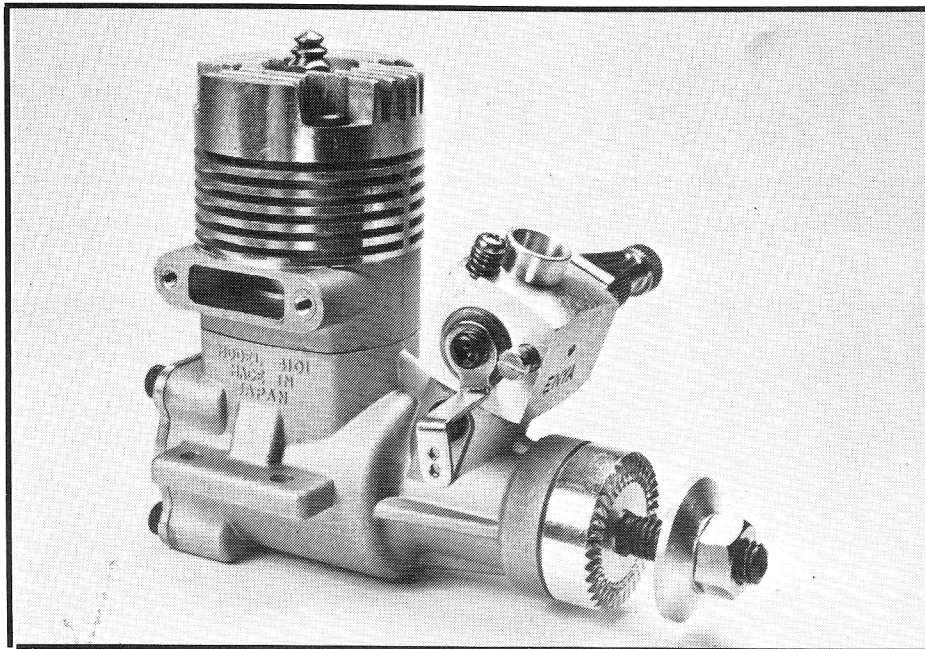
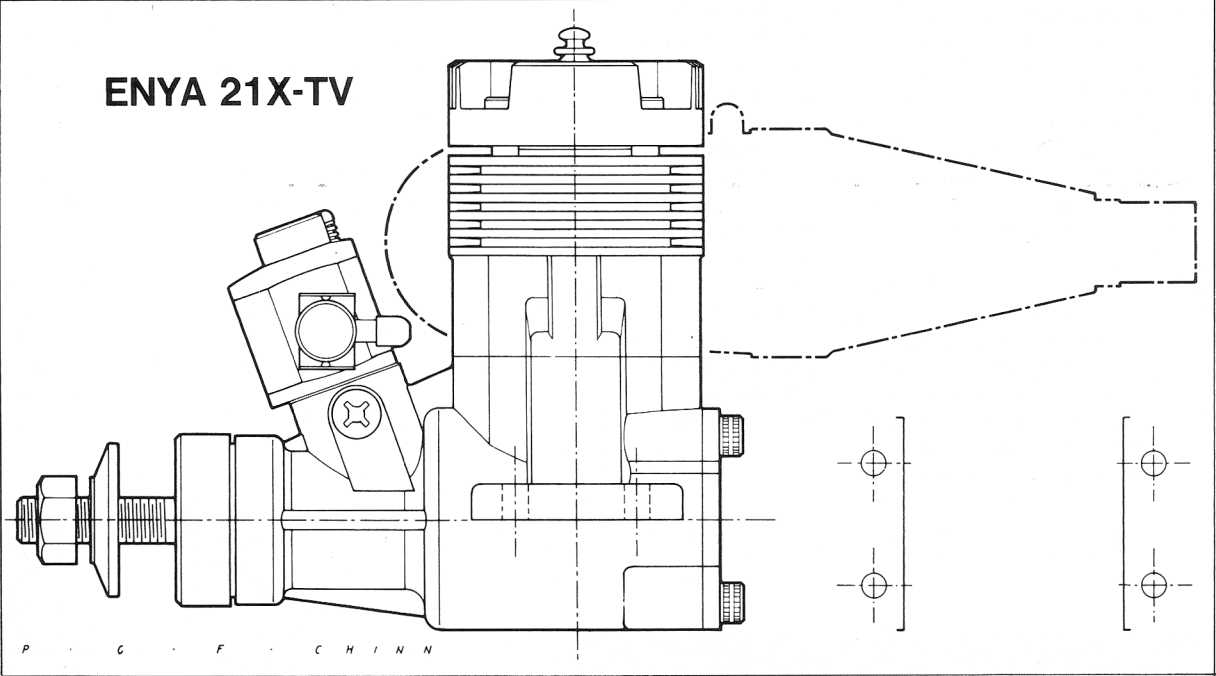
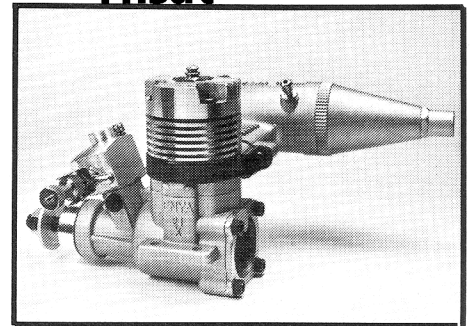


# ENYA 21X-TV

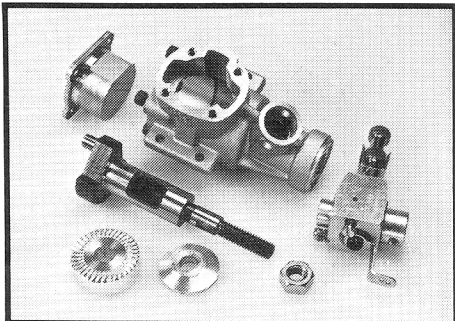


The Schnuerle-scavenged Enya 21X-TV is over 50% more powerful than the best of previous crossflow Enyas of similar displacement; castings are of very sturdy proportions.

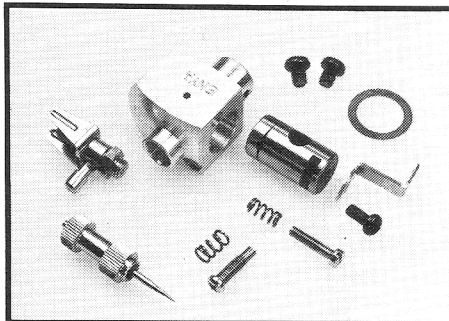
## Scanning and Digitization by Hlsat



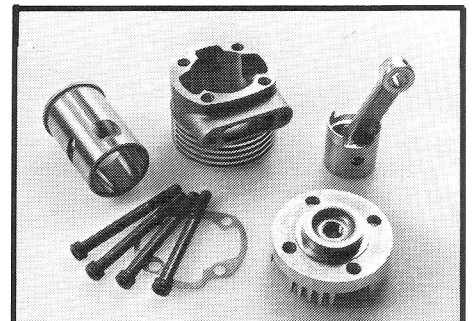
Power loss with muffler is most severe at power curve peak, modest on 9x4 or more.



21X has front housing in unit with crankcase while cylinder casing is separate.



Note tapered metering slot on barrel surface; throttle stop/airbleed screws front.



View of chromed aluminum sleeve, diecast block and ringless piston; huge conrod.

# ENGINE REVIEW

by Peter Chinn

## SPECIFICATIONS

**Type:** Single-cylinder, Schnuerle-scavenged, side-exhaust, two-stroke-cycle, with crankshaft rotary-valve and twin ball-bearings. Throttle type carburetor with automatic mixture control.

**Checked Weights:** 234 grams (8.25 oz) less muffler; 286 grams (10.1 oz) with muffler.

**Displacement:** 3.463cc (0.2113 cu in.)

**Bore:** 16.6 mm (0.6535 in.)

**Stroke:** 16.0 mm (0.6299 in.)

**Stroke / Bore Ratio:** 0.964:1

**Measured Compression Ratio (full stroke):** 8.5:1

**Measured Compression Ratio (effective):** 6.3:1

**Power Output, Gross (as tested):** 0.57 bhp at 18,500 rpm.

**Specific Output (as tested):** 2.70 bhp/cu in. (less muffler); 2.32 bhp/cu in. (with muffler).

**Power / Weight Ratio (as tested):** 1.10 bhp/lb (less muffler); 0.78 bhp/lb (with muffler).

**Manufacturer:** Enya Metal Products Co. Ltd., Tokyo 176, Japan.

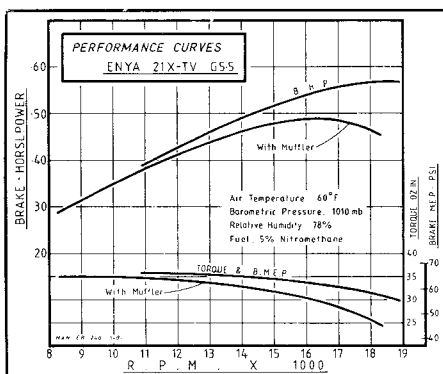
**U.S. Distributor:** Enya Model Products Co., P.O. Box 286, Fords, NJ 08863.

• Enya motors of around .20 cu in. have been quite numerous. It was with an engine of this size, the 0.196 cu in. "Model 4002," that the Enya brothers first began producing model motors on a mass-production basis nearly thirty years ago. Prior to this they had manufactured engines in smaller quantities, using sand castings, starting with the original large Enya 63 and 60 motors and going on to the original sand-cast Enya 19 in 1950 from which the diecast Model 4002 was developed.

In 1956, the Model 4002 was replaced by the Model 4003, otherwise known as the Enya 19-III and, as interest in radio-control began to increase, this motor was also offered in a TV (throttle valve) version. Six years later, the 19-III was superseded by the further improved Model 4004, or 19-IV, and in 1970 this was replaced by the Model 4005 19-V to which a ball-bearing version was added later. The current version is the Model 4006 or 19-VI, also available with either a bronze bushed bearing or twin ball-bearings.

All these engines have been of the traditional crossflow-scavenged type but, following the introduction of Enya's first Schnuerle-scavenged engines, the 60XF and 40X, an entirely new .20 cu in. Schnuerle-scavenged model, the 19X (0.198 cu in.), was added to the range.

Although several of the earlier models have been dealt with in the past, it is many years since we last featured one of these popular smaller Enya engines in *M.A.N.*,



so, when one of the latest series, the 21X, was submitted to us for editorial comment, it was decided to include it in the "Engine Review" test series.

The 21X is basically a stroked version of the 19X, but with an Al-Chrome piston/cylinder assembly—i.e., instead of having a lapped cast-iron, or ringed aluminum, piston in a steel cylinder liner, or a ringless aluminum piston in a chromed brass liner, it has (like the Enya 60X and 45X models) a ringless aluminum piston running in a chromed aluminum liner.

The 21X is also obtainable in a racing car version and it was, of course, to bring its displacement closer to the internationally recognized 3.5cc limit for R/C cars that its stroke was increased by just one millimeter, thereby raising the engine's swept volume from the 3.246cc (0.198 cu in.) of the 19X, to 3.463cc (0.211 cu in.).

It should be pointed out that there are a number of differences between the 21X car engine (see *M.A.N.* "Engine Round-Up," August 1980 issue) and the 21X aircraft engine dealt with here, including a heat sink head and a much larger bore carburetor, which give the 21X-Racing model a performance more appropriate to the needs of the modern high-performance model racing car.

Compared with the earlier crossflow-scavenged Enyas in the .20 cu in. group, the 21X is technically more advanced, of more refined construction and has considerably greater potential performance-wise. Details are as follows:

**CRANKCASE & CYLINDER BLOCK.** The 21X features a two-piece body casting in which the cylinder casing separates from the crankcase just below the exhaust stack. The two parts are aligned by the cylinder sleeve and the entire assembly, including the head, is tied together with four long 3.5 mm screws which pass through the head and block and into tapped holes in the crankcase.

Bypass channels are formed in both castings and a thin paper gasket is used between them to seal the joint. Both castings are of sturdy proportions and the crankcase includes an integral front housing and a 12 mm i.d. intake boss.

**CRANKSHAFT & BEARINGS.** The crankshaft, case-hardened and with a blued anti-corrosive finish except on its working diameters, is machined in one piece with a solid 5 mm diameter crankpin and a 7 mm thick crankweb. Counterbalancing is by means of web cutaways each side of the crankpin. The shaft has a 12 mm dia. main journal, a 7 mm dia. front journal and reduces to 6 mm for the M6 x 1.0 metric thread.

The gas passage through the shaft is 8.3 mm bore and draws mixture through a rectangular valve port, 13 mm long. This uncovers a parallel sided intake port for approximately 195 degrees of shaft rotation, timed from 36 degrees after bottom dead center to 51 degrees after top dead center—according to our measurements of the test motor.

The crankshaft runs in a 12 x 24 mm NSK-6901 10-ball steel-caged ball journal bearing at the rear, and a 7 x 19 mm NSK-607Z 6-ball steel-caged shielded ball journal bearing at the front. The front ball bearing is also protected by the aluminum prop driver which is recessed to fit over a relief on the o.d. of the front housing. The prop driver is keyed to the shaft by two flats on the end of the front journal.

**CYLINDER LINER.** The aluminum alloy cylinder liner has a hard-chromed bore and a wall thickness of 1.85 mm (0.073 in.). It has conventional Schnuerle-plus-third-port scavenging comprising an unbridged exhaust port that is flanked by two bypass ports and is diametrically opposite a third transfer port that is inclined upward fairly steeply. The main bypass ports are not only angled sharply away from the exhaust, they are also inclined slightly upward.

Port timings, according to our measurements of the test engine, are: exhaust 151 degrees of crank angle; main bypass ports 128 degrees; and third port 122 degrees.

The cylinder bore is, of course, tapered towards the top to improve piston seal with the ringless piston. The actual reduction in diameter is of the order of 0.001 in.

**PISTON & CONROD ASSEMBLY.** The ringless piston is machined from special high silicon content aluminum alloy combining the advantages of a low coefficient of expansion with hard wearing properties. It has a flat deflectorless head and rectan-

gular skirt cutaways, fore and aft, to avoid masking the main bypass channels at the bottom of its stroke. It is fitted with a full-floating 4 mm solid wristpin retained by wire circlips. Complete with wristpin, the piston checked out at 5.1 grams (0.18 oz). The connecting-rod is a hefty aluminum alloy forging with bronze bushes and lubrication holes at both ends. The rod, which weighs 3.8 grams (0.134 oz), has a 6.7 x 4.2 mm section shank and generously proportioned eyes; 8 mm o.d. x 8.3 mm wide at the wristpin end, and 9.8 mm o.d. x 5.5 mm wide at the crankpin end. The rod is 28 mm long (1.75 x stroke) between centers.

**CYLINDER HEAD & BACKPLATE.** The cylinder head is typically "Enya" in appearance: it is pressure diecast with fairly deep tapered cooling fins and a bright polished perimeter matching the cylinder fin edges. The combustion chamber shape is of the usual bowl-and-squish-band form; a 2.5 mm wide squishband surrounding a fairly shallow (2.6 mm) bowl. The ignition plug hole has a brass thread insert and a 0.3 mm (12 thou.) soft aluminum gasket was fitted to our test motor, giving a nominal full-stroke compression ratio of approximately 8.5 to 1. (This, incidentally, is rather less than the nominal figure quoted by the manufacturer.)

The crankcase backplate is a deep pressure casting and is attached with four 3 mm socket-head cap screws. A paper gasket is used to seal the joint between the crankcase and backplate.

**CARBURETOR.** The carburetor is an Enya G5.5 Type with 5.5 mm i.d. choke and an effective choke area of approximately 18 sq mm. This compares with approximately 30 sq mm for the G7 carburetor fitted to the racing version of the Enya 21X, but is still a relatively large area for a 3.5cc R/C engine.

Like others in the Enya 'G' series, the carburetor is of the fixed automatic mixture control type. Fuel is fed into the body through a conventional needle-valve assembly. From here, the amount of fuel conveyed to the jet tube, which is fixed in the throttle barrel, is regulated by a tapered groove in the surface of the barrel. The taper of the groove is such that the quantity of fuel metered to the jet is correctly matched to the air admitted as the throttle is closed—i.e., there is no provision for manually adjusting the fuel/air mixture ratio at part throttle settings. This simplifies throttle adjustment somewhat but, in order to ensure that the all-important idle mixture strength can be fine-tuned, an airbleed screw is also provided.

The carburetor has a machined bar stock aluminum body and a ground steel throttle barrel.

**MUFFLER.** The muffler supplied for use with the 21X is of the usual Enya design; namely, a plain expansion chamber with a pivoted cover plate to permit exhaust port priming. It also has a fitting for pressurizing the fuel tank and is attached to the engine by means of an external steel strap. The muffler has a volume of 40 milliliters and a 7.6 mm i.d. outlet nozzle giving a fairly generous outlet area of 45 sq mm.

**PERFORMANCE.** The standard Enya instruction leaflet supplied with the 21X lists three recommended fuel mixtures. Each is based on a 20 percent castor-oil lubricant content: the first a straight methanol/castor-oil mixture; the second containing 5 percent nitromethane; and the third specifying 10-20 percent nitromethane. We used the straight 80/20 mix for breaking-in, then changed to the 5 percent nitro mix for testing since this corresponds to the standard mixture used for most of our tests of R/C engines. The glowplug used for all the tests was the Enya No. 3.

Unlike some other engines using ringless aluminum pistons in chromed bore non-ferrous cylinders, the Enya's piston was not unduly tight at the top of its stroke. An excessively tight piston can complicate cold starting, but the 21X started easily from cold, and when hot it would usually restart on a single flip of the prop. The only time we found it a bit less responsive was after it had been allowed to cool, was not cold, but required slight choking. Quicker response was then obtained by applying an electric starter.

Overall handling qualities were very good. The engine always remained very docile when being hand-started, never kicking or biting, and it reacted positively to the needle-valve without being unduly sensitive.

No problems were encountered with the Enya during breaking-in. As already noted, it was quite free, from new, and it showed no tendency to overheat or tighten up. Our test motor was put through a series of slightly rich mixture runs totalling about thirty minutes, and then a further half-hour of running time was logged prior to any test figures being taken. In fact, this extra break-in time was given more as a courtesy than a necessity: checked on 10x4 and 9x4 props after 30 minutes and again after three hours of running time, no change in performance could be detected.

The effect of fitting a muffler to a two-cycle engine can differ markedly between one combination and another. Quite apart from the actual percentage power loss caused by different mufflers, the way in which this power loss is distributed through the output curves can vary considerably. Fitting a muffler may, for exam-

ple, lower the engine's torque over the whole of its full-throttle rpm range, the result of which will be a power curve following much the same shape as the open-exhaust one but with power reduced at all load speeds.

Alternatively, one may find that the muffler has little or no effect on maximum torque but causes an increasing loss as load is reduced, so that the full power-absorbing effect is only evident at the top of the power curve. Such was the case with the Enya 21X when fitted with the maker's muffler. Here there was very little difference in performance, with or without the muffler, when the engine was loaded down to around 10,000 rpm, but there was a power loss of approximately 14 percent at the peak of the bhp curve (which, incidentally, occurred at over 2,000 rpm earlier) with the muffler fitted.

In terms of power loss on the most useful prop sizes, the Enya muffler is not too bad. On 10x4 and 9x5 sizes, for example, the loss was only around 200-300 rpm, rising to 400-600 rpm on 9x4 and 8x5 sizes. These are static rpm figures, of course. The losses in the air would be a little higher.

Actual prop rpm recorded with the 21X, less muffler, included 10,100 rpm on a 10x5 Top Flite maple; 10,950 on a 9x6 Zinger maple; 11,600 on a 10x4 Top Flite maple; 12,000 on a 10x4 Zinger maple; 12,200 on a 9x5 Top Flite maple; 13,500 on a 9x4 Zinger maple; 14,200 on a 9x4 Power Prop maple; 15,000 on an 8x5 Zinger maple; 15,800 on an 8.5x4 Zinger maple; and 16,300 on an 8x5 Power Prop maple.

As the performance graph shows, gross power output, determined from the results of the dynamometer test, was approximately 0.57 bhp at 18,500 rpm. This, equal to a specific output of 2.7 bhp/cu in., is well up to expected levels for a modern Schnuerle-scavenged .21 cu in. R/C aircraft engine running on mild fuel. A nominal rating of 0.55 bhp at unspecified rpm is given in the manufacturer's publicity material, but this probably refers to the performance available with the most powerful of the three fuels recommended, i.e., a 20 percent, or larger, nitromethane content. In any case, it would not be unreasonable to estimate that, under more favorable conditions, a gross output of better than 0.60 bhp on 5 percent fuel might be obtained.

The throttle worked well and, notwithstanding the fact that the manufacturer quotes a minimum rpm of 3,000, our test motor idled safely and continuously at 2,600 rpm when checked on 9x5 and 10x4 props.

In all, the Enya 21X is a pleasant little motor; powerful, smooth running and seemingly without vices. Stripped down and examined at the conclusion of our tests, it was found to be in excellent shape. Apart from slight discoloration of the combustion chamber and the interior of the exhaust stack, it appeared as new: the cylinder wall and piston skirt were virtually unmarked and all bearings were in perfect condition. ■