

SHADOW D - SERIES



MICROLIGHT AIRWORTHINESS APPROVAL NOTES LIST

SERIES D-D

MICROLIGHT AIRWORTHINESS APPROVAL NOTE

MAAN NO:1877

ISSUE 2

DATE: 20 JUNE 2005

TITLE: Microlight Airworthiness Approval Note 1877, Shadow D, DD and D-SS aircraft, resolution of pitch circuit resonance (elevator flutter) concerns.

STAGE: Approval.

1. INTRODUCTION

The CFM Shadow D, DD and D-SS are Type Approved microlight types described in Microlight TADS BM55.

During the flight testing of a prototype Shadow ED aircraft, G-THAL, under authority of MAAN 1824 it was found that the aircraft suffered from a divergent resonance of the pitch control circuit; this was considered unacceptable and also non-compliant with BCAR S181. The sole currently flying example of the Shadow D-SS, G-MZLP, was subsequently tested and shown to display similar characteristics.

Following on from this, the BMAA conducted sample testing of two Shadow DD aircraft and four Shadow CD aircraft. Based upon this, the following conclusions were reached:-

- (1) Shadow CD aircraft (and thus by read-across, the B, BD and C aircraft) do not show any significant tendency towards pitch circuit resonance.
- (2) Shadow D-SS and DD aircraft (and thus by read-across D aircraft) do show a tendency towards pitch circuit resonance, which can become divergent. Where this becomes divergent it is unacceptable, in other cases, it is still a cause for concern.

It was therefore decided that action was required to minimise the risk of a flutter related accident in a D, DD or D-SS Shadow.

Issue 1 of this MAAN released Service Bulletin MAAN 1877/1 issue 1 which required a mandatory test flight before further flight, immediate grounding of any aircraft which showed divergent elevator flutter, and in any case grounding of all aircraft in this series from 20 June 2005 unless a permanent solution to the problem of elevator flutter could be found.

A modification has been developed which eliminates this tendency towards elevator flutter successfully; it does so by introducing an elevator friction damper. This MAAN approves this modification, and authorises issue of a mandatory service bulletin No. MAAN 1877/2 issue 1 associated with that modification.

2. BASIS FOR APPROVAL

The basis for approval is as shown in TADS BM55 in its latest issue.

3. DESCRIPTION

The CFM Shadow is a series of microlight aeroplanes as illustrated below. The BMAA has airworthiness oversight of the B, C, BD, CD, D, DD and D-SS variants of this aircraft. In brief summary, the differences between these are:-

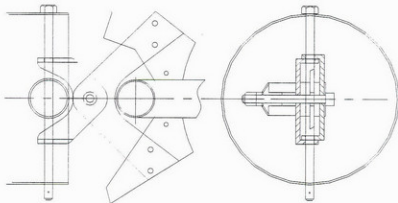
Model	Engine	Wing	Struts	Other details
B or BD	Fuji EC44PM, or Rotax 447	Original version	Round section	Narrowbody fuselage, MTOW 348kg or 374 kg
C or CD	Rotax 503 or 462	Original version	Aerofoil section	Narrowbody fuselage, MTOW 374kg
D or DD	Rotax 582	Stiffened compared to C	Aerofoil section	Widebody fuselage, MTOW 386kg
D-SS (Single seat)	Rotax 912	Similar to D	Aerofoil section	Widebody fuselage, MTOW 386 kg

(The "D" at the end of each name implies dual controls and is the most common variant of each model.)



Amateur build Shadow D and DD, Streak Shadow and Starstreak aircraft also exist under the supervision of the Popular Flying Association, but lie outside of the scope of this MAAN.

The device to be fitted to the aircraft consists of a series of greased nylon discs under compression, the tension on which may be adjusted, altering the rotating breakout+friction value. This is illustrated below:-



4. TECHNICAL INVESTIGATION

During the flight testing of a prototype Shadow ED aircraft, G-THAJ, under authority of MAAN 1824 it was found that the aircraft suffered from a divergent resonance of the pitch control circuit; this was considered unacceptable and also non-compliant with BCAR S181. The sole currently flying example of the Shadow D-SS, G-MZLP, was subsequently tested and shown to display similar characteristics.

Following on from this, the BMAA conducted sample testing of two Shadow DD aircraft and four Shadow CD aircraft. Based upon this, the following conclusions were reached:-

- (1) Shadow CD aircraft (and thus by read-across, the B, BD and C aircraft) do not show any significant tendency towards pitch circuit resonance.
- (2) Shadow D-SS and DD aircraft (and thus by read-across D aircraft) do show a tendency towards pitch circuit resonance, which can become divergent. Where this becomes divergent it is unacceptable, in other cases, it is still a cause for concern.

It was therefore decided that:-

- (1) Whilst no airworthiness action is to be taken in respect of Shadow B, BD, C and CD aircraft, airworthiness monitoring of the type is to be enhanced. This is outside of the province of this MAAN and only mentioned here for completeness.
- (2) All Shadow D, DD and D-SS aircraft were to be flown by a BMAA or CAA Test Pilot before further flight.
- (3) Any Shadow D, DD or D-SS shown to suffer from pitch circuit resonance were not to be flown until a BMAA or CAA approved modification had been made to the aircraft rectifying this.
- (4) All Shadow D, DD and D-SS aircraft were, in any case, to be modified by fitment of suitable modification, approved by BMAA or CAA, no later than Monday 20 June 2005, otherwise the aircraft were not to be flown.

This MAAN approves and mandates this modification, and an associated Service Bulletin No. MAAN 1877(1) issue 2 which is at Appendix A to this MAAN. The modification is a development from one designed for a PFA administered Streak Shadow, G-MYTY which was found after initial flight testing in 1995 to suffer from severe and divergent elevator flutter similar to that which has been found by BMAA on E and D series aircraft.

The modification is described in Section 3 above, and fitting and adjustment instructions are given in Appendix A to this MAAN.

5. FLIGHT TESTING

Development and then approval flight testing of this modification has been carried out by a BMAA Test Pilot familiar with the type; in all but the most severe and deliberate excitation, elevator flutter did not occur. Longitudinal handling was degraded, in that the trim speed band was increased, but it remained within the requirements of the approval basis for the aircraft, and

was also considered acceptable.

Flight test results were reviewed separately by the BMAA technical office, CAA Flight Test Dept. and by Prof. George Done who is a flutter specialist. All considered that in this finally tested configuration the modification was satisfactory.

6. MANUALS, PLACARDS AND INFORMATION

BMAA SB MAAN 1877/2 issue 1 (which is at Appendix A to this MAAN) is to be retained with the logbook for all affected aircraft. In addition, the Shadow C and CD Service Manual (no separate manual exists for the D series aircraft) is to be amended at page 6-16 as shown by the SB, where that manual is used for a D, DD or D-SS Shadow.

In all other respects the aeroplane must be placarded and maintained according to TADS BM55 in its latest issue.

7. NOISE CERTIFICATION

Noise certification is unaffected.

8. RADIO

Any aircraft radio installation is not affected by this note.

9. INSPECTION

In accordance with procedures agreed between the BMAA and Broom Engineering (originally detailed in MAAN 1872), each mod kit is to be supplied with an installation drawing and parts list, which is to be checked and signed by a BMAA inspector (in category B); that document is then to be retained aircraft with documentation, acting as a certificate of conformity for the part. Broom Engineering will also separately supply a copy of each such document to the BMAA, identifying the aircraft for which it was supplied.

Subsequent inspection is to be to TADS BM55, this MAAN and the Service Bulletin at Appendix A to this MAAN.

10. WEIGHT AND BALANCE

The aircraft weight and balance is modified by the addition of 0.12 kg at 143 inches aft of datum; this will move the CG aft by about 0.05", and is not sufficiently significant to require preparation of a new W&CG report.

11. SIGNIFICANT FEATURES AND LIMITATIONS

A pitch damping mechanism is introduced, fitted at the elevator control horn (rear of the aircraft boom tube, above the fixed horizontal stabiliser).



12. CERTIFICATION

BMAA Major modification No. 1877 is approved, consisting of an elevator pitch damper for fitment to CFM Shadow D, DD and D-SS aircraft.

All CFM Shadow D, DD and D-SS aircraft must comply with the Service Bulletin at Appendix A before the first flight following 20 June 2005.

It is recommended that UK CAA issues a Mandatory Permit Directive (MPD) supporting the Service Bulletin at Appendix to this MAAN.

It is recommended that UK CAA passes details of this MAAN to all foreign authorities believed to have Shadow series aircraft on their national register.

Prepared by:	Authorised by
	
G B Gratton Chief Technical Officer British Microlight Aircraft Association	J A F Viner Deputy Chief Technical Officer British Microlight Aircraft Association

Initial Distribution:

- All registered owners of Type Approved D, DD and D-SS Shadow aircraft.
- CAA Aircraft Projects Dept (Gatwick), 2 copies: *FAO Mr A Love, Mr N Williams*
- CAA Flight Test Dept (Gatwick): *FAO Mr C Taylor*
- MAAN File 1877
- Shadow Flight Centre, Old Sarum.
- Chief Engineer, PFA (*Mr. Francis Donaldson*)
- Chairman, AOPA (*Prof. George Done*)
- Broom Development Engineering, *FAO: Mr M Broom*

(Appendix A only):

- All registered owners of type approved Shadow D, DD and D-SS aircraft.

SHADOW D - SERIES



BMAA SERVICE BULLETINS
SERIES D-D

BMAA – AIRCRAFT SERVICE BULLETIN

Title: Implementation of a new elevator friction device.

Reference: SB MAAN 1877/2 issue 1
(Appendix A to MAAN 1877 issue 2)

Applicability: All Type Approved D, DD and D-SS aircraft.

Issue date: 20 June 2005

Mandatory modification to aircraft

This SB must be incorporated before the first flight after 20 June 2005

1. Introduction

1.1. Why has this service bulletin been issued?

It has been discovered that some D-series Shadow aircraft have a tendency towards elevator flutter. This is a dangerous condition which should the pilot fly briefly "hands off" in moderate to severe turbulence or knock the stick whilst conducting a cockpit task, could occur resulting in damage to the pitch control circuit, and potentially loss of the aircraft.

Service Bulletin 1877/1 issue 1 has already been issued which required a flight test of all aircraft before further flight by 20 June 2005, and then in any case grounded all affected aircraft from 20 June 2005. This new Service Bulletin is additional to that, and describes a modification to the aircraft which will allow all affected Shadow aircraft to fly, subject to the normal conditions of a Permit to Fly.

1.2. What parts are affected?

No parts are removed, but a new elevator friction damper device has to be fitted into the tail of the aircraft.

1.3. What documents are affected?

An amendment to the maintenance manual is required, including the regular requirement to check adjustment of the new elevator friction device.

2. Qualifications

2.1. Who may implement this Service Bulletin?

This Service Bulletin can be implemented by any person competent to do so, and authorised by the owner of the aircraft.

2.2. Who may certify that this Service Bulletin has been properly carried out?

BMAA – AIRCRAFT SERVICE BULLETIN

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Correct implementation of this SB must be checked by a BMAA inspector authorised in category B. That inspector must not be the person who fitted the parts to the aircraft.

No flight test is required.

2.3. Where must record be made of the SB?

Correct incorporation of this SB must be recorded in the relevant section of the aircraft logbook, and subsequently on the form BMAA/AW/001 at each permit renewal. A copy of this SB, and also the installation drawing (supplied with the mod kit) signed by the inspector, are to be retained in the aircraft logbook.

3. What is required to implement this SB?

3.1. List of Parts Required

A modification kit is required, this is available at a cost of £100 including VAT and postage (to UK) from:-

Broom Development Engineering
Easton Neston
Towcester
Northamptonshire
NN12 7HS
United Kingdom
Phone 01327 353023

Email broom.engineering@btinternet.com

3.2. List of Equipment Required

You will require:-

- Two small G-clamps (or similar temporary clamping device)
- Hand drill, with 4mm diameter HSS bit
- Small deburring tool
- Metric Allen key set.
- 10mm open end spanner.
- Synthetic multi-purpose grease (e.g. Albida RL2)

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- (Recommended) Bottle of "Loctite blue" or similar thread locking compound.

3.3. Inspection Requirements

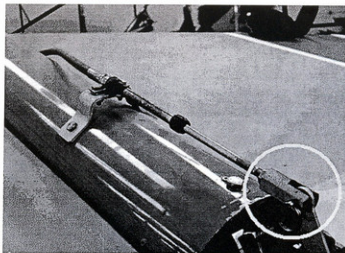
You will need a spring balance, capable of reading up to 3kg (6lb) or greater.

4. How to incorporate this Service Bulletin

IMPORTANT: Work in a clean environment, do not discard or damage any part that is removed from the aircraft – every part must be refitted in flying condition.

- (A) Carefully loosen or disassemble the elevator damper mechanism, smear all bearing surfaces with a thin layer of grease, re-assemble in the original order.
- (B) Disconnect the elevator Teleflex cable by removing the single pin and clevis ring at the top elevator horn (see Figure 1 below)

Figure 1. Elevator teleflex cable rear end and horn attachment

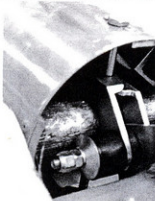


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- (C) Whilst supporting the elevator, disconnect QTY4 elevator hinge pins.
- (D) Carefully disconnect the elevator trimmer plug (square electrical connector) by squeezing the locking pins and gently pulling it out.
- (E) Remove elevator, set to one side.
- (F)
 - (i) Remove the lower safety pin from the elevator trailing edge locking bolt.
 - (ii) Carefully pushing the end of the elevator Teleflex to one side, remove the tail plane trailing edge locating bolt. You may need to tap it gently from underneath with a soft faced mallet or block of wood to encourage it.
- (G) Take the new elevator damper unit and place it so that the side with two brackets is around the fixed tail plane trailing edge spar with the hole through the trailing edge spar tube (see Figure 2 & Figure 3 below) [Note: photo below shows the elevator fitted, this is not how you should see it.]. **NOTE:** the damper rotating arm is vertically handed to match the elevator horn and that the assembly has a horizontal offset arranged by odd thickness friction washers to ensure that the rotating arm lines up with the horn when assembled and ready to be drilled/fitted.
- (H) Push the tail plane trailing edge vertical locating bolt back through the boom tube from the top so that it goes through. Refit the safety pin at the bottom (see Figure 3 below, elevator stop omitted for clarity).

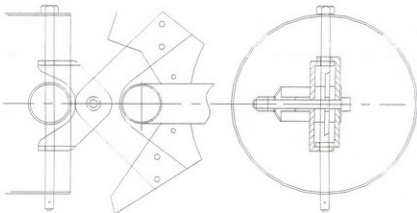
Figure 2, damper in place with vertical bolt refitted.



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Figure 3, Drawing of end of boom tube with elevator damper in place (elevator stop not shown)

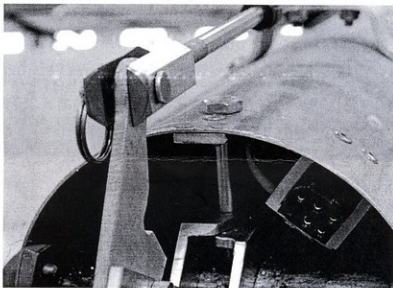


- (I) Refit the elevator, taking care to reconnect QTY4 elevator hinge pins (including their safety pins), then re-attach the elevator Teleflex attachment and clevis ring (see Figure 4 below).

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Figure 4, Re-fitted teleflex attachment with damper in place

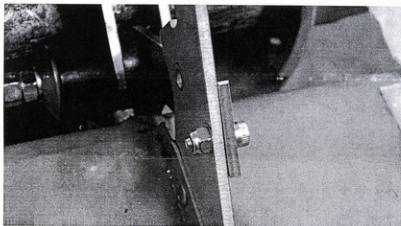


- (J) Place a G-clamp (or similar temporary clamping device) across the lower elevator damper arms and the elevator arm so that they are rigidly flush with each other, with the edges flush. **IMPORTANT:** Take care to ensure that the clamp jaw is covered with card, etc. to avoid scoring the aluminium alloy surface.
- (K) At the upper side there will be two holes drilled in the elevator damper arm. Ensuring that this arm and the elevator control horn are flush against each other by putting a small G-clamp (or similar) over the other hole drill through each hole with a 4mm HSS twist drill. After drilling the first hole carefully debur then fit the supplied caphead (Allen) screw and self locking nut. Tighten, then drill and debur second hole before fitting the screw to that hole. (Figure 5 below.)

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Figure 5, Matched up arms, drilled with first screw in place



- (L) Repeat this process for the underside arms. (Note: if available, it is permissible to add a drop of "loctite blue" or similar thread locking compound to the screws and nuts during fitting.
- (M) Re-attach elevator trim tab electrical connector plug and socket (see Figure 6 below)

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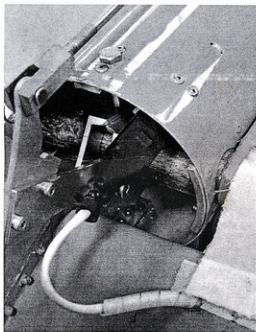
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Figure 6, Fully assembled parts at rear of fuse tube.



- (N) Now adjust the friction on the device using a 10mm open-end spanner and Allen key (see photo) so that with the elevator horizontal, you need 2.5 - 2.6 kg [5.5 - 5.7 lbf] of pull upwards (at the trailing edge of the elevator centreline, next to the trim tab hinge) to move the elevator. After the correct adjustment is found tighten the 6mm nylock locking nut against the aduster nut to secure. (Figure 7 below.)

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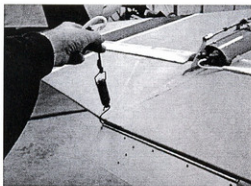
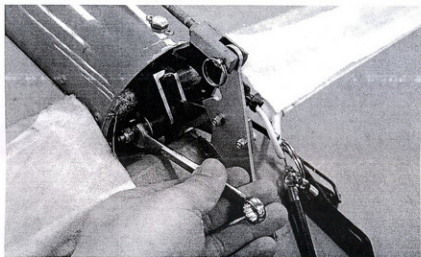
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Figure 7, Making adjustments to the damper mechanism,



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- (O) Re-check all of the fastenings and confirm correct functioning of the elevator trim tab, and full range movement of the elevator.

5. Changes to Operating Data

5.1. **Changes to Weight and Balance**

The aircraft weight and balance is modified by the addition of 0.12 kg at 143 inches aft of datum; this will move the CG aft by about 0.05", and is not sufficiently significant to require preparation of a new W&CG report.

5.2. **Changes to Operators Manual**

No change is required to the Operators Manual.



5.3. **Changes to Maintenance Manual**

Replace page 16-6 of the maintenance manual with that contained at Appendix A to this Service Bulletin.

5.4. **Changes to Placards.**

No changes are required to placards.

6. Authorisation

Prepared by:  G B Gratton Chief Technical Officer British Microlight Aircraft Association	Authorised by  J A F Viner Deputy Chief Technical Officer British Microlight Aircraft Association
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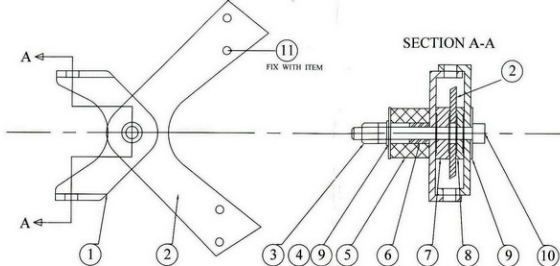
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List of Annexes to this Service Bulletin

Ref:	Title	No. Pages
Annex A	Amended page 6-16 of Shadow C-D Maintenance Manual When used for Shadow D, DD and D-SS aircraft.	1



11	4/4	M4 x 12 Cap Head Screw plus M4 Full Nylock Nut	2009 / 2128
10	1	M6 x 60 Cap Head Screw Plated	2011
9	2	6MM Penny Washer 25mm O.D.	2179
8	1	Friction Washer - Nylonon 25 x 4 mm x 6.5 Hole	MB - 1C
7	1	Friction Washer - Nylonon 25 x 7 mm x 6.5 Hole	MB - 1C
6	1	Centralising Spacer Nylon - 6	1565
5	1	Spring Black Rubber 50-70 Shore	1573
4	1/1	6MM Nut / 6MM plain Washer	2136 / 2132
3	1	6MM Nylock Full Nut	2144
2	1	Damper Rotary Arm 3MM Sheet 6082-T6	MB - 1B
1	2	Damper Fixed Arm 2.5" x 1" x 1/8" Channel 6082-T6	MB - 1A
Itemref	Quantity	Title/Name, designation, material, dimension etc	Material Supply Reference
Inspected and Approved for the BMAA		BMAA Inspector / No.	Signature / date
Retain Paperwork with Part / Log book			
The Part(s) issued with this drawing has been inspected		Batch No.	Signature
Certified as correct to Drawing and Released for Payment		ONE	
Designed by	Checked by	BMAA Approval	Issue/date
N. Beale	M. Broome	MAAN 1877	JUNE 2005
Inspection Date		Scale	NTS
21-6-05			
Elevator Damper Assembly			
Issue No		Issue No	Sheet
Initial		Initial	ONE

MASS 120 Grams
NATURAL FINISH
REMOVE ALL SHARP CORNERS
TOLERANCE UNLESS STATED
OPEN DIM ± 1.00
0.0 DIM ± 0.5
0.00 DIM ± 0.05

FITTED TO AIRCRAFT G-MGTW
SELLER TO COMPLETE AND SEND A
COPY TO BMAA

1	Issued for Manufacture	21/6/05	M.B.
Initial	Issued for discussion and Approval	8/4/05	M.B.
Issue No	Revision note	Date	Signature
			Checked

BROOM DEVELOPMENT ENGINEERING
EASTON NESTON
TOWCESTER

NN12 THS 01327 353023

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