# Cox Tee Dee .010

ENGINE ANALYSIS 88

## COX TEE-DEE ·010

By R. H. WARRING

The Tee Dee .010 was the first of the new Cox front rotary series which we have had the pleasure of handling and testing and without qualification we rate it as the finest example of precision miniature production engineering we have seen. Pro-British as we may be this is a job which only Cox could have done so well and we freely admit that no British manufacturer could begin to compete on such lines. Apart from the consider able difference in the commercial market the Americans have about ten times the sales potential with their greater population and higher average income we just have not got the equipment or "know how" in this country to tackle such a sub miniaturised job so successfully.

The Tee Dee .010 is worth the money just to look at and handle, outstandingly attractive in appearance and presentation and equally admirable as an example of engineering skill. The Tee Dee design and this will, no doubt, apply throughout the rest of the series has the same impact on the model engine world as did the Arden when it first appeared a design and production in a class apart.

The Tee Dec .010 is, of course, really a "toy" with a primary appeal because of its novelty value in matching tiny model sizes. It is not the smallest commercial motor that has been produced, nor the lightest, but whereas its sub-miniature predecessors have been "marginal" in power output and often tricky to start and handle the Tee Dee retains ample "lull size" model engine characteristics and develops plenty of power in proportion to its size. It is the only sub-miniature motor which has yet been produced which will fly a stunt control line model, for example, and give a genuine aerobatic performance. Many motors four times the capacity of the Tee Dee leave much to be desired in this respect.

On the performance side the most outstanding characteristic of the Tec-Dec is its extremely high operating speed, and also the considerable range of speeds over which it can be run. The extremely efficient moulded plastic propeller supplied by the engine is 3 inches diameter by If inch pitch with wide blades, which it turns at 27.000 r.p.m. to develop a very appreciable thrust. It will also drive larger size propellers right up to 6 x 3 sizes, but not with the same verve. Starting remains easy, but the engine is definitely struggling on a 6 x 3 or 5 x 4 and revs quite obviously pulled right down Thrust is also decreased, and in view of the characteristics of the torque curve there is no point in trying to operate the engine on larger propellers. It develops maximum torque somewhere around 24.000 r.p.m. and maximum power output at approximately 32.000 r.p.m.

Since the torque generated is only of the order of one ounce-inch, testing an engine of this size sets particular problems as conventional equipment is not sensitive enough or accurate enough to measure the small difference involved. Even speed measurement is difficult, without further special equipment, since the "normal" r.p.m. operating range for the Tec-Dec is well above the maximum available on the stroboscope. Nor can a reed tachometer be used to check the order of stroboscope readings. Apart from the fact that the reed tach, scale does not extend up to anything like the speed range covered, there is just not enough vibration most times to energise the reed in any case.

The majority of torque readings were, therefore, established using calibrated torque bars normally used for sub-miniature electric motor testing. These readings must still be regarded as somewhat tentative, largely because the calibration figures are not rated for such high speeds and true values may be modified by scale effect. Although shown to be free from scale effect, for the purpose for which they were originally intended, this did not visualise speeds greater than 10.000 r.p.m. and hence torque absorption figures have been extrapolated from the original calibrations.

In any case, the peak B.H.P. figure is largely of academic interest only. The real proof of performance is that there is a sub-miniature engine which will really fly a matched size of model, free flight or control line, with performance to spare, on the design propeller.

The peak B.H.P. figure arrived at, in fact, is quite fantastic virtually the same order as that of 0.5 c.c. glow motors but direct comparison is unrealistic because of the extremely high speed at which peak B.H.P. is given. Thus the useful load in terms of propeller size is directly restricted by the necessity of obtaining high speed operation so that a small diameter size and very small pitch is the only practical choice.

Starting characteristics ate excellent, and perfectly straightforward. A coil spring starter is supplied, which can be slipped in place over the front of the engine and located by engaging the loop end over the stub pipe on the side of the intake moulding. The Tee Dee likes a little prime through the exhaust with the port closed and needle valve opened to a slightly rich position (approx., five turns open).

The only thing that does upset the handling characteristics to an extent is gumminess resulting from residual fuel, causing excessive initial drag on the piston (and possibly a flooded cylinder by the time it has washed off), or even clogging the jets. It will not take kindly to being left after running on some of the fuels notorious for the gummy deposits they form on standing.

We did not find fuel mixture as such critical, but a high nitro content fuel is necessary for maximum performance and smoothest running. A nitromethane content of 10 per cent, seems a minimum requirement. All the test running was conducted on Record Super Nitrex which have perfectly smooth running and first time starting and a r.p.m. figure for the standard propeller within 100 of the manufacturer's figure (the manufacturers specifically recommending Thimble Drome fuel for optimum performance.

Constructionally, the Tee Dee features a number of original design features. The familiar Cox type crankcase is retained, machined from solid bar, with a standard Cox type mild steel cylinder screwing into position. Two transfer ports are formed on the inside of the cylinder, diametrically opposed, overlapping the exhaust by some 80 per cent. The turned aluminium head containing an integral glow element screws into the top of the cylinder and seals on a thin copper washer.

A front rotary port opening is machined in the top of the crankcase bearing length giving a rectangular opening approximately 5/16 in. long and just over 3/32 in. wide in a cut-out "flat". Onto this assembles a plastic moulding comprising a sleeve and angled stub intake tube. A ridge inside this moulding locates it accurately with respect to the "flat" so that the choke tube opens directly into the crankcase port. The moulding, which is an infection moulding, is retained in position by a threaded collar screwing onto the front of the crankcase.

To complete the intake assembly a venturi insert screws down into the plastic stub tube, carrying also the needle valve housing. The latter comprises a screwed housing for the needle valve itself to the rear of the main body which is drilled out to fit over the venturi stem. A small hole admits the fuel mixture into the body hole (and how this small hole is drilled, we do not know).

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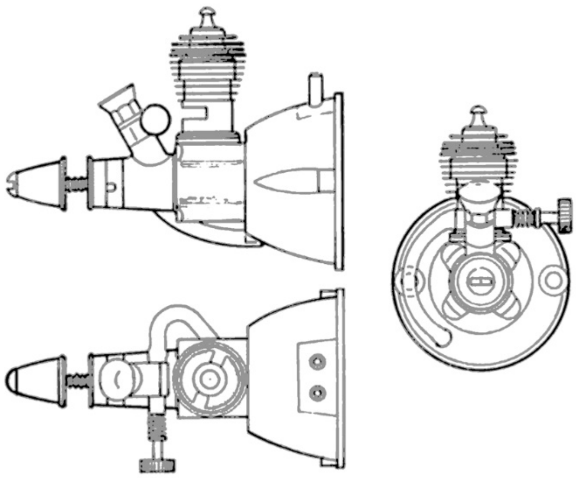
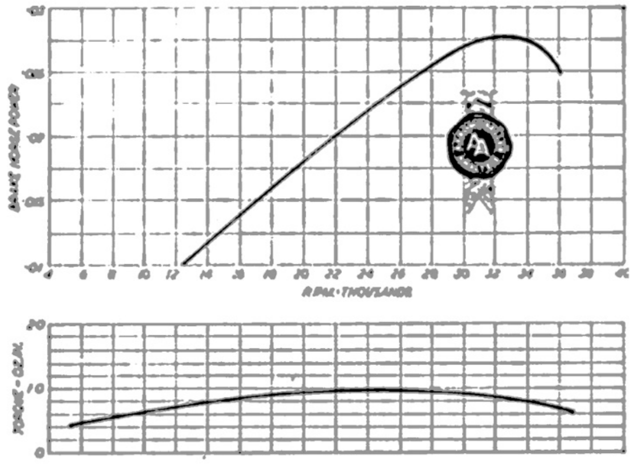





From there passage into the venturi throat is around a narrow circular passage covered by the needle housing body and three tiny holes through the venturi stem.

These four small holes are the ones which can readily be blocked with dirty or gummy fuel. The spray-bar body, incidentally, can be locked in any position when tightening the venturi, so if desired it can be angled backwards slightly. Provision is also made for utilising the crankshaft port to provide tank pressurisation, if required. A pressure tapping point is given by a small tube projecting to the right on the plastic moulding. This is blanked off by the crankcase metal, as originally fitted, but can readily be drilled through (with shaft removed) to produce the necessary port opening.

The crankshaft is quite large for the size of engine .162 in. diameter with 3/32 in. diameter hole down the centre. The port is rectangular, just under 3/16 in. long and 3/32 in. wide. The shaft terminates immediately in front of the bearing in a knurled length carrying the propeller driver and is drilled and tapped from the front to carry a screw to form the propeller shaft. The crank web is 5/16 in. diameter and counterbalanced, with a 1/16 in. diameter crankpin. The whole shaft is hardened and ground to finish, including the crankpin. The main bearing length appears to have been honed to finish.

The flat topped piston is machined with very thin walls, copper plated inside and the top and then hardened and ground to finish.

The diminutive connecting rod actually tapers in diameter, terminating in a ball little end, spun over to lock into the top of the piston. Piston cylinder fit is extremely good and undoubtedly truly concentric. Compression is quite outstanding.

Two alternative back plates are provided, both injection moulded plastic. One acts simply as a back plate and radial mount; the other incorporates a tank and integral radial mount. Each back plate attached with four screws to the crankcase and in the case of the tank mount a further moulded plastic back plate is used, held by a central screw, to provide a tank end. The material used for these mouldings and the front intake unit, is one of the high strength materials peculiar to America and relatively unknown in this county, combining the strength of nylon with none of its disadvantages.

The complete pack also includes a diminutive "universal" wrench for disassembling all screwed parts, moulded propeller, starter spring and alternative back plate.

If a summary of qualities is needed, we can best say that the Tee Dee .010 is way out ahead of anything else in its class in performance, design, quality of workmanship and value. Not even the most competent model engineer could produce a better job as a “one off” project.

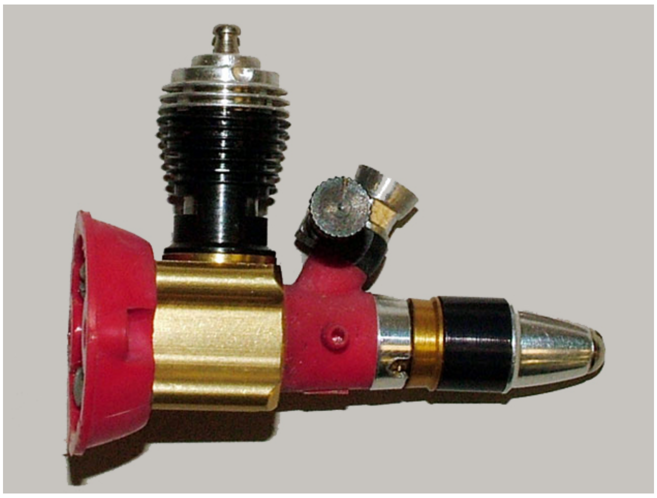
# Cox Tee Dee .010

**SPECIFICATION**

**Displacement:** .163 c.c. (.00997 cu. in.)
**Bore:** .237 in.
**Stroke:** .226 in.
**Bore/stroke ratio:** 1.05
**Weight:** ½ ounce
**Max power (approximate):** .028 B.H.P. at 32.000 r.p.m.
**Max torque:** 1.0 ounce – inches at 24.000 r.p.m.
**Power rating:** .172 B.H.P. per c.c.
**Power/weight ratio:** .056 B.H.P. per ounce.

**Material Specification:**
**Crankcase:** machined from light alloy bar, "gold" finish overall
**Crankshaft:** hardened steel. 1/16 in. diameter steel screw propeller shaft
**Piston:** hardened steel
**Cylinder:** soft steel
**Connecting rod:** machined from dural (ball-and-socket little end)
**Intake body:** moulded plastic, located by screwed dural collar
**Venturi:** turned aluminium
**Spray-bar housing:** steel
**Cylinder head:** turned dural, integral 1.5 volt glow clement
**Crankcase back cover:** moulded plastic
**Rear-cover tank:** moulded plastic, with plastic end
**Main bearing:** plain
**Manufacturers:** L. M. Cox Mfg. Co. Inc., Santa Am, California, U.S.A.
**British Importers:** A. A. Hales Ltd., 26 Station Close, Potters Bar, Middlesex.

| Propeller | R.P.M. Figure |
|---|---|
| 3 x 1 3/4 Cox plastic | 27.000 |
| 5 ¼ x 3 ½ D-C Nylon | 7.800 |
| 6 x 3 Top Flite nylon | 5.800 |
| 5 ¼ x 3 Top Flite nylon | 6.000 |
| 5 ½ x 4 Top Flite nylon | 5.500 |
| 5 x 4 K-K nylon | 6.000 |
| 5 x 3 K-K nylon | 7.000 |

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