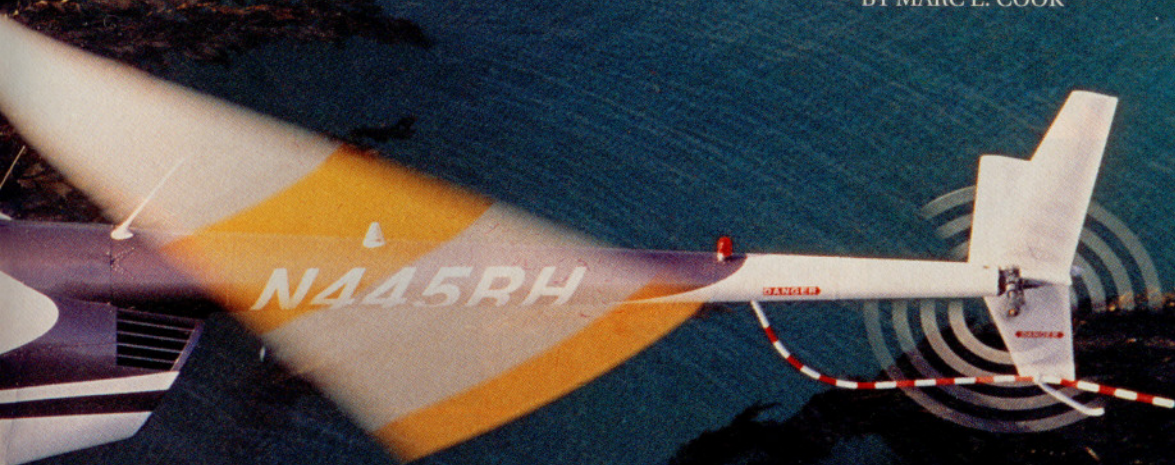


ROBINSON R44 ASTRO

ROOM FOR FOUR, SPEED FOR ALL

Modern maturity: The Robinson helicopter grows up.

BY MARC E. COOK



Details. Committed as afterthoughts, they can steal success from an otherwise sound design. Executed with care, they can elevate that same design to greatness. Done right, details are magic. ■ For Frank Robinson, the magic lives, among other locales, in door hinges—specifically in the pivots adorning his newest namesake helicopter, the Robinson R44 Astro. Not mere pieces of bent aluminum whose sole lot in life is to support the ship's four portals, the R44's pivots are emblematic of Robinson's seemingly tireless pursuit of a better helicopter. In early iterations of the R44, the hinges, small aluminum tabs barely a half-inch deep, protruded from the

PHOTOGRAPHY BY MIKE FIZER

cabin 45 degrees to the slipstream. Much to the dismay of his production people, Robinson insisted the hinges be streamlined by angling them into the wind. He notes that individually the benefits of streamlined hinges are not even measurable. "But if you apply that kind of logic to the whole helicopter," he says, voice trailing off. Perhaps he's thinking of the next knot to be found, another smidgen of efficiency hiding out.

While Robinson the man considers further detailing, the bulk of his company's engineering efforts, for now, is

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will, at Robinson's demand, take homes close to the factory so that any early changes can be implemented easily. Robinson is a careful man in this regard. Early glitches with the company's first effort more than a decade ago, the two-seat R22, though quickly remedied, still live fresh in his mind. The R44 will suffer no such indignities.

Not that it will require many apologies—right out of the crate, the R44 impresses with its maturity—it has an all-of-a-piece feel often lacking in a totally new product. This is all the more impressive considering the buy-in is a relative bargain at \$235,000, including most of the options usually ordered, like rotor brake, auxiliary fuel tanks, and cabin heater, plus VHF com radio and intercom. Our resident helicopter buff, Tim McAdams (with 4,000 rotorcraft hours, half of them in R22s), comments that there are no surprises, nothing that feels or appears to be poorly thought-out. Everything works as you'd expect.

One does not, however, expect the R44 to be so impressively speedy. McAdams and others have come back from first flights commenting that the R44 is unusually fast. Claimed cruise speed is 113 knots, making the R44 a match for the much more powerful Bell JetRanger. It climbs well, too, showing 1,000 feet per minute at its maximum gross weight of 2,400 pounds. Also, the factory's numbers appear to be conservative. We witnessed indicated speeds of 120 knots at maximum cruise power. The scuttlebutt around the Robinson factory is that the ship will easily cruise at that velocity but that the company's patriarch would prefer the buyers discover that themselves.

Attention to aerodynamics gets the credit. As mentioned, the door hinges are constructed to reduce parasite drag. Landing-gear legs extend from the cabin structure at optimum locations for drag reduction. Items as diverse as the location for the fresh-air vents and landing lights to the angle of the skid stanchions were scrutinized in an effort to pare drag.

Cleanliness helps provide a flat glide angle, too, a claimed 5.5:1. McAdams commented that his first few approaches nearly resulted in



Frank Robinson, at home in the driver's seat of the new R44.

done. The four-seat R44 received Federal Aviation Administration certification last December and is about to hit the production line running. Initial drawings sprang from Robinson's head in 1984, and the first R44 flew on the last day of March 1990. When we visited the factory, four ships had been completed—three engineering prototypes and one production ship—but about a dozen more were on the manufacturer's Torrance, California, assembly line.

The initial run of a dozen or so ships





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The teetering rotor system shows R22 heritage (top). The tail rotor spins opposite the R22's.



overshoots. Using sight pictures and speeds from other helicopters—especially the R22—can put one on the other side of the touchdown spot quicker than you can say “whoops.” Once learned, however, the R44 can be set down precisely.

Combine this tendency with generous rotor mass, and you have the recipe for docile handling during autorotation. Where the R22 calls for instant pilot response to an engine failure, the R44 is less demanding. McAdams says it feels much more like a JetRanger in the autorotation than its size would suggest. With the longer tail boom, you must flare higher than in the R22, but the rotor system has more than enough inertia to handle that. Any pilot who has learned in the R22 will quickly get the hang of autorotations in the R44. The four-seater

autorotates almost casually, with none of the express-elevator behavior of the R22.

That the R44 is such a departure in flying qualities from the R22 serves to illustrate the effects of size and mass on aircraft. Why? Because in many respects, the R44 owes much of its design to little brother R22.

Along with that comes mechanical simplicity and bulldog ruggedness for which the R22 is famous. Indeed, Robinson estimates that 75 percent of the R44's components are basically just larger versions of R22 pieces. Beneath the skin, the R44 uses a power transmission system that's a real kissing cousin to the R22's. A series of belts (with twice as many plies or grooves as in the R22) route power from the carbureted Lycoming to the transmission. The tail rotor is motivated by a one-piece driveshaft with Robinson-designed flexible couplings at each end, although it turns opposite that of the R22's. In other words, the R44's tail rotor turns in the preferred direction for keeping downward-moving main-rotor vortices from being sucked into the tail rotor, which helps preserve authority. McAdams points out that the JetRanger routinely runs out of tail-rotor authority—not so on the R44.

In other ways, the companion pieces for the R44 started on a clean

sheet. The transmission, for example, has two roller bearings at the top and bottom of the main shaft, compared to the latest R22 part, which employs a single ball bearing at the top and a single roller bearing at the bottom.

Also, as with the R22, the four-seater gets its power courtesy of Lycoming; a parallel-valve O-540 lives behind and slightly below the passenger compartment. This high-compression powerplant will churn out 260 horsepower at sea level and 2,800 rpm and was originally configured for helicopter use. Ever conservative, Robinson reduced normal operating speed to 2,700 rpm and limited manifold pressure to provide 225 hp for five minutes and 205 continuous. Operated thus, this Lycoming ought to make the 2,000-hour time between overhauls without much difficulty. (As has the down-rated O-320 Lycoming in the R22; uncommon is the ship that doesn't reach the 2,000-hour TBO.)

With the more powerful engine comes a completely different governor. In the R22, an optional electric governor—whose job it is to maintain engine rpm through manipulation of the throttle and collective—gets its information from the transmission, sensing rotor speed. In the R44, an electronic governor watches just engine rpm and has authority over the throttle only. The advantage is that it is much quicker and more accurate than the already-good R22 device. We noticed that it held engine rpm to within 1 percent. This is as good if not better than most turbines. One disadvantage, common to all helicopters except the R22, is that if you run out of throttle at high density altitudes, you are on your own to lower the collective to regain rotor speed.

A wholly new trim system bows with the R44, too. In the R22, there's a simple manual trim for the cyclic, intended to remove stick pressure. In the R44, which has considerably heavier stick forces and generally slower responses, something new was called for. Permanently mounted strain gauges at the base of the trademark teetering cyclic sense control forces and direct the trim motors to automatically remove them. In essence, you fly the R44 on the trim motors, providing some control displacement and allowing the very quick trim system to take out the pressure.

In a perfect world, that would be all



you need to have a constantly in-trim aircraft. But to help quell some stick shake (which we'll touch on in a moment), Robinson fitted the control column with a leatherette bag filled with between 5 and 7 pounds of lead; its mass helps absorb some of the shaking. But this weight, located between the pilot and the strain gauges, can fool the trim system when the helicopter is pitched nose down for forward flight. The trim system cannot tell if it's the effect of the weight or a pilot's control movement—hence the manual trim. You don't often have to trim the R44 by hand, though; it is accomplished through the typical four-way switch above the pilot's cyclic grip. (One complaint registered by instructors is the lack of manual trim control on the left stick. It's missing due to the complexity of hooking up the wires to a removable control position.)

In a case of a flying machine's reputation preceding it, many pilots are primed to notice what some have called predominant stick shake in the R44. The vibration is a result of aerodynamic forces in the rotor system being fed back through the purely mechanical controls. As Robinson explains, control forces go up with the cube of the rotor blade chord, and so does the feedback. In the R22, the forces are so light that the stick shake,



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R44's 2,000-hour TBO.***

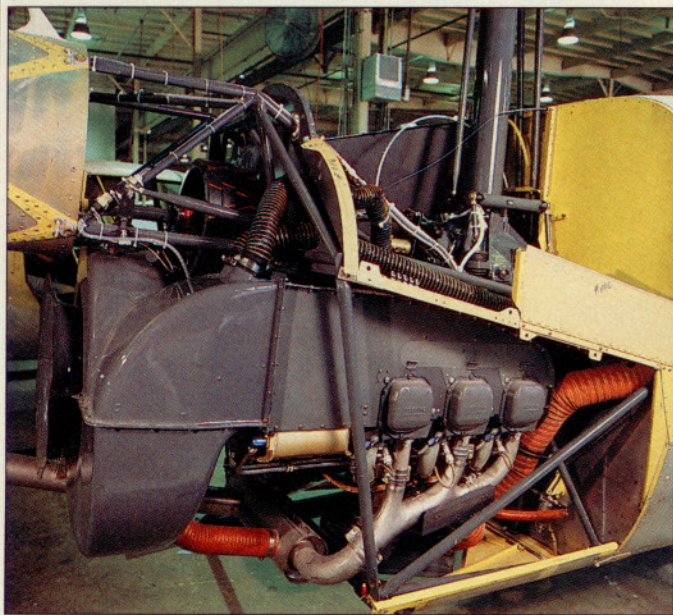
while noticeable, is not objectionable. Few pilots with much time in the R44,

however, will call its stick shake objectionable. Yes, it's there and more pronounced than the R22's—or the Jet-Ranger's, no surprise because the turbine ship employs hydraulically boosted controls that prevent such feedback. Robinson was considering hydraulic boosting for the R44 but has since shelved the idea because pilots and potential customers have said that removing the shake isn't worth the added weight, complexity, and potential failure modes of hydraulics. Also, tighter tolerances on blade balance and track at the factory are said to have quelled a bit of the shaking since our visit.

Aside from the view of the quivering cyclic and a bit of vibration at high cruise speeds, the R44's cabin is a pleasant place to reside for the ship's three-hour endurance. Although knee

room for the back-seaters is a bit tight, the space for humans is at least quite broad (listed as 4 feet) and gifted with enough window area to ward off claustrophobia. In fact, all four seats have a commanding view. Baggage space, as in the R22, resides inside the cabin, under the seats.

At least there's enough room in the weight-and-balance envelope to fill those four seats. Robinson claims to have the widest center-of-gravity range of any light helicopter, and with



a best-case 700 pounds' full-fuel (50 gallons in two tanks) payload, the R44 can easily lug four FAA-standard adults and their briefcases.

Such load-carrying abilities will mark the R44's utility role, according to Robinson. "Police will be a major market. The R22 was just too small, just couldn't carry the equipment. [The R44] has the capability to carry the additional equipment [and] more people, and it has the speed. Particularly the speed will be important to the police department," says Robinson. Also, he expects tour operators, pipeline patrollers, and other commercial firms that now use JetRangers and Hughes/McDonnell 500s to find homes for R44s. Because they cost about a third as much to buy and operate as a turbine single, it is hard to argue with him.

Finally, the long-term market for the R44 is even rosier, according to Robinson. "We think the eventual market for the R44 is considerably larger than the market for the R22. Just like in the light airplanes, [the manufacturers] sell more four-place models than two-seaters. Because the versatility is so much greater," he says. And this optimism takes into account the tremendous popularity of the R22 as a trainer, filling a very large void in the light helicopter market. Likewise, the R44 is alone in its class.

Whatever the demand, Robinson will be ready to supply R44s. The company is expanding from its current facilities to a new, leased 265,000-square-foot building on Torrance's Zamperini Field that should be complete by the end of the year. Initial production will be one a week, expanding quickly to double that; eventually, Robinson sees his company turning out five a week, and should the R44 enjoy the runaway success the R22 enjoyed from 1989 to 1991, he stands ready to crank out 10 a week, or two every workday. For now, sales of the R22 are down a bit, conveniently making room for the R44 in the company's current digs.

Alongside new production, Robinson will provide complete refurbishing at the R44's 2,000-hour TBO. As the company has done with the R22, the four-placer will come back to the factory and be reinserted into the production line. It comes out the other side with an overhauled engine, all-new life-limited parts, and a fresh coat of paint. The R44 owner gets a virtual-

ly new ship, and Robinson gets valuable feedback on how its wares handle life in the field. Cost is estimated at 40 percent of a new ship. Presumably you could overhaul your R44 in the field, but few who have tried this tack with the R22 report success; the cost of buying the needed parts from Robinson amounts to about the same cost as having the factory do the whole job.

Before thinking about refurbishing any R44s, however, Robinson will have to get cracking to catch up with the 150 orders currently on the books—which are, incidentally, about 80 percent from foreign buyers.

Whether at home or abroad, pilots are going to discover that flying the R44 is a treat, and a long-term relationship is sure to point out how those well-worked details, whose individual benefits are indefinable, contribute to the whole. They are the magic that makes the R44 a bit more than just a machine. □



Robinson R44 Astro

Base price: \$235,000

Specifications

Powerplant	Lycoming O-540, 225 hp for takeoff; 205 hp continuous
Recommended TBO	2,000 hr
Length	38 ft 2 in
Height	10 ft 10 in
Main rotor diameter	33 ft
Main rotor disc area	855 sq ft
Power loading	10.7 lb/hp (takeoff)
Seats	4
Cabin length	7 ft 1 in
Cabin height	4 ft 5 in
Cabin width	4 ft
Empty weight	1,400 lb
Maximum gross weight	2,400 lb
Useful load	1,000 lb
Payload with full fuel	700 lb
Fuel capacity	50 gal (50 gal usable)
Oil capacity	12 qt

Performance

Maximum rate of climb	1,000 fpm
Max level speed	130 KTAS
Cruise speed/endurance, maximum cruise power, 45-min rsv	113 KTAS/2.4 hr
Max operating altitude	14,000 ft
Hover in ground effect	6,200 ft
Hover out of ground effect	5,000 ft

Limiting and Recommended Speeds

V _X	50 KIAS
V _Y	60 KIAS
V _{NE}	120 KIAS at 2,400 lb; 130 KIAS at 2,200 lb

For more information, contact Robinson Helicopter Company, 24747 Crenshaw Boulevard, Torrance, California 90505; telephone 310/539-0508; fax 310/539-5198.

All specifications are based on manufacturer's calculations. All performance figures are based on standard day, standard atmosphere, sea level, gross weight conditions unless otherwise noted.