Note 20

Coventry Climax: Specific Power variation with Stroke

The 1953 – 1966 Coventry Climax series of DOHC Naturally-Aspirated racing engines provides a good illustration of the effect on Volume Specific Power (PP/V) and Piston Area Specific Power (PP/PA) of shortening Stroke (S). The details and charts are given on pp.2, 3 and 4.

This series has the valuable advantage for comparison purposes of a common design, detailing, manufacturing and development philosophy under one chief, Walter Hassan, and all powers tested to the same standard have been published by the company.

To remove the (fairly small) variation of Compression Ratio (R) the powers have been "normalised" by Air Standard Efficiency (ASE) to R = 12 and, for the 2 units running on alcohol-base fuel, an adjustment to petrol equivalent of1/1.12 has been applied (these adjustments are RA and AA respectively, as described in the Key to Abbreviations to Appendix 1). This "normalised" Peak Power is identified as PPA. Purely to give a convenient number 1/S is shown as (100/Smm).

It can be seen on Fig. 104/DST on p.2 that for this engine series – in which the 1st, the V8 FPE was not fully-developed – there is a steady decline in the gain of PPA/V as 100/Smm increases. The last engine produced in 1965 for the 1.5 L formula, the F16 FWMW, may have been very near the maximum attainable, although it also was not fully developed before the project was dropped.

In choosing 16-cylinders in late 1963 for an engine which he hoped would be available for racing in 1965, Hassan was unfortunately influenced by the old theory:-

"Power proportional to Piston Area".

This of course *would* be true if Brake Mean Effective Pressure (BMEP) and Mean Piston Speed (MPS) were constant. He took the PP/PA achieved by the then-current FWMV3 at 4.5 HP/sq. in. (=0.7 HP/cm^2) and thought that an increase in PA of 27% (45 to 57 sq.in.) would provide an engine giving 240 to 250 HP (34). See Fig. N20A on P.4.

Fig. 105/DST shows clearly that the "old theory" does *not* apply even for engines of given technology. The FWMW never gave over 209 HP.

Fig.106/DST on p.3 illustrates the way that MPSP (MPS at Peak Power) drooped off in the Climax range by about 25% as 1/Stroke was reduced to raise RPM. Apart from "normal" friction losses the F16 seems to have had an oil churning problem to reduce its Mechanical Efficiency (EM).

Fig. 107/DST suggests that, with an *average* BMPA of 12.1 Bar, there was an optimum around 12½ Bar (+ 3%) in the middle of the range. The FWMW, with the smallest cylinders of the series (B = 54.1 mm; S = 40.6 mm) had actually fallen off to only 10.4 Bar as flow pressure loss and heat loss increased, i.e. Volumetric Efficiency (EV) and Combustion Efficiency (EC), as well as EM, fell, as

(Surface Area/ Volume) proportional to (1/Characteristic Dimension) increased.

Fig.108/DST gives BMPA translated into Combined Efficiency, ECOM%, for these Naturally-Aspirated engines for which Manifold Density Ratio (MDR) was 1, so

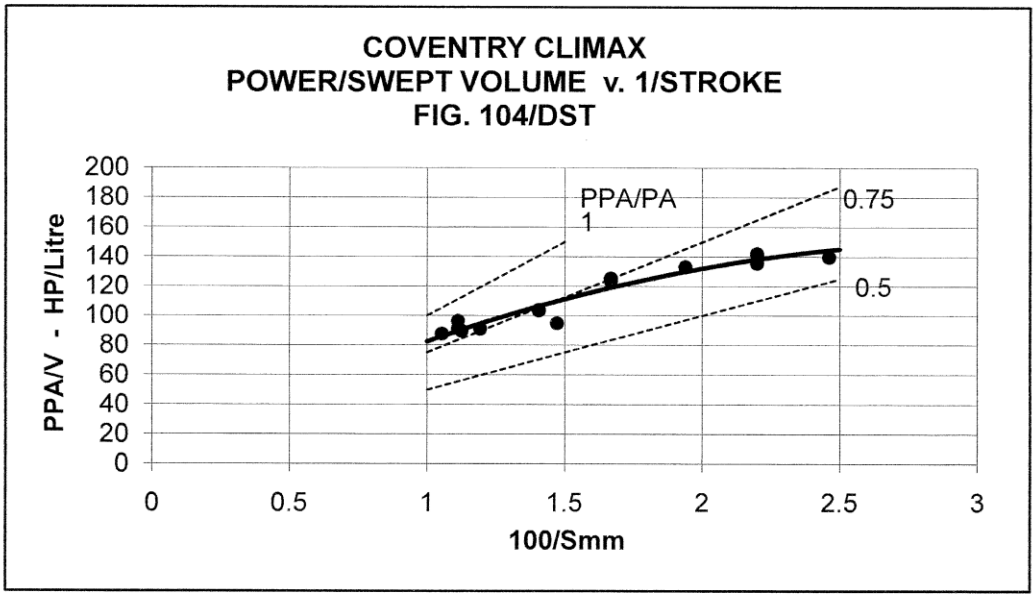
ECOM% = BMPA x 100/23.94.

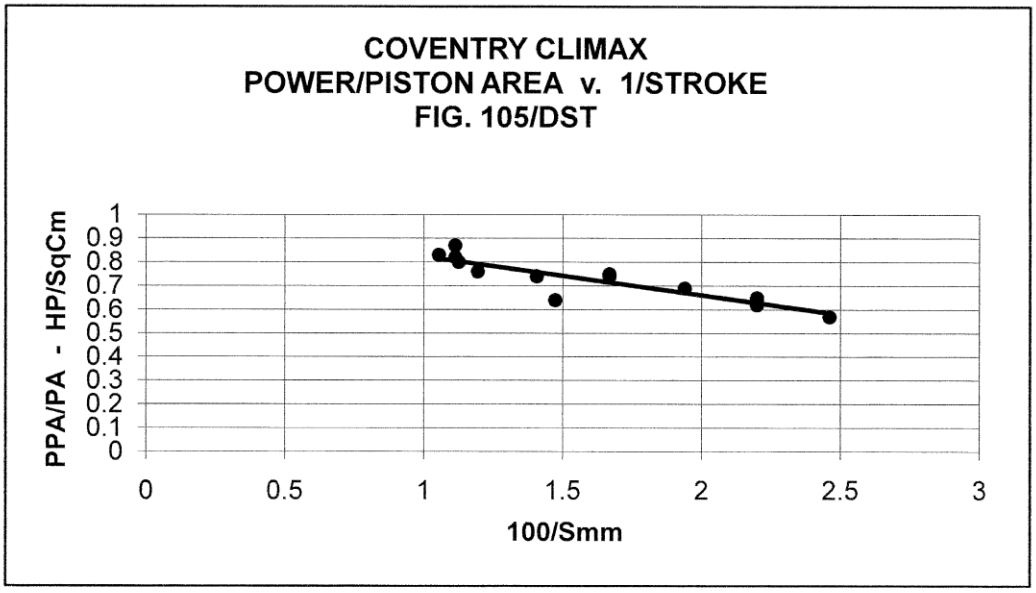
The average value was 50.7%. The best value was for the 90V8 FWMV Mk 1 1.5 L at 55.2%. As that family of V8 engines was developed to shorter Stroke and higher power, ECOM declined to 50.7% at the Mk 7. The F16 FWMW 1.5 L was only 43.6%.

COVENTRY CLIMAX. DOHC Racing Engines. Normally-Aspirated

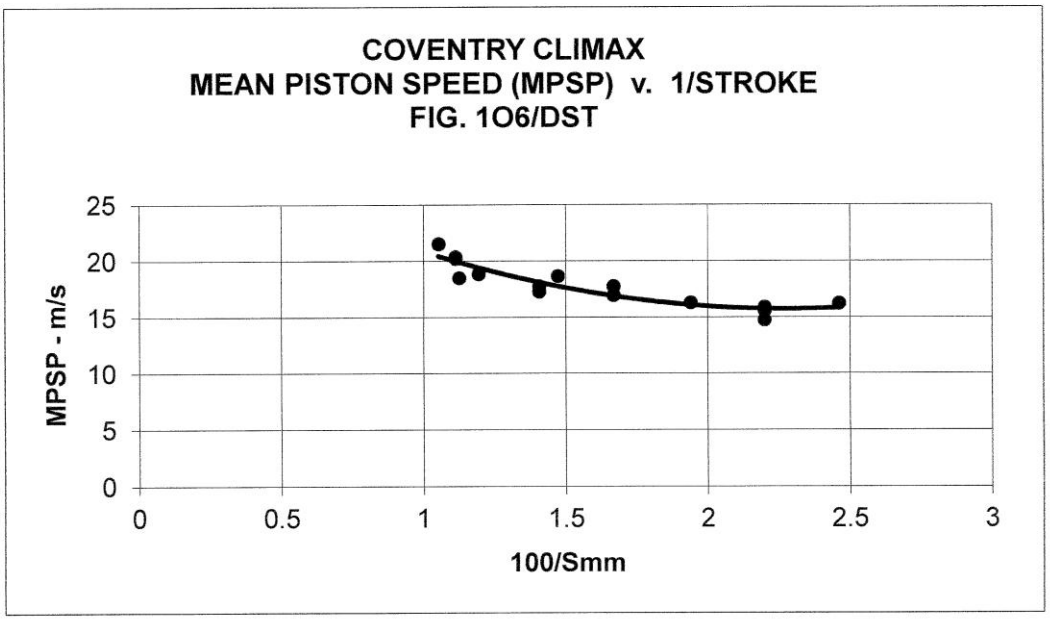
Sources: DASO 33, 34, 54, 57, 131, 131B, 249, 515.

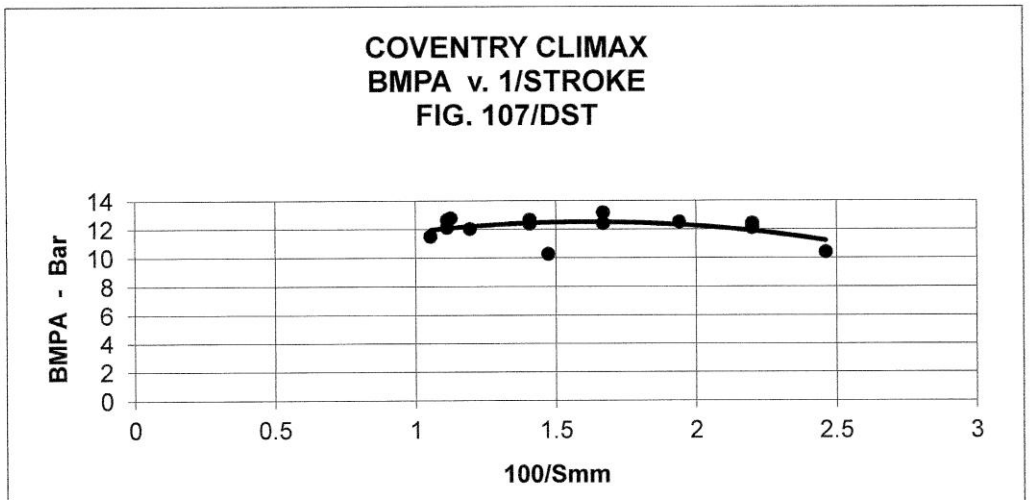
S/No.	Year	Type	V cc	100/Smm	PP HP	R	RA	AA	PPA HPnormal	PPA/V HP/Litre	PPA/PA HP/SqCm
1	1953	FPE	2479	1.472	258	11	1.021	1.12	235.2	94.9	0.64
2	1957	FPF	1476	1.406	146	10	1.047	1	152.8	103.5	0.74
3	1957.5	FPF Mod	1964	1.193	180	12.4	0.993	1	178.7	91	0.76
4	1958	FPF Mod	2207	1.125	194	11.1	1.019	1	197.7	89.6	0.8
5	1959	FPF GP	2496	1.112	220	10.3	1.038	1	228.5	91.5	0.82
6	1960	FPF GP	2496	1.112	240	11.9	1.002	1	240.5	96.4	0.87
7	1961	FPF Mk2	1495	1.406	151	10.7	1.029	1	155.3	103.9	0.74
8	1961.5	FPF Indy	2751	1.053	270	12	1	1.12	241.1	87.6	0.83
9	1961.8	FWMV 1	1495	1.668	181	10.4	1.036	1	187.5	125.5	0.75
10	1963	FWMV 3	1496	1.939	195	11	1.021	1	199.2	133.2	0.69
11	1964	FWMV 5	1497	2.199	203	12	1	1	203	135.6	0.62
12	1965	FWMV 6	1497	2.199	212	12	1	1	212	141.6	0.64
13	1965.1	FWMV 7	1497	2.199	213	12	1	1	213	142.3	0.65
14	1965.2	FWMW	1495	2.461	209	12	1	1	209	139.8	0.57
15	1966	FWMV 10	1974	1.668	244	12	1	1	244	123.6	0.74





S/No.	Year	Type	V cc	100/Smm	ECOM%	MPSP m/s	BMPA Bar
1	1953	FPE	2479	1.472	43.0	18.68	10.29
2	1957	FPF	1476	1.406	53.0	17.31	12.69
3	1957.5	FPF Mod	1964	1.193	50.4	18.86	12.06
4	1958	FPF Mod	2207	1.125	53.6	18.52	12.82
5	1959	FPF GP	2496	1.112	50.7	20.23	12.14
6	1960	FPF GP	2496	1.112	53.0	20.38	12.68
7	1961	FPF Mk2	1495	1.406	51.8	17.78	12.4
8	1961.5	FPF Indy	2751	1.053	48.2	21.53	11.53
9	1961.8	FWMV 1	1495	1.668	55.2	16.98	13.21
10	1963	FWMV 3	1496	1.939	52.4	16.33	12.54
11	1964	FWMV 5	1497	2.199	52.0	14.78	12.45
12	1965	FWMV 6	1497	2.199	51.4	15.61	12.31
13	1965.1	FWMV 7	1497	2.199	50.7	15.91	12.13
14	1965.2	FWMW	1495	2.461	43.6	16.26	10.43
15	1966	FWMV 10	1974	1.668	51.9	17.78	12.43





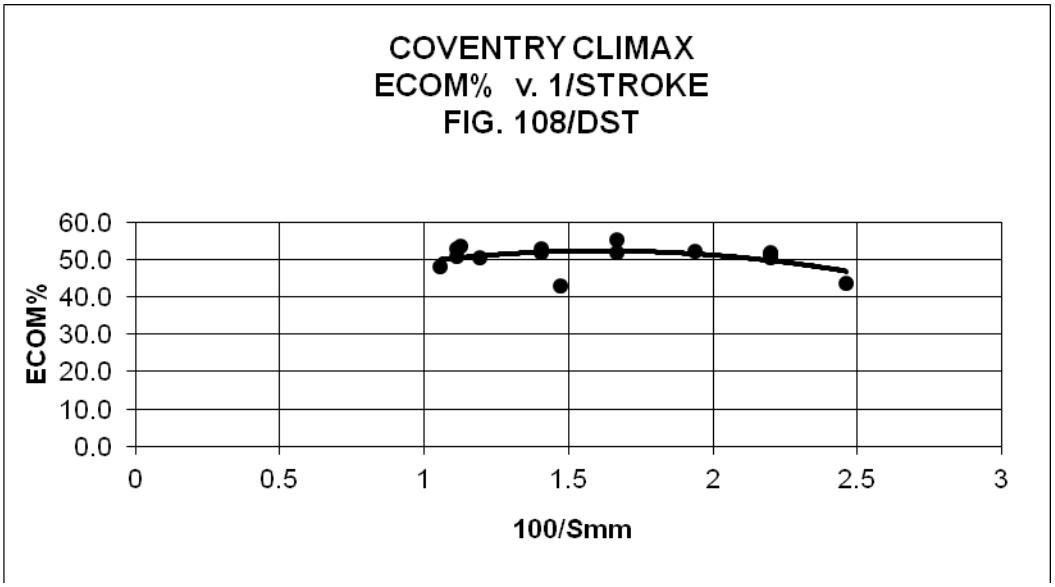


Fig. N20A
1965 Coventry Climax FWMW
F16 2.13''/1.60'' = 1.331 91.22 cid
(54.102mm/40.64 1,495 cc)