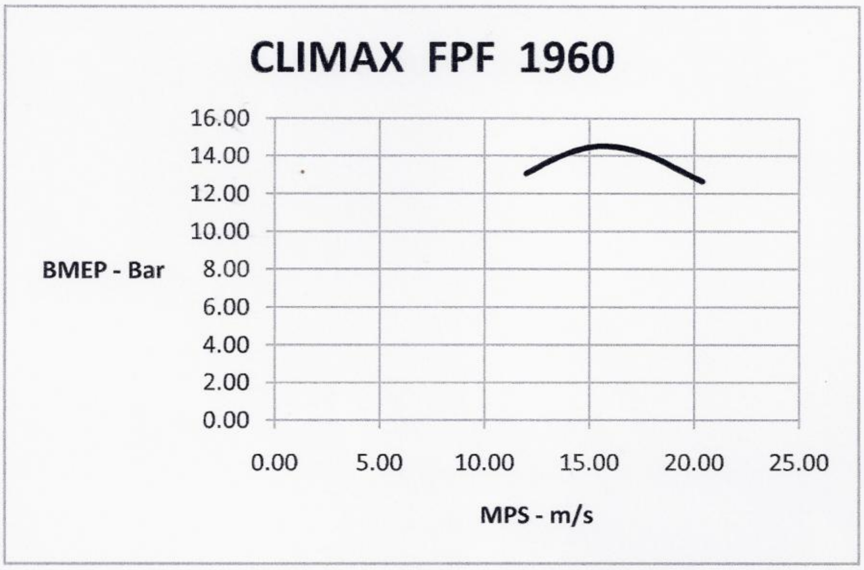
Fig. 39B
Note that the pistons were solid-skirt.
DASO 131



POWER CURVES

Eg.	39				
DASO	33				
YEAR	1960				
Make	Climax				
Model	FPF				
Vcc	2495				
Ind. System	NA				
Confign.	IL4				
Bmm	93.98	(3.70")			
Smm	89.916	(3.54")			
	N		P	MPS	BMEP
	kRPM		HP	m/s	Bar
	4		146	11.99	13.09
	4.5		175	13.49	13.95
	5		202	14.99	14.49
	5.5		222	16.48	14.48
	6		234	17.98	13.99
	6.5		238.5	19.48	13.16
	6.8		240	20.38	12.66
	7		239	20.98	12.25





Summary of the 2.5Litre Formula

Summing-up the 2.5L Formula, which ended after 1960, It *reversed* the “natural” trend of limited swept volume stimulus towards an increasing number of cylinders (CN) (with Bore/Stroke ratio averaging around 1.1) because in the 7 years the 8 CoY sequence (Including separate Drivers’ (D) and Constructors’ (C) in 1958) ran as follows:-

CN 8 8 8 6 6(D) 4(C) 4 4.

Maserati *did* build a 12 cylinder engine in 1957 but it was unsuccessful.

Although recognising that every CoY engine in the formula drew on many years of piston-engine technology (eg. the Mercedes M196 having a cylinder construction dating back to 1912 and the Vanwall V254 using Norton top-end experience from 1938) it is still interesting to examine the first CoY success of each full-size 2.5L unit versus its racing years:-

CoY in its 1st year:-	Mercedes M196; Ferrari 246; Climax FPF.
” ” ” 3rd ”	Ferrari-Lancia D50.
” ” ” 4th ”	Maserati 250F1.
” ” ” 5th ”	Vanwall V254.

The Maserati, Ferrari, Vanwall and Climax had all “grown up” from smaller engines of the same basic design, which is a classic way to obtain good Power/Weight ratio.

The 2.5L formula had begun in 1954 with the most powerful, most complex and most expensive car and engine of the period produced by the oldest and grandest company. It ended with a car produced in little more than an ordinary garage fitted with the simplest and easily the cheapest engine of the formula having less power than its seasonal rivals and 2.5L predecessors. Yet lap speeds had risen 11% at the medium-speed Silverstone circuit. Perhaps 2½% was due to new nylon-casing racing tyres; perhaps 1% to circuit improvements (see Note 67). Perhaps 5% was the result of the mid-engined stable-steering “Cooper Revolution” (see also Note 66). The rest of the gain being “normal” annual increments or “Learning Curve”.

After 1960 *all* Grand Prix cars, bar one which was not CoY (see Note 68), have been mid-engined.