An unusual 4-stroke design with power to spare

RCV .91 CD

by Andrew Coholic
andrewc@flyrc.com

RCV Engines Ltd., based in the United Kingdom, has been producing their distinctive line of 4-stroke engines since 1997. The company has based all of its designs on the rotating sleeve principle (currently the only model engine manufacturer to do so), which uses no separate valves to control the intake and exhaust porting: the cylinder itself rotates, resulting in the opening and closing of the respective ports. The original SP designs ran the propeller at half of the crankshaft speed, while the CD series is of the conventional "propeller running at crankshaft speed" type. The .58 CD (reviewed in the February 2004 issue of *Fly RC*) released almost two years ago has been found to be a reliable and practical powerplant. With the release of the .91 CD, RCV has expanded its engine line to encompass five different models.

Left: With the case removed, you can clearly see the cylinder and see how it is driven off the crankshaft gear. Also note the port window.

PHOTOS BY ANDREW COHOLIC

INITIAL IMPRESSIONS

The .91 CD comes packaged in a smallish box, colorfully decorated with the RCV logo and very sturdy. The engine itself comes wrapped in a heavy plastic bag, and the engine is well oiled. The muffler and carburetor are packaged separately, as well as some Allen wrenches and the instruction sheet. The foam wrapping protected the individual parts well, preventing damage during transit. The included package of silica gel is a good idea, especially when transporting the product across oceans, thereby reducing moisture. RCV has also included an O.S. type F 4-stroke plug (not mounted but new in the package) which happens to be their recommended plug. It's always nice to get a good quality brand-name plug with an engine!

The instruction manual is well written, with clear recommendations as to what type of fuel, propellers, etc. to use. Although RCV doesn't advise the user to disassemble the engine, there are specific directions for reassembly: no doubt some of us will want to take the engine apart at one time or another, perhaps just to see what's inside.

RUNNING THE ENGINE

RCV recommends a fuel for the .91 CD that contains (ideally) 15% oil, of which only 3% to 6% is castor, with 10% nitro. I used Morgan Omega fuel for testing, which contains 17% oil in a 30%/70% castor/synthetic blend (approximately 5% castor oil), after confirming with an RCV representative that this fuel was indeed ok to use.

For the recommended half an hour of run-in time, I mounted a Zinger 14x6 prop and the supplied O.S. F glow plug. The first run was performed with the carb barrel approximately 3/4 open, and the high-speed needle two and a half turns out. At this setting, it took seven minutes to burn the first tank of fuel. I ran two more 10-ounce tanks of fuel through the engine, but opened the carb barrel fully and slightly leaned the high-speed needle on each run (and during the run every minute or so).

During the test runs, I recorded the rpm, head temperature and exhaust temperature (at the muffler exhaust) with the help of the RCATS unit that feeds the information to my laptop computer. I double-checked the temperature with my infrared temperature gun, and verified the rpm readings with my Glowbee digital tachometer. The temperature during my testing was a cool 65°F, with relative humidity at 45% and a falling barometric pressure. (See Table 1.)

Table 1
Results from initial 3 runs (10 oz. each consumed)

Tank #	Run Time	EGT	CHT	Max rpm
1	7 minutes	169 F	117 F	6,000 - 6,250
2	8 minutes	185 F	126 F	6,200 - 6,400
3	10 minutes	172 F	152 F	7,100 - 7,350

With the settings used for run three, the minimum idle recorded was 2,450 rpm; hand starting was easily achieved following a healthy prime. This engine likes to be fairly "wet" to hand start.

At this point, the engine was ready to run some different propellers. For the first test, I continued to run the same 10% nitro fuel and O.S. F plug. For each propeller I let the engine warm up, recorded the temperatures and maximum rpm, and then tested the lowest reliable idle rpm. (See Table 2.)

The transition from idle to full throttle was observed to be very good. Hand starts were fast and, using the electric starter, immediate.

For the second run with the same propellers, I went up to a 15% fuel. For the results, see Table 3.

As you can see, there was really no noticeable increase in rpm, and the temperatures were very close. In my opinion, there is no advantage to running the engine on the slightly higher (and more expensive) 15% fuel instead of the 10% nitro fuel.

By the end of my bench running, I had burned an additional four 10-ounce tanks of fuel. It was time to mount the engine in the test aircraft and go have some fun flying!

GLOW PLUG TESTING

For the glow plug test, I ran the engine first with the supplied O.S. F plug, using a Zinger 14x6 prop and 15% Omega fuel. I recorded minimum reliable idle rpm, maximum rpm, and the engine's response to

Table 2
Results from the first run of props (all Zinger brand)

Propeller	Idle rpm	Max rpm	Max EGT (F)	Max CHT (F)
12x8	2,500	10,150	253	275
13x7	2,450	8,900	188	271
13x8	2,400	8,640	169	277
14x5	2,350	9,660	184	294
14x6	2,350	8,490	168	249
14x8	2,200	7,620	156	271
15x6	2,200	7,680	157	306
15x8	2,000	6,750	149	294

Table 3

Propeller	Idle rpm	Max rpm	Max EGT (F)	Max CHT (F)
12x8	2,500	10,230	219	286
13x7	2,500	8,940	190	284
13x8	2,500	8,730	176	273
14x5	2,350	9,630	178	266
14x6	2,400	8,500	161	229
14x8	2,200	7,710	156	278
15x6	2,100	7,710	152	274
15x8	1,900	6,720	145	267

SPECS

ENGINE: RCV .91 CD

MANUFACTURER: RCV Engines

DISPLACEMENT: .0.91ci / 15cc

WEIGHT: 28.2 oz. as measured with supplied muffler

TYPE: Single cylinder rotary cylinder valve 4-stroke cycle, utilizing a single conventional ringed aluminum piston, ball bearing supported crankshaft, twin-needle carburetor

PROP RANGE: 12x8 to 15x8; 13x8 or 14x6 recommended for general sport use

STREET PRICE: $229

SUMMARY

RCV engines appear to be quite different from the rest of the market's offerings—that's a fact. Rest assured the engines provide the user with a practical powerplant for regular flying. The .91 CD is a smooth running engine, producing comparable power to competitors' similar displacement engines. It is reliable, easy to handle, and sounds great in the air. The smaller size (namely height of the cylinder) will enable easier installation in many cowled-in situations, perfect for the scale modeler. This engine is sure to turn a few heads with its distinctive styling and sound, while serving as a trouble-free "run it every day" engine. It's also a very quiet engine with the supplied muffler.

CLOSER INSPECTION

Because of the fact that the RCV engines are "different," I was a little apprehensive to disassemble my test engine until after the running tests. Upon disassembly, however, I found the engine to be no more difficult (and in many cases easier) to work on than any other 4-stroke, and in some cases easier than some 2-stroke engines! There is definitely a lower parts count in the RCV CD engines; doing away with poppet valves and related springs, clips, rockers, pushrods, etc. really cuts back on the number of individual components.

The .91 CD uses a die-cast aluminum two-part crankcase, split horizontally through the mounting lugs. The upper section contains the cylinder and cylinder bearing (a ball bearing on the lower portion of the sleeve, and a cast iron bushing in the upper portion). The lower section (in concert with the upper) retains the crankshaft bearings and acts as the "backplate" to keep the connecting rod from slipping off the crank pin. The two halves of the crankcase are held together with six Allen head cap screws. Some type of sealant is used on the mating faces of the crankcase halves. They do not need to be sealed completely airtight: the better the fit the less oil that will leak out along the joint line. It appears to be similar to a thread-lock compound.

The cylinder is machined from a steel bar, and I would assume it has been hardened for longevity. It is a snug press fit into the cylinder bearing, but requires no heat to remove. The lower section of the liner has a flange, against which the driven gear seats. The gear is a large helical steel affair, and is keyed to prevent rotation on the cylinder.

All the components that make up this high quality mill.

Moving up the liner, the main cylinder ball bearing is seated against the upper part of the flange on a slightly raised section of the cylinder. At the top where the port's windows are cut into the sleeve, the cylinder's smaller diameter runs in a cast iron bush, pressed into the case upper. As the window cut into the sleeve goes round, it opens and closes both the intake and exhaust ports and the glow plug cavity, allowing ignition of the fresh fuel charge. The crankshaft is quite massive, and is machined from bar stock steel alloy. It uses a pressed-in-place pin, which is solid (not drilled) and ground to size after being pressed in place.

The crankshaft rides on two bearings that are similar in size, and the driving gear is pressed in place (and keyed) up against the crank web, which utilizes dual cutaways for counterbalance. The bearings have an aluminum retainer/spacer between them, with an aluminum ring in front of the forward bearing that keeps it from exiting the case front. The bearings are locked into position with some thread lock on the outer races. The connecting rod is machined from alloy aluminum bar stock and is bronze bushed at either end. It is a quite massive rod, and it should prove more than adequate for years of service. The extremely shallow piston is machined from an aluminum casting and has a single unpinned compression ring. The solid steel wrist pin floats in the blind bored piston, with a Teflon end pad on one end only.

There are no bushes in the piston wrist pin seats, as the alloy is no doubt of high silicon content and is a good wearing material on its own. Interestingly, the top of the piston has a small raised portion that fits up into the combustion chamber portion of the cylinder. I'm not sure whether this is to strengthen the top of the piston or something to aid the combustion process. A small cast aluminum top cap with a gasket seals the top of the crankcase, and it is held in place with four small Allen head cap screws.

The intake manifold is a cast aluminum elbow, affixed to the cylinder with two cap head screws and a gasket. The two-needle metering rotating barrel carb (aluminum housing with a steel barrel) is held into this with a draw bar and nut, and sealed with a single O-ring. The carburetor can be positioned with the main needle on either side, and the throttle lever can be positioned on either the top or bottom, allowing the user to hook up the throttle pushrod where it will best suit the application.

The drive washer is machined from aluminum alloy and is held in place with a Woodruff key. The prop washer and twin nuts (locking type) are steel, with a black oxide finish. The supplied baffle-less muffler is an aluminum chamber, which threads onto the chromed steel elbow that in turn threads directly into the head. The muffler is positioned and locked in place with two steel jam nuts.

Following the instructions in the manual for reassembly, I had no problem getting the engine back together.

throttling up and down. Then I replaced the plug with a Saito "SS" 4-stroke plug and repeated the tests. There was no measurable difference in rpm, either high or low, and transition both up and down was excellent with either plug. Head and exhaust gas temperatures were also within a few degrees. I wouldn't hesitate to use either plug.

In the RCV instruction manual, they advise against using any plug that will protrude into the glow plug cavity and interfere with the cylinder ports, warning especially against the use of idle bar plugs. Since the Saito plug is identical in dimensions to the O.S. F plug, I knew it was ok to use.

TEST FLYING THE RCV .91 CD

I chose my well-used SIG Astro Hog for test flying the RCV .91 CD. The plane weighs just over seven pounds, and because it had previously been flying with another brand of .91 4-stroke, I was curious to see how the RCV .91 would compare.

For test flying, I mounted the engine on a pair of aluminum beam mounts. The RCV does need a good size mount owing to the wider than normal lug spacing. A normal .90 size engine mount will not be wide enough for the RCV .91 CD. For all test flying, I ran a Zinger 14x6 propeller, Omega 15% fuel (recommended by RCV as one of the compatible fuels to use) and the supplied O.S. type F plug that I used for all bench running. I installed the RCV .91 and performed a balance check. Although it was heavier than the last few engines (also 4-strokes) it flew with, it was able to keep the balance point within the specified limits for the plane.

At the field, I found the engine very easy to start and tune (similar to my bench tests) and in no time I was taxiing out to get airborne. The engine holds a nice steady idle and transitions smoothly from even a prolonged (>1 minute) idle without any hesitation or coughing. The .91 CD had no problems taking the Astro Hog skyward, and I found it very comparable in flight performance to the other "major brand" .91 4-stroke that I have used in that plane for years. Throughout all regimes of flight, including all basic aerobatic maneuvers, I found the engine to run smoothly and

steadily. There were no fuel draw issues when performing hard turns, tight repeated loops, or maneuvers such as snap rolls.

Throughout it all, the RCV exceeded my expectations and then some. Its noise level is very low when in the air, with a sound distinct from that of other poppet valve engines. On the ground, I took noise readings with my Radio Shack digital dB meter and got readings of 89 dB in front, 86 dB off to each side, and 85 dB behind the model, standing about nine feet away with the engine running at full throttle.

WISH LIST

There was no significant "wish" I had after running the RCV .91 CD, as it performed up to my expectations in all respects. However, there is one issue that may be of some concern to some, and that is weight. The RCV .91 CD is unique on the market today (without a directly competing engine), but when compared to similar sized poppet valve 4-stroke engines on the market, it is somewhat heavier. In many scale models for which this engine is particularly suited, this will not be an issue.

Ok, I lied: I do have one more wish. Because of the engine's layout, I think it just begs to be made into a twin. With all cylinders being able to be geared off the same drive gear, a V-twin, or opposed twins are possible. I'm sure I am not the only one who would like to see RCV put two of these .91s together!

ENGINE MOUNTING DIMENSIONS

The 4-strokes in the RCV CD series have an extremely low profile. The .91 reviewed here is no taller than some competing .52 size poppet valve engines.

The overall height from the bottom of the lugs to the head (with a little clearance) is 3 5/8 inches. The length from the crankshaft nose to the back of the carb is 6 inches, and the distance from the drive washer to the carb (with enough to clear the firewall) is 4 7/8 inches. The cylinder width when looking at it from the front is approximately 2 1/4 inches.

CONCLUSION

With most of today's 4-stroke engines being very similar, it is indeed refreshing to see a company strike out and market something unique and different. The RCV .91 CD is different enough in appearance that it will draw some attention at most fields, and once in the air, the sound is distinctive enough that many will want to know what you are running "under the hood."

Along with its uniqueness, this engine is proving to be a completely reliable and competitively powerful mill. The lack of any adjustments to be made will appeal to some, and the low profile will indeed be an asset to the scale modeler. (I find that sometimes the "average" modeler is somewhat reluctant to try a new design, or something that seems so much different from what they usually use.) If you buy this engine, you will be rewarded with a great running and reliable powerplant for years to come. Try one out and see for yourself! ✪

Links

RCV Engines, www.rcvengines.com,
44 (120) 287-7044 (UK).

For more information, please see our source guide on pg. ___.