The MIKE BILLINTON Test

SUPER TIGRE S61 HELI ENGINE

Being based on the well-proven 'S' series of two-stroke engines, this helicopter version guarantees strong, reliable and steady performance — factors which are vital to the rotating wing class.

Design layout is familiar to modellers everywhere: two-stroke Schnuerle ported, front inducted with ABC piston liner. Unlike the standard 'fixed-wing' engine however, this Heli. engine in common with other manufacturers' Heli. engines, comes equipped with a single compression ring to ease starting problems in the absence of large flywheel assistance granted by normal propellers. The piston ring does result in a slight power loss due probably to its higher friction and small leakage through ring gap. The use of larger diameter flywheels (at same weight) in Helicopters would increase starting inertia and thus enable more frequent use of the more powerful ABC lapped piston engines. The starting problem is of course more pronounced in the larger capacity sizes above say, .40 cu.in. It is worth noting that in the Marine world, even the largest capacity .90 cu.in. Racing engines use the plain unringed piston together with quite high compression ratios. Admittedly they usually have rather more in the way of flywheel weight, whilst the more solid structures of Marine craft can tolerate a greater degree of starter effort.,

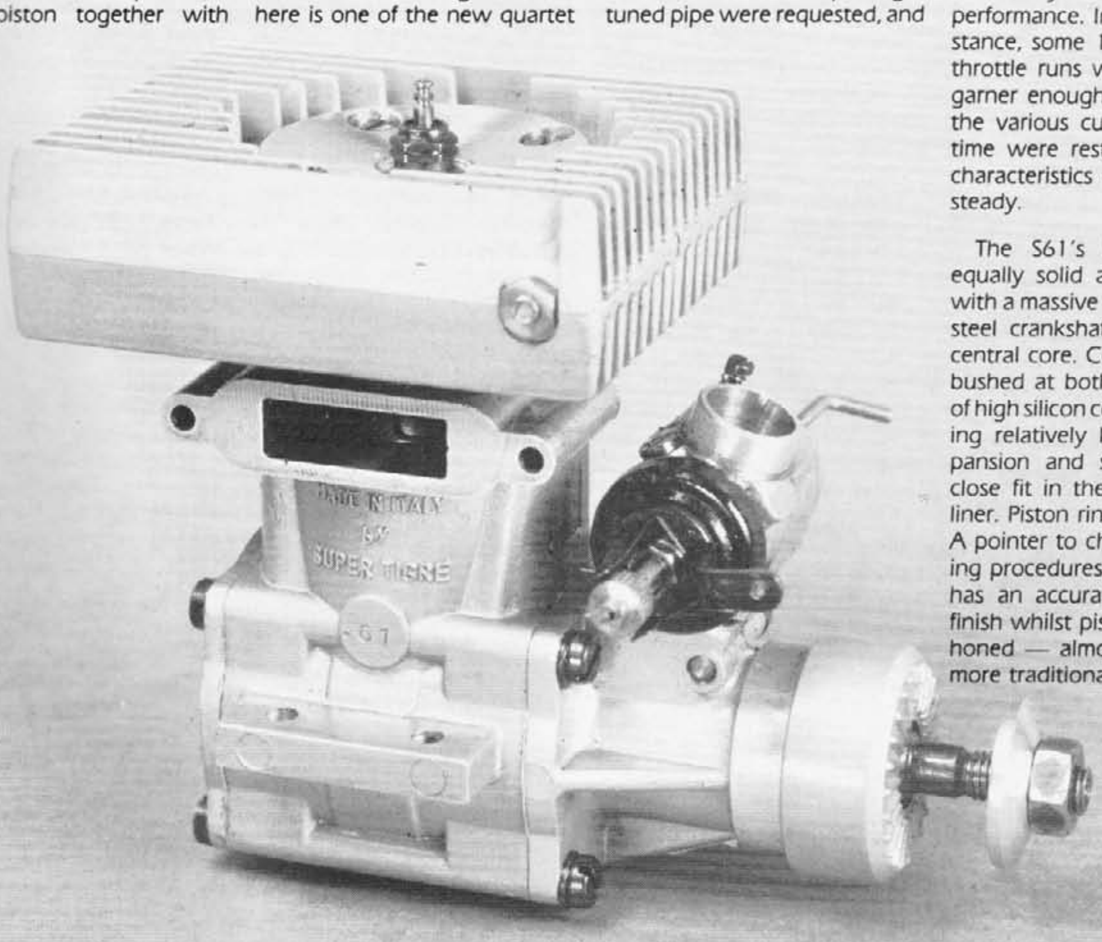
The S61 Heli. engine tested here is one of the new quartet of ringed ABC engines — S29, S45, S61 and S90, and was provided by Tigre Engines UK. It arrives complete with the very convenient and adjustable 'Swing' silencer and, to extend the range of this test, a tuneable 'PAW' muffler and Super Tigre tuned pipe were requested, and both arrived via Mick Wilshere's 'super-swift' spares service.

Together with the Open exhaust figures, the three separate exhaust extensions threw up a profusion of torque curves which necessitated two power graphs to prevent visual confusion. Unfortunately, fuel consumption figures were only obtained in the Open exhaust and 'Swing' muffler modes because of later measuring equipment failure.

Some Mechanical Points

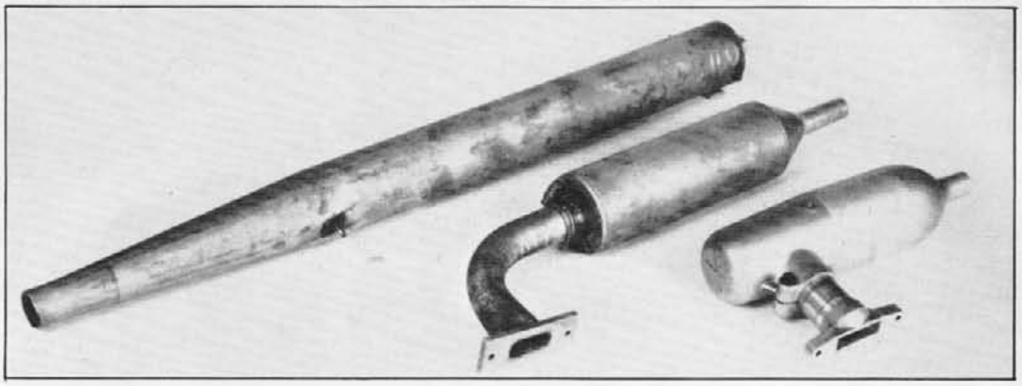
Structurally the S61 Heli. is distinguished by the very large metal heatsink clamped to the solid unfinned cylinder head, which itself is held down onto the very solid 4mm thick upper cylinder flange — a common feature of Super Tigre engines. Additional interest is that the normal copper head gasket is persuaded towards a better seal because the alloy head has a narrow raised ring 1mm wide which presses into the gasket more effectively than the more usual wide band, and mirrors some full-size racing engine practice. Together these upper cylinder features surely contribute to the S61's very steady trouble free performance. In this test for instance, some 130 separate full throttle runs were required to garner enough information for the various curves, and at no time were restarts or running characteristics other than very steady.

The S61's bottom end is equally solid and trouble free with a massive 17mm hardened steel crankshaft providing the central core. Connecting-rod is bushed at both ends. Piston is of high silicon content alloy having relatively low thermal expansion and so allows quite close fit in the brass chromed liner. Piston ring is of cast iron. A pointer to changing machining procedures is that the bore has an accurate fine grinding finish whilst piston is externally honed — almost a reversal of more traditional practice.

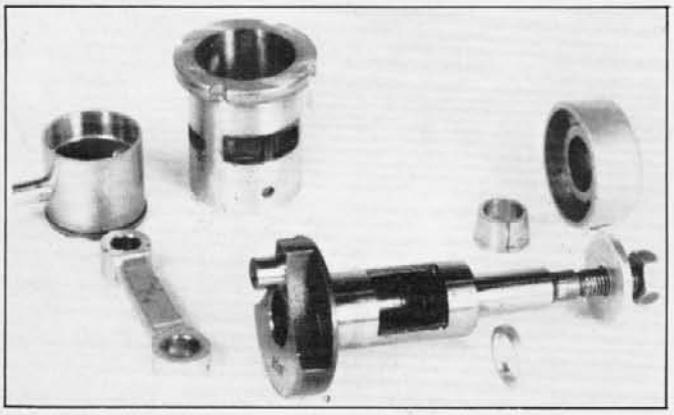


Power Tests
Several standard 'fixed-wing' airscrews were used during initial non-fussy running-in period, and after some ¾ hour running time rpm's were as shown. Fuel used during these checks and all following tests was: 5% Nitromethane, 10% Castor oil with 10% ML70 synthetic oil, 75% Methanol. Glow plug — Super Tigre 1½ volt as supplied.

Test 1. Open exhaust
Small size of fuel jet in carb. clearly required pressure feed of some sort, so a gravity head of 2ft. was used here.



Super Tigre tuned 'quiet' pipe is at top. Next down is the adjustable length 'PAW' muffler. Bottom right shows the Super Tigre 'Swing' muffler, which can be adjusted to a variety of positions.



Massive crank is noteworthy, as is thick cylinder flange at top.

Carburettor linearity test in this format showed that with fuel settings optimised at WOT (wide open throttle) and using a particular load allowing 13,839 rpm, the fuel settings remained nominally correct (without need of new adjustment) when loads and throttle settings were reduced whilst rpm's were maintained in the 13,800 area:—

12 in. This was not available at time of testing. The 'over-long' 18.5 in. tuned length was deemed to be of some interest however, and not surprisingly the peak resonance point was repressed way back to around 9,000 rpm giving a restrained HP of 1.3.

Throttle setting	RPM	Torque	HP	Load dia.
WOT	13,839	118 oz.in.	1.7	8.0 in.
½	13,859	63 oz.in.	.91	6.9 in.
⅓	13,876	38 oz.in.	.55	5.0 in.
¼	13,886	20 oz.in.	.29	4.0 in.
⅕	13,786	9 oz.in.	.13	3.5 in.

The performance result shows bias towards improving low-speed at some expense to the higher rpm end — similar to that noted in a recent Super Tigre G49 sports R/C engine test, and which under environmental noise pressures may become an increasing feature of model two-stroke engines for normal R/C use. Open exhaust HP max. was 1.63 at 15,600 rpm.

Test 2. Super Tigre 'Swing' Silencer
This well constructed device is highly adjustable and useful, and served to reduce sound output appreciably as well as to reduce torque by some 11% at low/medium rpm and 24% at higher rpm. This reined back HP max. to 1.3 at 13,00 rpm.

Test 3. Super Tigre 'PAW' Muffler at 12in.
(direct line from plug to extreme end)
This device restored torque to Open exhaust levels, but the tuned length used here prevented HP rising after 14,00 rpm. Sound output was on a par with the low level of the 'Swing' silencer. In the 10,000 rpm area (using this length), the engine would oscillate 'on and off' the pipe and so it appears preferable to operate the engine at no less than 11,500 rpm.

Test 4. 'PAW' Muffler adjusted to shortest 10¼in.
This raised rpm max. resonance point by 2,000, and liberated a fair amount extra HP to exceed the open exhaust figure as a consequence. Max. HP was now attained at 14,700 rpm and evidence suggests that were it possible to shorten the 'PAW' muffler yet further, then more HP would likely result — but at some cost in noise output.

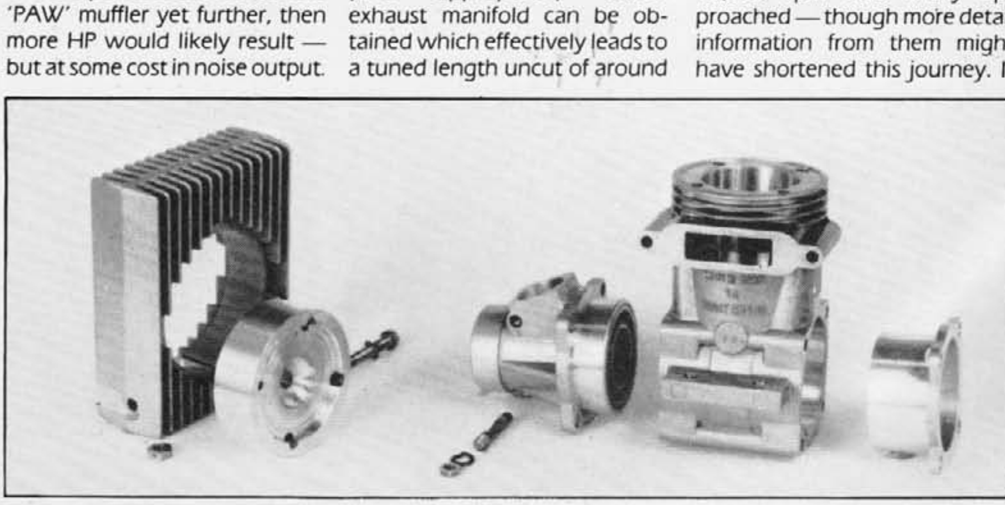
Engine 'osciallation' at this shortest length occurred near 11,600 rpm, so ground rpm should be kept above say, 12,300.

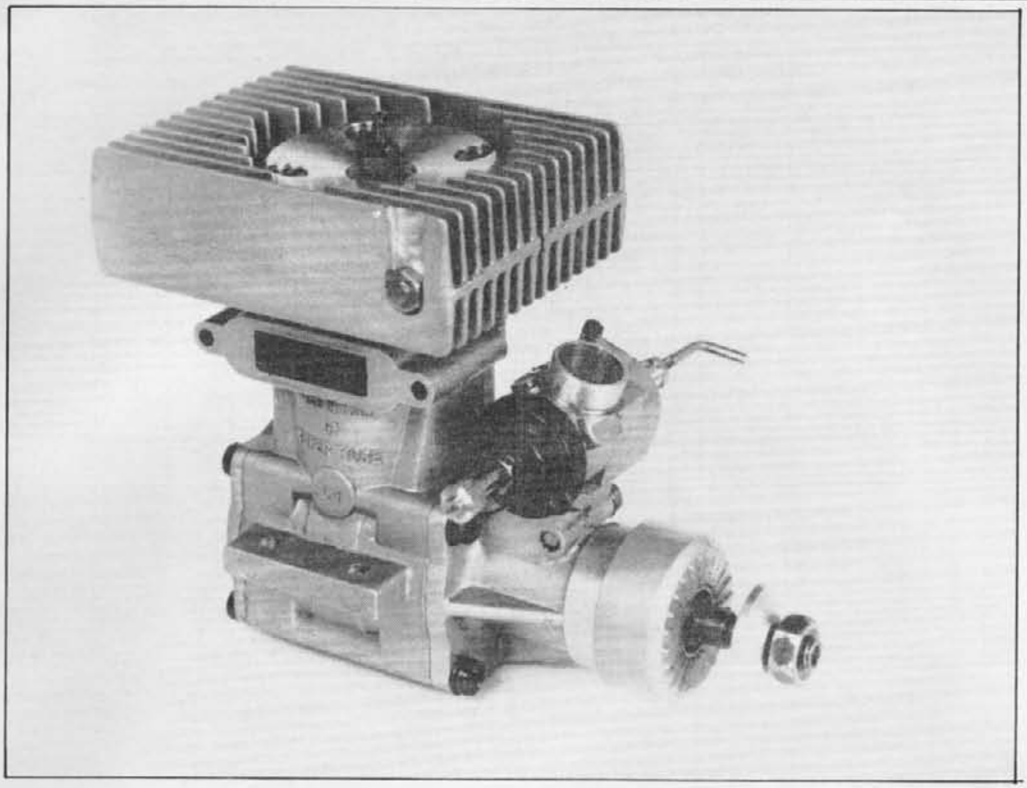
Test 5. Super Tigre tuned 'Quiet' Pipe at 18.5in. from first max. diameter to plug
This unusually long 'tuned' length arose from use of the long exhaust manifold pipe of the 'PAW' muffler in conjunction with the uncut Super Tigre tuned pipe. A more convenient (and appropriate) finned exhaust manifold can be obtained which effectively leads to a tuned length uncut of around

Test 6. Super Tigre pipe now shortened to 14 in.
Torque and HP peaks shifted up the rpm scale to give higher max. HP of 1.55 at 12,700 rpm.

Test 7. Super Tigre pipe now at 11 in.
This last test raised resonance point to a similar area of the Open exhaust peak and increased HP significantly to 1.82 at 15,300 rpm.

So, after some effort the manufacturer's HP claim of 1.8 at 16,000 rpm was finally approached — though more detail information from them might have shortened this journey. It





Large heat-sink head keeps temperatures under control.

serves to highlight the fact that very few manufacturers are giving too much away as to precise equipment used when obtaining their figures — which is a bit unfortunate giving that the two-stroke engine is quite capable of having its power levels doubled when fitted with appropriate tuned pipe plus use of more powerful fuel.

Consequential points

1. Time precluded more moves up the rpm scale by yet further shortening of pipe length, though the modest exhaust timing of 160° probably means that no great gains should be expected.

2. As noted before, the Super Tigre 'quiet' pipe is both a quite flexible and non-peaky tuned device and as such does not extract the maximum power which can be obtained by other design tuned pipes. This probably results from the widely known effect of long parallel sections of the pipe between the two pipe tapers. In the Super Tigre pipe this section is 5 in. in length. The implication must be that the S61 would reveal more power if an alternative pipe were to be used.

3. The adjustable 'PAW' muffler almost generates as much power as the Super Tigre 'Quiet' pipe, and band-width flexibility is similar. Its main virtue is the speed with which its length and thus max. HP point can be adjusted on the flying field. It would seem therefore to offer much convenience to the Helicopter flier who could then be somewhat freed from changes to Heli. head gear ratios which can be required to suit particular fixed engine parameters — the 'PAW' muffler becomes in a way a useful adjustable 'gearbox'.

4. As can be seen from the two graphs, the modern two-stroke engine can be persuaded to produce performance in a variety of rpm areas and so an engine test such as this really begins to shade over into more of a 'tuned pipe' test.

An Idling speed of 2,400 rpm was an easy achievement using a Graupner 11 x 6 propeller and when Tuned pipe at 11in. was fitted.

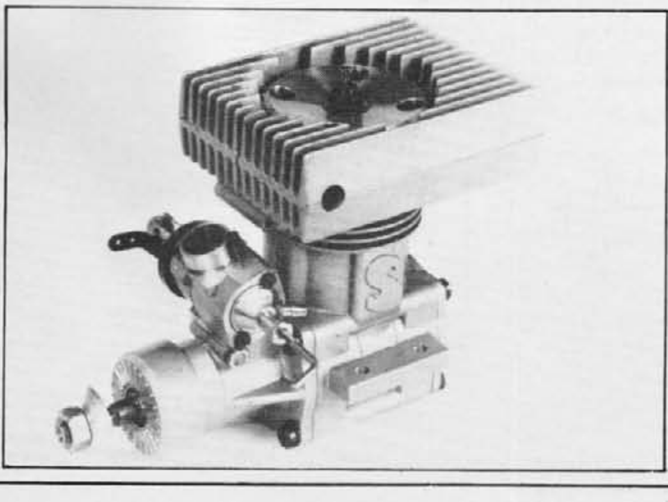
Summary

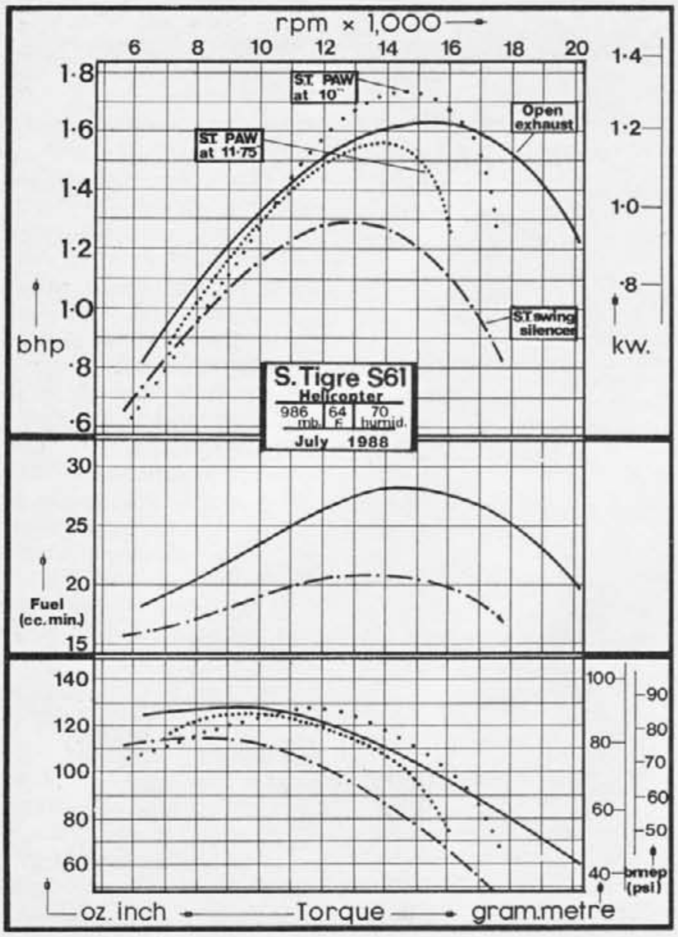
The S61 Heli. engine is typical of Super Tigre products — solid, honest down to earth engineering offering good value. Performance is continually predictable and, yet again judged at least by the test results, seemingly likely to occur over long periods of time.

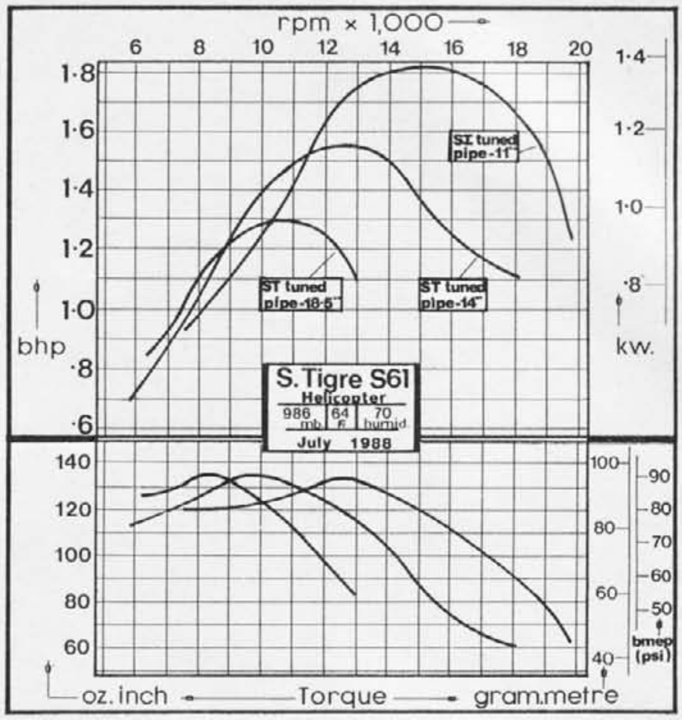
Dimensions and Weights

Capacity — .6068 cu.in. (9.97cc)
Bore — .946 in. (24mm nominal)
Stroke — .866 in. (22mm nominal)
Stroke/Bore ratio — .916/1
Timing Periods — Exhaust — 160°
Transfer — 126°
Boost — 116°
Front Induction — opens 34° ABDC
closes 46° ATDC
Total 192°
Blowdown 17°
Exhaust port height — .244 in. (6.2mm)
Combustion chamber column — .7 cc
Compression ratios — Geometric — 15.2/1
Effective — 11.2/1
Cylinder head squish — .022 in. (.56mm)
Squish angle — 3°
Squish band width — .134 in. (3.4mm)
Crankshaft dia. — .6695 in. (17mm nominal)
Crank bore — .,471 in. (11.97mm)
Carburettor bore — .36 in. (9mm nominal)
Crank nose thread — ¼ x 28 tpi (¼ UNF)
Gudgeon pin dia. — .237 in. (6mm nominal)
Connecting rod centres — 41mm
Crankpin dia. — .276 in. (7mm nominal)
Width between bearers — 1.66 in. (42.26mm)
Length — 3.56 in. (90.56mm) (backplate to prop. driver)
Width — 2.36 in. (60mm) (across lugs)
Height — 3.97 in. (101mm)
Ex. flange bolt spacing — 1.85in. (47.25mm)
Mounting holes — 20mm x 50mm x 4mm holes
Frontal area — 7.4 sq.in.
Overall weight — 23.4 ozs. (662 gms)

'S' series engines are soundly constructed guaranteeing long-term reliability.







Performance

Max. BHP — 1.82 @ 15,300 rpm (S.T. tuned pipe/5% nitro.)
1.63 @ 15,600 rpm (Open exhaust/5% nitro.)
Max. Torque — 135 oz.in. @ 10,000 rpm (S.T. pipe)
128 oz.in. @ 9,500 rpm (Open exhaust)

RPM's on Standard 'Fixed-Wing' Propellers

	Open ex.	Swing Muffler	PAW @ 11.75	PAW @ 10.	Tuned pipe 11"
15 x 6 Airflow	8,207		8,126		
13 x 6 MK glass	10,720	10,287			
12 x 7 Mastro	11,064	10,583			
10 x 8.3 Graupner 3-bl.	12,280	11,694		12,626	
11 x 7.5 Airflow	12,9091	12,353			
11 x 6 Graupner	13,720	13,123		13,939	14,192
10 x 6 MK Glass	14,605	13,949			

Performance Equivalents

BHP/cu. in. — 2.99
BHP/cc — .18
Oz.in./cu.in — 222.4
Oz.in./cc. — 13.5
Gm. metre/cc. — 9.52
BHP/lb. — 1.24
BHP/kilo — 2.75
BHP/sq.in. frontal area — .246

Manufactured by Super Tigre SRL, Bologna, Italy and distributed in the UK by Tigre Engines.