

HOW TO DESIGN YOUR OWN SPRING-TYPE LANDING GEAR

KITPLANES

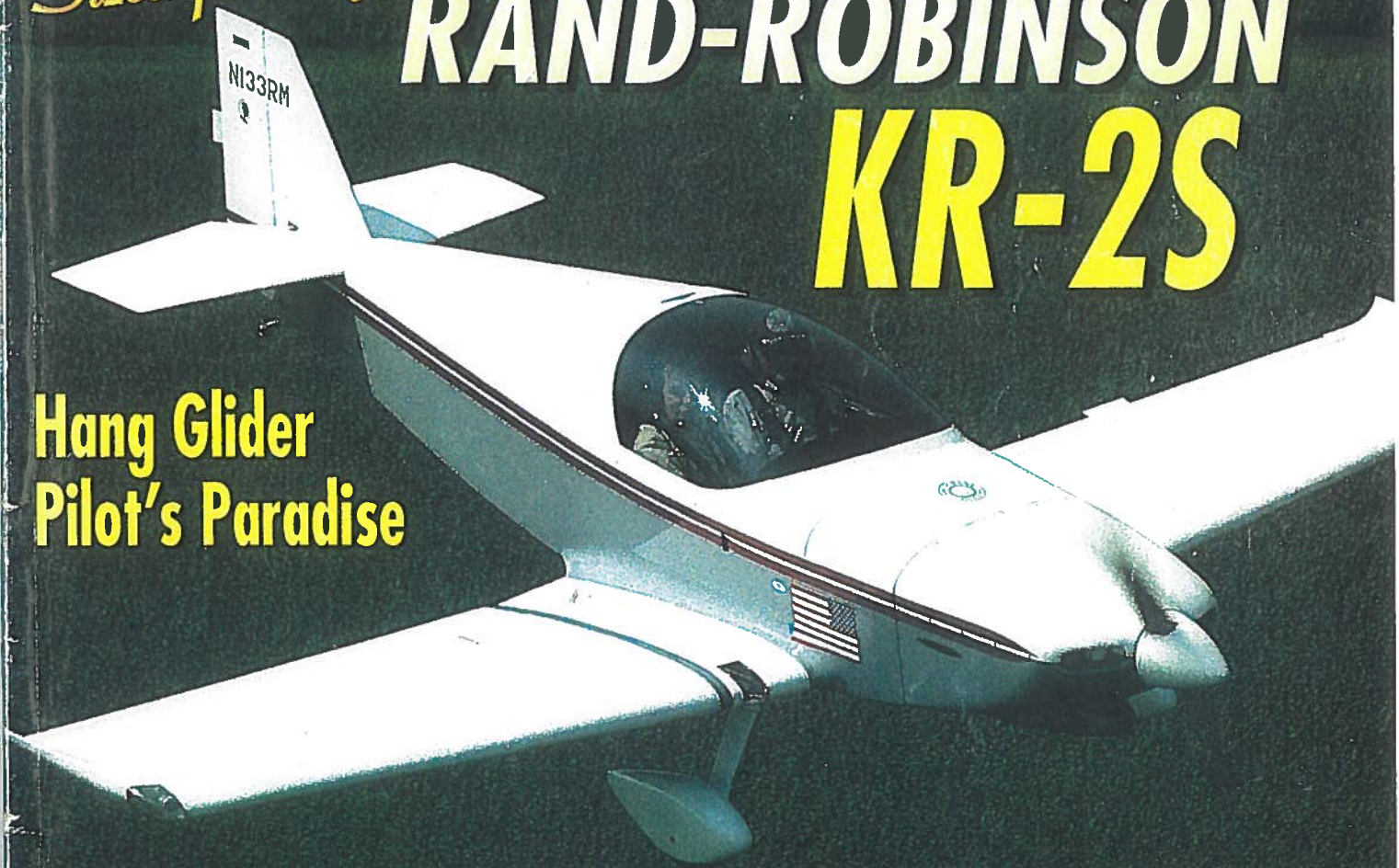
FOR DESIGNERS, BUILDERS AND PILOTS OF EXPERIMENTAL AIRCRAFT

JANUARY 1995, \$3.50 CANADA \$3.95

Sized for Bigger Pilots:

RAND-ROBINSON KR-2S

Hang Glider
Pilot's Paradise



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Stretching It

Rand-Robinson's KR-2S is now a bigger little airplane.

By LeRoy Cook

If one had to identify a small kit airplane that has persevered to win its way into the hearts of a multitude of builders, it would have to be the Rand-Robinson KR-2. When the late Ken Rand showed up at Oshkosh 1972 with his cute little foam-and-glass speedster, the line-up started. He and fellow McDonnell-Douglas engineer Stuart Robinson founded their company in 1973, after which the side-by-side KR-2 grew from the basic concept of the single-place KR-1.

After Rand's death, it fell to his widow, Jeanette Rand, to keep the company going and oversee the refinement of the KR-2, which grew to encompass fixed-gear, trigeared, and Continental O-200 powerplant options. With the recent introduction of the KR-2S, Rand-Robinson's line expands a bit further, while retaining the basic KR philosophy of delivering the most performance for the dollar of just about any kit going.

The Early Concept

As originally conceived, the KR-1 was to be powered by an 1834-cc Volkswagen engine. Using moldless, foam-core epoxy wing and tail construction with wood spars, a simple, flat-sided wooden fuselage and a fiberglass cowling and turtledeck, the KR was quick and cheap to build. With the VW powerplant, it could be built and flown for less than \$10,000, fully equipped. The KR-2 was even more popular, offering two, snug, side-by-side seats on basically the same airframe, with power upgraded to the 2100-cc Volkswagen.

The KR-2's low-drag, 4-inch retractable mainwheels, folding straight back under the wing like a Bellanca Cruisemaster's gear, didn't suit everyone's tastes, especially for sod strip operation. Thus a fixed-gear system was developed to raise the propeller and optimize takeoff and landing attitude. Once the fixed conventional gear was available, it wasn't long before tricycle gear



was also offered, with a free-castering nosewheel. After exhausting the VW engine's growth potential, the airframe was beefed up to handle the 100-hp Continental O-200 certificated engine.

Enlarging the KR

Through it all, a primary characteristic of the KR series never changed: its size. KR-2s are small! Light weight and low drag are two keys to performance on a budget, and the KR-2 embodies both. The plane can zip past 150 mph in cruising flight—and if the occupants aren't very well acquainted before the flight, they certainly will be at end of it. While popular with 5 foot 8 inch builders, there were some larger individuals who were interested in building the KR-2, if only they could figure out how to fit into the

airplane. The obvious solution was to scale up the aircraft to accommodate bigger bodies, yet it had to be done within the confines of the Rand-Robinson concept. We can now report that the waiting is over—the Big KR has arrived.

How much bigger is it? The KR-2S' length is 1.4 feet greater than the stock KR-2, and the wingspan is 2.2 feet greater. The aft fuselage is 14 inches longer, allowing room for a small baggage sling behind the cockpit, but more important are the 2 inches added to the forward stations, enhancing legroom. The most significant change was raising the turtledeck and canopy by 3 inches, so taller pilots would no longer have to shave their heads to get the canopy down. The cabin width can also be increased by about 2 inches if the builder



Roy Marsh's KR-2S is the first stretched KR-2 to fly. It is a speed machine that can hit 190 mph on about 80 hp.



KR-2S

continued

desires, limited only by the ability to form the canopy to cover a widened cockpit opening. In all, the KR-2S adds a few inches here and there, but visibly it is still very much the diminutive KR.

First to Fly

The first completed KR-2S was built by Roy Marsh of Santa Maria, California, and it was his aircraft that was on display in the Rand-Robinson booth at Oshkosh '94. Marsh's airplane was fresh from the Sun 100 air race at the Sun 'n Fun fly-in in April, where it won the under-100-hp class, turning in an amazing 190.54 mph over the 96-mile triangular course—not bad for a plane with a Volkswagen-

A stretched fuselage and taller turtledeck allow larger pilots to fit the KR-2S.

based powerplant!

In truth, Marsh's engine is a far cry from a stock VW. He's running a Turbo Revmaster 2100DT conversion, capable of pumping out a nominal 80 hp at 38 inches of manifold pressure (somewhat more during a race), and he has nothing but praise for Joe Horvath's handiwork at Revmaster. Equally appreciated is the 54-inch diameter, 50-inch pitch propeller by Ed Sterba, built with a racing profile.

Roy Marsh's KR-2S started out as a standard KR-2 kit, but he converted it to a KR-2S as soon as he learned of the plans to develop a stretched version. His wings, therefore, are built from foam and glass in the traditional manner; the first production set of premolded KR-2S wings are going on the factory demonstrator, a time-saving option that



Marsh's panel is optimized for VFR cross-country travel.

The KR-2S canopy rotates up and forward on overcenter supports.

simply bonds together around the massive 7x2.5-inch mainspar and 4x1.25-inch aft spar. The foam-core wings remain a low-cost version, saving as much as \$3000, according to Jeanette Rand. Because Marsh was after the checkered flag at the Sun 100, he clipped a foot off the stock KR-2 stub wings, reducing his plane's wingspan to 19.9 feet, and he also left the cockpit width untouched from the plans. As per the plans, the dihedral angle is set at 3°.

Marsh's 6-foot ailerons are pushrod actuated and extend over most of the wingspan, with upward-curving wingtips to contain spanwise flow. To make up for the lack of wing flaps that normally extend from the trailing edge of the stub wings, Marsh installed a perforated belly board dive brake under the cabin, actuated by a handle between the seats.

A taller rudder is usually installed on the KR-2S when it is powered by the Continental O-200 engine, although Marsh says the smaller tail works fine with his 80-hp Revmaster. A MAC electric trimtab is mounted on the left elevator, while small fixed tabs are located on the rudder and left aileron. Fully rigged for night flying, N133RM has a tail navigation light at the base of the rudder, wingtip nav lights under flush wingtip lenses, a belly-mounted strobe, and dual landing lights in the leading edges of the wings.

The main landing gear is a slightly wider two-piece fiberglass design marketed by Dan Diehl, which places the wheels outside the propeller's arc, compared with Rand-Robinson's one-piece aluminum spring gear. The factory also offers composite gear legs for mounting as trigrar or conventional gear. Lamb 11-4.00x5 main tires were installed on Matco wheels and brakes; Marsh recommends the Cleveland brakes instead, as his lighter Matco units will not hold his airplane under full power. The steerable, non-swiveling solid rubber tailwheel is part of the kit from Rand-Robinson.

Inside Work

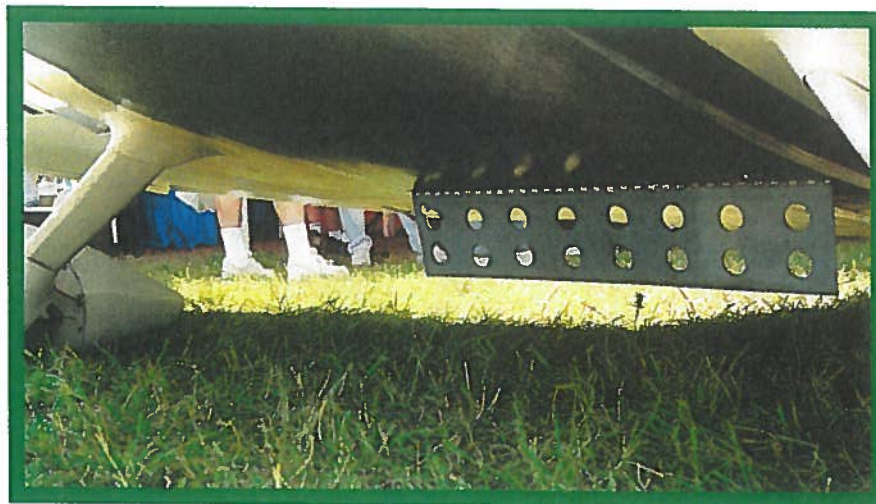
Marsh will be 76 years old by his next birthday, and his lean, fighter-pilot

Marsh installed a perforated belly board that is extended to add drag during landing.



physique belongs to a man 15 years his junior. He plans to stay active and looks forward to joining the Flying Octoge-

narians in a few years. When it came time to fly, he simply picked up the tail and starting walking the 585-pound air-



craft out to the flight line while I huffed and puffed to keep up. His well-equipped cockpit and interior are obviously intended for cross-country use; this is no hangar queen, but was built for flying back and forth across the continental U.S.

Included are comfortable foam seats and headrests, padded sidewalls with storage pockets, and a 3-cubic-foot baggage area under the turtledeck. There's plenty of instrumentation for serious VFR flying: remote compass, electric turn coordinator and G meter, plus CHT and EGT for the engine. Avionics consists of a King KX 145 navcom radio, an Azure Long Ranger F/P Plus Ioran receiver, and a Flitecom intercom. The manifold pressure gauge, redlined at 50 inches, is a clue to the serious nature of his raceplane, vindicated around the pylons at Lakeland. Marsh intends to install an encoding transponder shortly so he won't have to deviate around high-class airspace.

A total of 17 gallons of fuel is in the header tank behind the firewall; Marsh eschewed wing tanks by shortening his stub wings. With a full tank, about 300 pounds can be carried in the cabin before exceeding the 1000-pound gross weight. Marsh reports about 5 gph are burned in cruise, and after 3 hours in the saddle, most KR pilots are ready for a break anyway. Factory fuel options call for a 13-gallon header tank, plus two 6-gallon wing tanks that can be pumped into the main tank as it burns down.

The canopy swings up and forward on articulated arms to facilitate entry. We stepped onto the wingroot pad (there's no need for a boarding step with the low-slung KR) and planted a foot in the middle of the vinyl seat to gain access, after which it's a matter of slithering one's legs under the panel to reach a semi-supine position. Wiry Roy Marsh threaded himself in with the ease of a 22-year veteran of Air Force fighter cockpits (P-38s to F-101s).

A four-point harness clipped each of us in place, and four over-center latches secured the canopy. The extra room of the KR-2S was quickly used up by two medium-size occupants; never fear, the KR-S heritage lives on! Marsh and I accommodated one another's needs in the snug cockpit, reaching across to latch

each other's side of the canopy, moving a leg aside when full stick travel was needed. The pilot-not-flying quickly assumes a chummy arm-on-seatback mode to increase shoulder room. No doubt the KR-2S would be quite comfortable when flown solo, as it would be most of the time. Marsh's background would require him to do occasional aerobatics, of course, but he limits them to nice, positive-G loops and barrel rolls.

Flying the Stretched KR

A twist of the key brought the Turbo Revmaster to life, and once the propeller was turning, the boot-cowl's NACA-ramp inlets brought enough ventilation into the cabin to sustain life. A lengthy taxi and 5-minute wait for takeoff clearance was not uncomfortable at all, and one can always unsnap the canopy fasteners and lift the edge of the frame to catch a breeze.

Cleared into position, we checked trim neutral, controls free, and made a final magneto check at 2200 rpm. Marsh did the takeoff, as he had the only set of brakes in the house, and he fed in 36 inches of manifold pressure, the start of the yellow arc on the gauge, giving us 3000 static rpm with the fixed-pitch prop. The tail was up at 40 mph, with rpm building to about 3200 and 34 inches as liftoff came at 55. Once we were 300 feet or so above the terrain, Marsh pushed on his ram-air bypass, discarding warm, filtered air from the engine plenum for a direct boost of two extra inches of manifold pressure. Marsh climbs at 90 mph with two up, and at our light weight we could hold nearly 1000 fpm; Marsh says 1200 fpm at 100 mph is normal when solo. We leveled at 3000 feet after leaving the pattern, set the power to 3400 rpm, and watched the airspeed march right on up to 165 mph IAS, for a TAS of about 180 mph. Not bad at all! Kinda makes the cozy quarters seem worth while, doesn't it?

Handling is, as might be expected from a small kit airplane: quick and powerful. I fingertipped the stick near the base, which gave me more than enough purchase, and found the elevators to be about half again more sensitive than the ailerons. The longer fuselage may increase elevator arm; Marsh is considering reducing the bellcrank gearing. Significant rudder input is required to combat adverse yaw during roll maneuvers, so the large ailerons have their price. More interesting was the lightening of pitch force as the stick moved

aft; Marsh pointed out that the 17-gallon forward fuel tank was now less than one-third full, and with two persons aboard the c.g. was decidedly aft of normal. We gingerly reduced airspeed at about a knot every two seconds, once we slowed below 100 mph, and finally encountered a healthy stall buffet just before a break at 40 mph. Surprisingly docile, there was no immediate rolloff and the recovery was immediate. With the belly board down, the same stall characteristics were present.

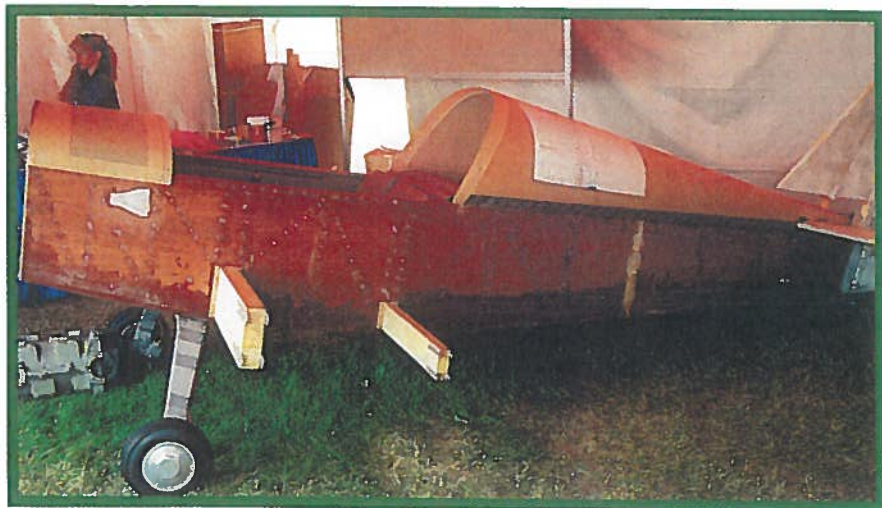
Returning to the field for a typical landing, we set up for 100 mph on downwind, slowing to 80 mph on the base leg, and came across the fence at 70 mph with the dive brake extended, giving Marsh just enough energy for a brief flare before the main tires squeaked on. He prefers to land on the back of the main wheels, as opposed to a full-stall landing, keeping the tailwheel just clear of the pavement during touchdown. Roll-out is straight and true, and about 1500 feet is ample for stopping.

Recommendations

Now that the KR-2 design has been enlarged enough to accommodate 6-foot-tall builders, its performance and sleek looks will no doubt attract even more devotees. A good checkout in another builder's KR would be wise, to prepare for the sensitive controls of a 1000-pound airplane going 180 mph. As with all of the smaller designs, there's no mystery to flying the airplane, but it is different. Marsh is looking into moving his ELT out of the tailcone, along with the remote compass unit, to shift c.g. slightly. More than most kit airplanes, the diminutive KR must be built light; there's just not much arm to make up for mistakes.

Marsh estimates that his project's total building time covered the better part of three years, but as with any first-of-type, there was quite a bit of measuring and deliberating when fitting the pieces together, so the next airplane would be completed much more quickly. With the premolded wings, building the KR-2S will require fewer hours and deliver more predictable results.

The basic KR-2S kit is priced at \$6745 on tailwheel gear, with the trigear version at \$7119. Jeanette Rand esti-



The factory prototype KR-2S fuselage was displayed at the Rand Robinson tent at Oshkosh '94.

mates a delivered KR-2S kit at \$7500 with foam wings, compared with \$5500 for the standard KR-2 kit. Of course, KR plans are still available (at \$240, in the case of the KR-2S) for the builder who prefers to scrounge parts and mate-

rials and trade time for money. We expect to be seeing Rand-Robinson designs at fly-ins for decades to come, thanks to its value-packed appeal. **KP**

FOR MORE INFORMATION, contact Rand-Robinson Engineering, Inc., 15641 Product Lane, Suite A-5, Huntington Beach, CA 92649; call 714/898-3811, fax 714/890-1658.

Rand-Robinson KR-2S

Prices:

Standard kit.....	\$7500
Standard kit, plus premolded wings	\$10,500
Information package	\$8
Videotape & info pack.....	\$24.95

Specifications:

Wingspan.....	23.37 ft.
Wing area.....	88 sq. ft.
Aspect ratio.....	6.23:1
Length.....	16 ft.
Height ...6 ft. (3.92-ft. canopy height)	
Landing gear type	fixed, tailwheel
Tire size, mains	11:x 4.00x5
Tire size, tail.....	4.00x2
Seats	two

Weights and loading:

Maximum gross weight	1000 lb.
Empty weight, standard	520 lb.
Empty weight, as tested.....	585 lb.
Useful load, standard.....	480 lb.
Useful load, as tested	415 lb.
Baggage capacity	35 lb.
Wing loading	11.36 lb./sq. ft.
Power loading, standard	13 lb./hp
Fuel capacity, standard/optional	12/24 gal.

Engine

Volkswagen four-cylinder, four-stroke, direct-drive, normally-aspirated, 2180-cc, 76-hp.

Propeller:

Edward Sterba Aircraft Propellers, 54x50, two-blade, fixed-pitch, laminated wood, 54-inch diameter.

Performance:

Maximum speed	200 mph
Cruise speed	180 mph*
Rate of climb, sea level, gross.....	800 fpm
Service ceiling.....	15,000 ft.
Range, maximum	1080 miles
Stall speed.....	48 mph*
Approach speed.....	70 mph
Takeoff ground roll	350 ft.*
Landing ground roll	600 ft.

Manufacturer:

Rand-Robinson Engineering, Inc., 15641 Product Lane, Suite A-5, Huntington Beach, CA 92649; call 714/898-3811; fax 714/890-1658.

*performance from factory brochure.

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