



For going places, the Shadow remains a microlight without peer.

Right: Practical it may be, but the new footwell could never be called elegant.

Further right: Six feet four and seated in comfort — now that's an improvement.

History & Construction

The Shadow, according to the BMAA inspector datasheets, was the first fixed-wing microlight to gain type approval, no less than 13 years ago in 1985. The first prototype flew as long ago as 1982. It is a testament to its design that in 1998 it is still widely regarded as a modern high-performance machine.

Dave Cook, the original designer, was one of the early British microlight pioneers and was the first to cross the English Channel by microlight aircraft. Always one for rigid-wing flight, Dave flew the Channel in (or rather under) a VJ23 rigid-wing powered hang glider, powered only by a 9hp engine.

If you look very closely at the Shadow alongside a photo of a VJ23 — I don't think you will find a real one for comparison, unless you know different (try the Manchester Air & Space Museum — Ed) — you can just see a faint heritage in the wing shape and fuselage boom layout...

The construction of the Shadow utilises many materials rather than just one theme. The principle is that the most suitable material in terms of strength, weight and cost is used for each specific area of the aircraft. The wing is made around a main spar of aluminium spar caps with a plywood shear web. Foam nose ribs are bonded to this, sheeted round with plywood to form a torsionally rigid D-box.

To the rear of the spar, foam ribs are again used, along with a drag spar of the same material all wrapped with glassfibre to give strength. Flaps and ailerons are made from aluminium.

and light. Plywood is used to fair in the cockpit sides, and there is a moulded glassfibre nose cone.

The fuselage boom is aluminium tubing and the tail surfaces are a mixture of plywood and aluminium tube. All the flying surfaces are fabric covered and painted.

The first type of Shadow to go into production was the BD powered by the Rotax 447. This was then superseded by the CD, which used the more powerful Rotax 503 and had its wing struts changed from round to streamline section to reduce drag. Other modifications included the fitting of an electric pitch trim.

Another Shadow variant is the Streak Shadow. This has a smaller wing area and falls into the Group A category, unless registered and flown purely as a single-seater to reduce wing loading back to the microlight definition. Engine options include Rotax 582, 618 and 912. There is a further variant, the Star Streak, which has an even smaller wing area for increased speed and manoeuvrability.

CFM Aircraft Ltd

Despite being Britain's largest producer of fixed-wing aircraft during the late '80s and early '90s, CFM Metal-Fax, the original manufacturing company, encountered financial problems that slowly



For the pilot, visibility is now very good indeed.

Paul Dewhurst tries the long-awaited D Series and finds the Shadow concept as valid as ever.



Fresh as a Daisy

got worse until trading ceased in early 1997.

The design rights, factory and tools have since been sold lock, stock and barrel to Shadow fan David Moore who has relaunched the range with a new company, CFM Aircraft Ltd.

Most of the original construction and technical staff remain and they are back in production with the Streak, Star Streak and new D Series Shadow.

The D Series

The D Series Shadow is a development from the CD, of which the major criticism



In this side view, the extra glazed area between front and rear cockpits can be clearly seen.

CFM Aircraft Ltd SHADOW D SERIES

MANUFACTURER

CFM Aircraft Ltd, Unit 2D, Eastlands Industrial Estate, Leiston, Suffolk IP16 4LL; tel 01728 832353; fax 01728 832944; website <www.cfm-aircraft.co.uk>

SUMMARY

Tandem two-seat high-wing monoplane with conventional three-axis control. Wings have sweptback leading edges, swept forward trailing edges and tapering chord; flaps fitted, two-fin tail. Pitch control by elevator on tail; yaw control by fully flying ventral rudder; roll control by half-span ailerons. Wing braced by strut bracing from below; wing profile CFM, 100% double-surface. Undercarriage has three wheels in tricycle formation with additional tailskid; bungee suspension on nosewheel and glass-fibre suspension on main wheels. Ground steering by differential braking; castoring nosewheel. Brakes on main wheels. Honeycomb laminate fuselage, totally enclosed. Engine mounted below wing, driving pusher propeller.

EXTERNAL DIMENSIONS & AREAS

Length overall 6.40m, 21.0ft. Height overall 1.75m, 5.8ft. Wing span 10.00m, 32.9ft. Chord at root 1.77m, 5.8ft. Chord at tip 1.22m, 4.0ft. Dihedral 0°. Sweepback NA°. Main wing area 15.3m², 164ft². Total aileron area 1.49m², 16.0ft². Fin area 0.28m², 3.0ft². Rudder area 0.74m², 8.0ft². Elevator area 0.74m², 8.0ft². Tailplane area** 1.07m², 11.5ft². Aspect ratio 6.7/1. Wheel track 1.52m, 5.0ft. Wheelbase 1.83m, 6.0ft. Main wheels dia overall 33cm, 13 in. Nosewheel dia overall 33cm, 13 in.

** excluding elevator

POWER PLANT

Rotax 582 engine, liquid-cooled. Max power 64hp at NA rpm. Propeller diameter and pitch 1.32x1.40m, 52x55 inch. Gearbox reduction, ratio 2.58/1. Max static thrust NA. Power per unit area 4.18hp/m², 0.39hp/ft². Fuel capacity 23 litre, 5.0 imp gal, 6.0 US gal.

WEIGHTS & LOADINGS

Empty weight 203kg, 447 lb. Max take-off weight 390kg, 860 lb. Payload 187kg, 413 lb. Max wing loading 25.5kg/m², 5.24 lb/ft². Max power loading 6.1kg/hp, 13.4 lb/hp. Load factors +4.0, -2.0 recommended, +6.0, -3.0 ultimate.

PERFORMANCE*

Max level speed 111mph. Never exceed speed 124mph. Economic cruising speed 80mph. Stall speed 38mph. Max climb rate at sea level 950ft/min. Min sink rate NA. Best glide ratio with power off NA. Take-off distance to clear 15m obstacle on grass NA. Landing distance to clear 15m obstacle on grass NA. Service ceiling 25,000ft. Range at average cruising speed 140miles. Noise level NA.

* Under the following test conditions —

Airfield altitude 0ft. Ground temperature 15°C. Ground pressure 1013mB. Ground windspeed 0mph. Test payload 187kg, 413 lb.

PRICE INCLUDING VAT

£22,995 ready to fly, £16,495 kit

Figures above are manufacturer's data
Figures in text are tester's experience

NA = Not Available

was that the cockpit area was too narrow and legroom in the rear cockpit very limited. The D has a cockpit 5cm wider than the previous models and also has an extended footwell for the rear cockpit. The canopy height too has been raised and an extra clear view panel added between front and rear canopies for better visibility.

The other major change is the engine, as the 503 has been replaced with the 582 which gives an extra 12hp. To accommodate the extra weight, and the aerodynamic forces of higher cruise and increased V_{ne} speed, the wing has been beefed up internally with extra nose ribs to increase torsional strength and a forward anti-drag spar set in the leading edge. The tailplane angle has also been reset to reduce trim drag at high speed. Maximum take-off weight has been increased from 375kg to 386kg.

The wider cockpit also allows for a wider main fuel tank which increases fuel capacity from 23 to 35 litres. Other cosmetic changes include undercarriage fairings and an engine cowling which also increases cooling efficiency.

Although certified under the current microlight rules and definition, CFM says that the aircraft was changed with the expected weight increase in mind. The undercarriage is the only real barrier at present to a higher take-off weight and a new composite undercarriage is currently under test to address this.

The aircraft is available either as a factory finished aircraft, or as a kit, with construction overseen by the PFA.

The Result

I had the luxury of being given the factory demonstrator for several days to play with, so I could really get to know it and assess it. First impressions were of a well finished aircraft with shiny blue paint work on all the hard surfaces, and white for all the fabric-covered areas. The cockpit is nicely finished in non-reflective satin finish grey.

The instrument fit comprises ASI, alt, VSI, compass, RPM, water temp and dual EGT. The trim is electrical and on the test aircraft is actuated by two small buttons on top of the control stick, fighter style. An illuminated trim position indicator is fitted centrally in the instrument panel.

The engine is started in traditional armstrong fashion with the recoil handle situated behind the pilot's head on the right-hand side. You need to be very strong to start the aircraft from the inside, but it is easy enough from the outside, as all the engine controls are easily to hand and there is a wing strut and several feet between you and the prop, so safety is not compromised too much. Better still is to have someone pull the cord for you while you sit inside. An electric start would be a sensible option if the new weight limit allows.

You sit in the front cockpit in a reclined

supine position which is very comfortable. I am 6ft 4 inches and was immediately glad of the extra width and canopy height of the D. Leg room is a little short for me (as in every other aircraft!) but by substituting my special thin cushion for the standard thick one it was no problem.

Taxiing takes a little getting used to. The nosewheel is fully castoring and steering is effected by independent heel brakes. They feel a bit fiddly at first but after a little practice you soon get used to it. The secret is to remember to increase power a little as the brake is applied and keep the speed up. The advantage of this system is that the aircraft is very manoeuvrable; with one wheel stationary you can pivot around it in a very small turning circle indeed.

In the neutral position the side stick is canted over slightly, so it's important to visually check that the ailerons are neutral before beginning the take-off run, at least until you're very familiar with the aircraft.

The Shadow sits on the ground with the wing at a slightly negative angle of attack. The take-off procedure

therefore, is to lift the nosewheel as soon as possible and balance on the main wheels until lift off. Failure to raise the nose will result in a very high speed taxi into the far hedge! The test aircraft was easy to control and lifted off solo in an estimated 60m and dual in about

70. This was using 15° of flap. Flapless take-offs are just a little longer.

The aircraft climbs very well. I measured 1200ft/min solo and 900 dual, a little less than the factory specs quoted in the panel. The prop was pitched at 6200rpm in the climb at 55kt. Reducing the pitch so that the engine could rev to 6500rpm (peak power) would increase the climb rate probably to the factory figures, but this would be at the expense of cruise performance. The attitude in the full-power climb is very nose-high and feels very sporting.

Levelling off and measuring the cruise performance, 5000rpm gives a very comfortable cruise of 70kt, while 5500rpm (the Rotax maximum recommended cruise) gives just over 80kt. Full power results in just under 100kt. This is very impressive performance indeed.

The downside is that at speeds of over 70kt the noise level in the cockpit is very high. Some attention to sound deadening on the rear bulkhead and in the cavity above the rear pilot's head may pay dividends in this area. Good quality headsets are a must.

Sitting ahead of the wing, the visibility from the front cockpit is excellent. The new clear-view panel removes the traditional Shadow blind spot to the rear quarter and also makes the cockpit seem much larger and airier.

The aircraft is very stable in pitch and manoeuvring pitch forces correspondingly high. However, out of trim forces can quickly



and easily be removed with just a touch on the electric trim button. Once trimmed the Shadow will fly hands-off for long periods, even through mild turbulence, with no pilot input required. Trim range with my rather heavy weight in the front was 55-105kt.

Aileron response is leisurely but quite adequate and I measured 3.5s to reverse a 30° bank at 70kt, which works out at 17°/s. Again the control force is a little on the high side for my liking but the aircraft is very stable and only small corrections are required when cruising through turbulence. Roll rate reduces and control forces increase as airspeed is increased above 70kt.

Adverse yaw is quite noticeable as with most microlights, but is easily countered with proper rudder co-ordination. Rudder forces are low and response is nice and progressive.

The test aircraft was brand new and not fully set up. Feet off the pedals, it wanted to yaw to the left whenever the engine was at anything over the idle rpm. This can easily be cured with a tab on the rudder. Compared to the B and C series it felt to me that directional stability was not quite as sharp. This may be due to the increased side area ahead of the CG from the raised canopy and deeper footwell. General handling impressions are of an aircraft intended for comfortable fast cruising rather than semi-aerobatics.

The Shadow is famous for its stall, or rather lack of one. The D is no exception. If the airspeed is reduced at the regulation 1kt/s it ends up with the stick on the back stop and the aircraft happily flying along at 35kt, not at all bothered. In this condition all controls continue to operate in the correct sense and no amount of my abuse could induce bad behaviour.

Accelerated stall entries produce a lazy float down of the nose and just a little shimmy of stall buffet, with airspeeds as low as 20kt or less at the top of the arc. The full power stall produces a crazy nose-high attitude before the nose once again just gently falls. Applying flap at either of the two settings (15° and 30°) does not affect the stall behaviour other than to slightly reduce the minimum airspeeds.

The Shadow has a surprisingly good glide. With engine idling I found the best sink rate to be 350ft/min at 50kt; this gives a gliding angle of 14:1. Some residual thrust remains from the idling engine which no doubt helps and I would expect the sink rate to increase with the engine stopped. Using the Shadow for thermalling with the engine idling (in-flight restart would not be easy) should yield good results and this could add an extra and enjoyable dimension to flying with no particular place to go — just think of the fuel saving!

Landing the Shadow, especially a short-field landing, requires attention to airspeed control. Unlike most microlights the Shadow has to be slowed down for the landing approach: 60kt is the recommended airspeed for a normal landing approach and this can be reduced to 50kt for a short-field approach in still air.

The earlier B and C series Shadows have flap limit speeds of 59kt for 15° and 52kt for 30°. This has been increased to 61 and 59kt respectively on the D, which makes the flaps a lot more useful and the danger of inadvertently exceeding the limit speeds less. None or 15° of flap should be used for normal landings and 30° for a short-field landing. Thirty degrees of flap increase the descent rate by another 200ft/min compared to no flap and allow steeper approach over obstacles, and also lower the nose for better forward visibility. Aileron response is also increased at low speeds with the flaps down.

It is important not to come in to land too fast, as the Shadow is very clean and would float for an excessively long time and use a correspondingly large length of field. With the correct technique accurate landings are very easy, and a flatteringly smooth landing can be achieved without excessive pilot skill — good for impressing passengers! Maximum crosswind component limit in the pilot's notes is given as a whopping 20kt. I tried a 15kt crosswind component landing which was okay but this was as much as is comfortable for me. This is still a very good capability, but I would leave the twenty knotter for the ace of the base.

During testing I also spent some time in the rear cockpit. At 6ft 4 inches the original rear cockpit of the B and C series aircraft is a

place of severe torture for me (*try it without the cushion — Ed*). Someone once unkindly but somewhat accurately described it as 'the dog kennel'.

I am pleased to report that the D is a definite improvement. The deeper foot well gives much needed extra leg length, and depth to lower the knees, and the wider cockpit also increases the gap between the structural rear bracing tubes and stops me getting my head wedged between them. The new clear view panel between front and rear canopies gives much needed extra visibility to view the countryside and the sky instead of the back of the pilot's head!

The Shadow is standard with full dual controls in the rear cockpit with the exception of brakes, which are an extra. Nevertheless the rear cockpit is still a rather poor substitute for sitting in the front.

Conclusion

The Shadow D is a definite and long-awaited improvement over previous models. Its stability lends itself to comfortable fast cruising; performance is excellent and surely sets the standard for others to beat. Visibility and comfort in the front cockpit are unparalleled.

Rigging and de rigging is easier than most other current aircraft, making trailer storage

at home a viable alternative to expensive hangar bills. Also compared to most other microlight aircraft, it looks cool. Current pricing is very keen too.

Criticisms are that the cockpit is noisy and that although vastly improved, the rear cockpit remains a poor place to be compared with the front and is awkward to get in and out. But overall, 13 years on, this latest version of Dave Cook's original Shadow is looking as fresh as a daisy and a hard act to beat. **MF**

D SERIES DEMO DAY

Microlight Sport Aviation is organising an open weekend on 8-10 May at Chatteris Airfield in conjunction with CFM Aircraft who will be offering flight demonstrations of the new D Series Shadow. Factory experts will be on hand to answer queries and demonstrate some of the kit build. To book your trial flight, call MSA on 0181 325 1097.



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