Mike Billinton

O.S. 12 LD-X Engine Test

Benchmark

This fascinating developmental exercise is a logical attempt by the world's largest model engine manufacturer to 'make the engine fit the car'. It is also an interesting marketing move given that the engine cover has the appearance of current full-size F1 V-10 cylinder layouts!

Currently named 'Powerblock' by O.S., this 2.1 cc engine is an extreme move along the path set by the earlier CZ-12ZX and 12-CV-X car engines, and uses the same bore/stroke as them. As the same power claim of .56 HP @ 29,000 RPM is made for each of these 3 engines, this suggests that similar internal parts are used.

Although described as being a 'high-performance engine for 1/10 class R/C racing cars', the UK class rules allow a full 2.5 cc. engine size (such as OS 15RX), so the resultant capacity deficit of some 18% and considerable performance handicap compared with such as the 15RX makes it unlikely that the 1/10 I.C. class is the 12LD-X's natural area of competition. Traditional model engine vertical cylinder orientation represents many years of experience, so changes to engine layout are likely to need differing operational approaches. The 2-stroke's closed cylinder having exhaust port at bottom is less likely to become over-full of fuel during starting procedures, whilst the 4-stroke's poppet valves always allow excess fuel to escape whatever the orientation. Placing the 2-stroke cylinder upside down (head at bottom and exhaust port at top) runs the risk of engine damage if excess fuel is present.

So, the laying of cylinder sideways (as used in this unique technical layout from O.S.) is a 'half-way' position which benefits from some care at starting times particularly having regard to fact that exhaust manifold itself extends upwards from the exhaust port.

The highly convenient O.S. built-in 'pull-start' device thus has definite attractions because its use easily signals the onset of excess fuel in the cylinder. Its gearing is such that much force would be needed to rotate the engine if too much fuel is present, whereas larger external starters can provide hidden amounts of damaging force in similar situations.

Removal of glow-plug to clear engine of fuel excess is a useful last resort if the user is unwilling to turn the car/engine upside down to clear fuel from cylinder.

At the left are the starter drive and housing. Side carb mounting (compared with a normal engine) means that the crank's induction opening is moved 90° from normal position. Small boost port in piston is just visible. Carb's insulating gasket is at the right.

'V-10' case cover incorporates built-in air filter. The Starter system performed faultlessly throughout the test.

Mechanical details:

The 12LD-X's unusual construction and base mounting has led to a 30% weight increase over the earlier (standard-style) CZ-12ZX recoil-start car engine. Of itself this means longer warm-up periods before engine is ready for full-power runs and before the ANC piston/liner cold clearances becoming slightly looser.

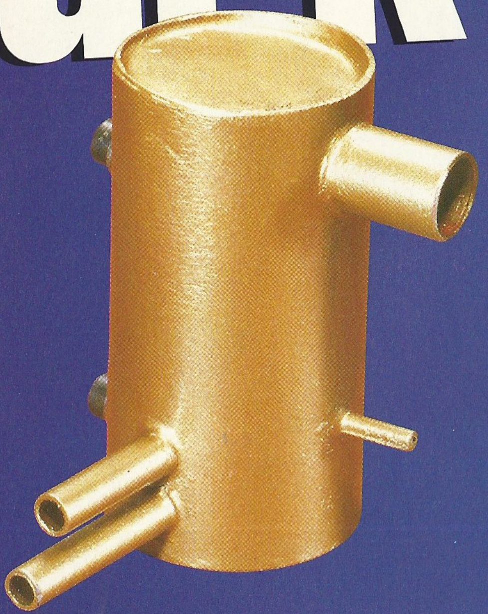
This is a relative matter depending on engine's 'newness'; fuel (Nitro) content; throttle openings and operational RPM's. Suffice to say that early runs on gentle fuels and RPM's led (in this writer's hands) to slightly unsteady running which eased once running-in had been completed and the engine was made to run hotter by being pushed a little harder. The 4 oz. engine block is heavily finned overall and is an ingenious piece of work by the O.S. engineers - representing a considerable investment which may yet have ramifications for other engine designs.

The brass cylinder liner is 'Nicasil' plated and has been rotated 60 from the current rear exhaust position to allow the gudgeon pin to traverse an unported cylinder wall - thus eliminating the need for any circlip retentions within the hi-silicon piston. PTFE end pads in the gudgeon pin prevent wear from sideways pin forces. Bore size at bottom of liner is .0025 in. oversize.

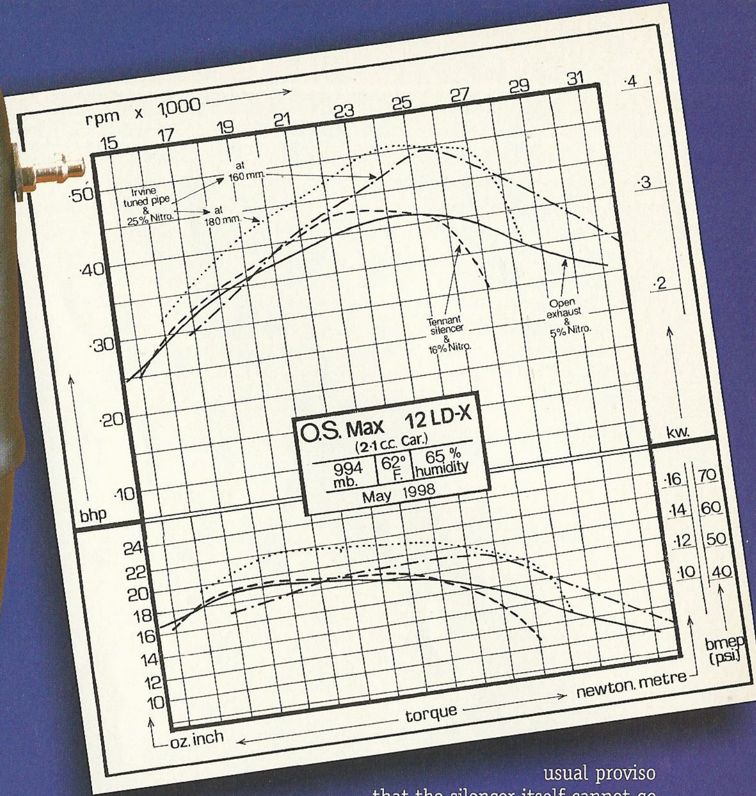
Transfer passages are currently being machined (rather than cast) from within crankcase by use of a ball-cutter. No Boost passage is provided in case, but limited Boost flow occurs through large hole in piston via liner wall thickness.

An aluminium connecting rod (even at this small engine size) has phosphor-bronze bushings at each end, and in common with all other parts is produced to the unremittingly high O.S. standards.

Normal combustion chamber geometry applies here, with a slightly high-side 8.29/1 Effective compression ratio.. probably reflecting the need for more heat in small engines. Actual heat-sink shape is in keeping with the unusual overall engine shape. A normal car style slide carburettor is employed, though its housing and mounting reflects the unusual layout involved. Standard main needle and secondary needle controls are fitted, with 'O' ring seals to ensure precise mixture. An insulating gasket is fitted between carb. and case.



Irvine tuned pipe on the right, prototype 'Can' silencer by Trevor Tennant



The 'recoil' pull-start mechanism

This incorporates rear bronze bearing, a one-way clutch bearing, and the supplementary crank which takes drive from the hand-rotated one-way bearing and transmits this direct to crankpin. These 2 extra bearings are a continual running friction load to the engine, and are a likely power loss relative to the 12-LD (non-starter) engine, although O.S. claim same power figures for both.

What is clear, is the very different 'feel' of such starter-equipped engines. Only having the ability to rotate manually in one direction means that the usual methods of ascertaining compression seal and freeness of rotation are not easily possible. Fortunately, reliance on O.S. workmanship can unhesitatingly relied upon. Early unsteady running has been commented on, and is more an 'operator awareness' point than any engine shortcoming. When higher heat levels were eventually allowed, the 12LD-X really began to sing - and very steadily so. Arguably 'over-cool' running should not be allowed, though this is a difficult decision area for the user faced both with a new engine needing 'running-in' and more so, with an unusually strange configuration. In the event the engine proved more resilient than the writer's apprehensions by some margin.

Test 1

Open exhaust. Fuel 5% Nitromethane with 15% ML70 synthetic and 5% Castor oils. Balance Methanol Plug O.S. no.8.

The usual wide and flat torque curve in Open exhaust form proved true to the normal car engine expectations, though HP peaking at 24,200 RPM was a somewhat lower speed than could be expected from the small engine capacity. It was reasonably obvious at this stage that the O.S. HP claim mentioned earlier did not refer to any Open exhaust usage, though as is frequently the case, they give little information on the precise conditions of use, i.e.. fuel, pipe etc.

Test 2

Trevor Tennant silencer. Fuel 16% Nitro. Same oil and plug as Test 1.

Use of this 'back-pressure' silencer and 16% Nitro. was to provide a 'half-way' house to later more stressful pipe and fuel configurations. It has been an understandable finding that use of medium Nitro. contents (20% to 30%) and silencer combined gives power curve of similar shape and value to the same engine's open exhaust curve when using say, 5% Nitro. but with the usual proviso that the silencer itself cannot go on allowing power levels to be maintained at ever higher RPM's due to inevitable back-pressure restriction. These features were both present here with the exception that a clear advantage over open exhaust was present between 20K and 24K RPM. Trevor Tennant suggests that there is a 'tuned' effect at work. Variously changing overall length of silencer/manifold would enable clearer assessment of its 'tuneable' possibilities for differing RPM's but unfortunately time intruded in this case. As tested here with the standard O.S. exhaust manifold, there is some useful extra urge at medium RPM's where much running could occur.

Test 3 & 4

Irvine tuned pipe (D-IRV101) Fuel 25% Nitro. Oil and plug as Test 1.

The O.S. matching tuned silencer (T-1020) was not available at time of test, therefore the nearest equivalent was provided by the O.S. distributor. Given that O.S. leaflet allows use of both low and high Nitro fuels (5 to 40%), and that a non-OS pipe was now to be used, it can be seen that there was little chance of duplicating the O.S. power claim result. In the event this test

Solid, well engineered crankcase block and base mount combined allowed low vibration levels even at high RPM

a radical approach from O.S.

HP came close, though there was a general reluctance to match the O.S. claimed RPM points for maximum HP. This also raises the question of possible friction differences as between this starter-equipped version and the starter-free 12LD model.

Test 4 showed result of shortening the Irvine pipe by 20 mm. in the hope of reaching to higher RPM for maximum HP. This had little effect on HP itself, but certainly allowed the engine to rotate to much higher RPM's - though at ever-declining HP values.

A Sports Engine

As can be seen there were various different or unknown parameters involved in this test, any one of which may have pinned down the disparities more clearly.

As the 12LD-X is, from the general results obtained here, very much a 'Sports' engine as opposed to an out-and-out racing engine, then the precise performance differences are unimportant. Far more important are the general practicalities of this unusual new engine. This writer went through a sort of 'learning curve' during this test, with the result that the unusual became familiar, and the O.S. virtues of predictability and reliability were re-emphasised.

Once the needle control positions had been finalised, (2.25 turns open for Main needle and 2.75 turns open for Secondary needle) throttle response using Irvine pipe, pipe pressure to fuel tank and 25% Nitro fuel proved satisfyingly vivid. Plug life was less noteworthy using the higher Nitro fuels whereas 16% or lower amounts allowed almost unlimited plug life.

Summary

It was maybe predictable that O.S. would take a serious look at new engine orientations for specific model applications. Their history of mass-production innovation - Wankel, Supercharged 4-stroke - are of themselves proof of their abilities and interest in this direction. Whether sheer competition will see a significant measure of the fruits of these innovations is less certain, because so much experience and know-how has been expended in the 'traditional' layouts by many other manufacturers that the resultant competition is commensurably severe. For the present, this new 'Powerblock' 2.1 cc car engine is an intriguing engine worthy of serious use, adding an unusual flavour to the 'Sports' car arena. RRCI

'The eagle has landed...

O.S. MAX 12LD-X

Weights and Dimensions:

Capacity:	.128637cu.in. (2.1079cc.)
Bore:	.5515in. (14.01mm.)
Stroke:	.5385in. (13.6779mm)
Stroke/Bore ratio:	.976/1
Timing periods:	Exhaust - 157° (angled down 15°) Transfer - 120° (angled up 15°) Boost - 120° (angled up 60°) Front induction - Opens 41°ABDC Closes 54°ATDC Total period 193° Blowdown 18°
Combustion volume:	.20 cc.
Compression ratio:	Geometric 11.54/1 Effective 8.29/1
Exhaust port height:	.166 in. (4.23 mm.)
Cylinder head squish:	.013 in. (.34 mm.)
C/head squish angle:	3°
Squish band width:	.105in. (2.67 mm.)
Carburettor bore:	.212 in. (5.40 mm.)
Crankshaft dia.:	.354 in. (9.00mm.)
Crankshaft bore:	.258in. (6.57mm.)
Crankpin diameter:	.157 in. (4.00 mm.)
C/shaft nose thread:	.194in. x 32 T.P.I. (All near: 5mm x .8mm; 3/16 BSF; 2BA)
Gudgeon pin dia.:	.1375in. (3.5 mm.)
Connecting rod centres:	.92975in. (23.6mm.)
Engine height:	2.52in. (64.03mm.) (Base to filter housing top).
Width:	3.420in.(86.88mm.) (Ex. manifold to pull start casing).
Length:	3.03in. (77.00mm.) (Prop.driver to starter rear).
Mounting hole dimensions:	31.50mm. x 23.0mm. x 3mm. holes
Ex. Manifold bolt spacing:	- 1.023in. (26.0mm)
Starter shaft dia.:	.3145in. (8.0mm)
Weight:	Bare:11.650zs. (331g.) With Irvine D-101 Tuned Pipe 12.950zs,. (368g.) With Tennant Silencer 14.900zs. (423g.)
Crankshaft weight:	.650zs. (19g.)
Piston weight:	.050zs. (2g.)

Performance.

Max. BHP	.51 @ 24,200 RPM (Irvine tuned pipe @ 180mm. & 25% Nitro.) .43 @ 22,400 RPM (Tennant Silencer & 16% Nitro.) .42 @ 24,200 RPM (Open Exhaust & 5% Nitro.)	**Max. Torque**	22 oz. in. @ 18,850 RPM (Irvine pipe @ 180mm & 25% Nitro.) 19.4 oz. in. @ 18,340 RPM (Tennant Silencer & 16% Nitro.) 19 oz. in. @ 17,180 RPM (Open Exhaust / 5% Nitro.)

RPM'S ON STANDARD 'FIXED-WING' PROPELLERS

	Open Exhaust & 5% Nitro	*Tennant Silencer & 16% Nitro*	*Irvine Tuned Pipe @180 mm + 25% Nitro*
7 x 4 Graupner	12,540	12.450	13,060
7 x 4 Taipan	16,060	16,150	16,750
5.5 x 4 Cox	22,550	22,660	23,180
4.5 x 3 Master (from 6x3 Master)	27,750	27,060	28,300

PERFORMANCE EQUIVALENTS:-

BHP/cu. in..	3.26	3.34	3.96
BHP/cc.	.199	,204	.23
BHP/lb.	.576	.46	.63
BHP/kilo.	1.27	1.016	1.38
Oz. in./cu. in..	147.70	150.80	171.00
Oz. in./cc.	9.00	9.20	10.40
Oz. in . / l b	20.50	20.86	27.20
Oz. in./kilo 57.40	45.86	59.80	
Nm./cc.	.064	.066	.074

Manufacturer:- O.S. Engines Mfg. Co. Ltd., Osaka, Japan.
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