

## MICROLIGHT AIRWORTHINESS APPROVAL NOTE

MAAN NO:1762

ISSUE 2

DATE: 22 July 2004

**TITLE:** Microlight Airworthiness Approval Note 1762, Crosbie replacement undercarriage for CFM Shadow aircraft (all microlight variants). Also increase in maximum permitted empty weight and modification to the maintenance manual to include mandatory nosewheel inspection.

**APP:** All Microlight CFM Shadow aircraft

**STAGE:** Approval.

### 1. INTRODUCTION

The CFM Shadow is a microlight aircraft which exists in a number of variants described in Microlight TADS BM6, BM19, BM40, BM41 and BM55. Most variants of the aircraft administered by the BMAA are type approved, although some C series variants hold amateur built permits to fly, as it is intended does a single "E-series" Shadow which is currently under investigation under project number BMAA/HB/239.

This MAAN refers primarily to a modification proposed by D & J Crosbie Engineering of The Mere, Bures Road, Sudbury, Suffolk, C010 0NW. This modification replaces the main gear with a unit of new design and manufacture as a direct replacement.

In addition, this MAAN introduces for all such aircraft a mandatory periodic inspection, to be included within the maintenance manual, of the nosegear assembly following concerns of some nosegear failures having occurred due to incorrect adjustment of the nosegear bungee.

In addition, this MAAN authorises a modification to the TADS for each variant of the Shadow increasing the maximum permitted empty weight.

These modifications are in response to a grounding of the Shadow type by UK CAA following an analysis of the existing undercarriage design and history by the authority which concluded that the existing main gear in particular was unsafe and should not be permitted to continue flying.

This MAAN issue 2 replaces issue 1 for the following reasons:-

- To clarify requirements for amendments to documentation
- To address concerns raised by CAA concerning the clarity of instructions with regard to avoiding damage to Fibrelam structure on the fuselage underside. This is by modification of the working instructions in Appendix C.
- To amend the detail of the modification, replacing a small alteration to a

plywood bulkhead with packing by a 1mm aluminium plate. This does not remove approval for previous version of this modification, but alters the approved basis for all future fitments of the Crosbie undercarriage. This is shown in Appendix C.

- To correct the inadvertent omission from section 12.2 of reference to TADS BM19.
- To clarify the statement concerning the required amendment state of the operators manual for each type (new section 12.5 refers).

## 2. BASIS FOR APPROVAL

The basis for approval is BCAR Section S issue 3 with the exception that propeller ground clearances are not shown to comply, but the design is accepted on the basis of no decrease in propeller clearance and no increase in undercarriage displacement with load compared to the existing undercarriage (which has no history of propeller strikes whilst the undercarriage remained intact).

## 3. DESCRIPTION

The CFM Shadow is a tandem pusher 2-seat microlight aeroplane, a description of the design of which may be found in it's operators manual.

The Crosbie undercarriage consists of a steel tube and plate framework at the upper part, lateral bracing wires, with suspension provided by two composite rods running into a steel hub axle assembly. This is illustrated below. (Note, the illustration shows the undercarriage under load test conditions, the composite rods are straight when unloaded.)



## 4. TECHNICAL INVESTIGATION

The main gear has been shown fully to comply with BCAR Section S issue 3 with respect to all requirements that affect the integrity of the undercarriage and its attachments for aircraft weights up to 430kg with a wing area equivalent to that of any currently approved Shadow variant, including the PFA Streak Shadow. This analysis and test reports is held in the BMAA project

file associated with this MAAN.

The nosegear has no history of failure when correctly adjusted, and therefore has not been replaced. Analysis carried out by the Popular Flying Association (PFA) and accepted by the BMAA has shown that a correctly adjusted nosegear is not subject to failure in normal operating conditions. PFA have reported this analysis in *MOD/206/002*, which is the basis for Appendix A of this MAAN.

It has been shown that the new main undercarriage is slightly more stiff than the previous with (vertically) identical geometry and therefore offers no increase in risk of propeller strike. This aspect is therefore approved on the basis of “no worse than before” combined with no history of propeller strikes, rather than absolute compliance with the standard.

Data has been supplied by Rotax for the 503 and 582 engines which allows an increase in maximum permitted empty weight for all C and D variant shadows based upon a reduction in Maximum Continuous RPM from the current (single tier) limit to 6,000, whilst leaving maximum take-off power unchanged.. This is read across also to the Rotax 447 fitted to the B series Shadow. Specifically:

D series (582) Fuel consumption at MCP is reduced from 25 litres/hr to 21 litres per hour, permitting an increase in maximum permitted empty weigh of 2.9kg (nominally 3kg) from 196kg to 199kg.

C series (503) Fuel consumption at MCP is reduced from 21 litres/hr to 19 litres/hr, permitting an increase in maximum permitted empty weight of 1.5kg.

B series (447) Fuel consumption at MCP is reduced from 21 litres/hr to 19 litres/hr, permitting an increase in maximum permitted empty weight of 1.5kg.

Since the weight increase due to the installation of this undercarriage is 1.2kg, this will permit the undercarriage to be fitted to any currently legal aircraft.

The forward and side view cross-sections of the aircraft are unchanged, therefore it is considered that performance and handling of the aircraft will be unchanged.

Given that the undercarriage is now fully compliant with structural requirements it is also considered that previous CAA prohibition on fitment of the Fibrelam “slipper” fuel tank may be removed. Therefore compliance with this MAAN cancels SB 1193.1 (removal of slipper tanks).

## 5. FLIGHT TESTING

Flight testing, including extensive ground handling assessment and a large number of deliberate hard landings, on a variety of surfaces, have been carried out on a sample aircraft. This testing is considered acceptable by the BMAA, and is held on the project file associated with this MAAN.

## 6. MANUALS, PLACARDS AND INFORMATION

Appendix A to this MAAN is to be added as an Amendment to the Operators manual for all Shadow aircraft, including those to which another approved main gear is fitted.

Appendix B to this MAAN shows the worksheet for manufacture of this undercarriage. A copy of this worksheet, which when completed (including a signature by a BMAA inspector authorised for the purpose) becomes the MANUFACTURE CERTIFICATE OF CONFORMITY for the undercarriage when completed, is to have been supplied with the undercarriage and shall be retained with the aircraft logbook once fitted.

Appendix C to this MAAN shows the worksheet for installation of this undercarriage. A copy of this worksheet, which when completed becomes the INSTALLATION CERTIFICATE OF CONFORMITY for the undercarriage when completed, is to have been supplied with the undercarriage and shall be retained with the aircraft logbook once fitted. The inspector signing for the installation may not be the same person as has carried out the fitment of the undercarriage.

The RPM gauge is to be modified so that an amber arc stretches from 6000rpm to the maximum RPM limit rpm, with a red radial line at the maximum RPM limit itself.

In all other respects the aeroplane must be placarded and maintained according to TADS BM6, BM19, BM40, BM41 and BM55 as applicable.

## 7. NOISE CERTIFICATION

Noise certification is not affected.

## 8. RADIO

Any aircraft radio installation is not affected by this note.

## 9. INSPECTION

To TADS BM6, BM19, BM40, BM41 and BM55, this MAAN and the operators manual.

A new 50 hour/annual inspection action is introduced, as described at Appendix A to this MAAN.

## 10. WEIGHT AND BALANCE

The aircraft weight is increased by 1.2kg at 51.2” AoD, procedures for addressing this are at the end of Appendix C to this MAAN.

## 11. SIGNIFICANT FEATURES AND LIMITATIONS

The main gear is replaced with a new item of superficially similar appearance, but more substantial construction.

A new limit of “maximum continuous RPM” is introduced at 6,000 RPM.

A new inspection action is introduced, see Appendix A.

## 12. CERTIFICATION

12.1 I certify that a CFM Shadow B, BD, C, CD, or DD aircraft which complies with this MAAN has an undercarriage which is acceptable and fully compliant with the certification basis, and therefore may continue to fly under, and have revalidated, a microlight permit to fly.

12.2 I recommend that TADS BM6 and BM19 be revised to include mandatory compliance with this MAAN (except where an alternative modification has been approved by BMAA or CAA), and to increase the maximum permitted empty weight to 188.5kg. In addition a new maximum continuous RPM value of 6,000 with an associated requirement for placarding is to be introduced.

12.3 I recommend that TADS BM40 and BM41 be revised to include mandatory compliance with this MAAN (except where an alternative modification has been approved by BMAA or CAA) and to increase the maximum permitted empty weight to 188.5kg. In addition a new maximum continuous RPM value of 6,000 with an associated requirement for placarding is to be introduced.

12.4 I recommend that TADS BM55 be revised to include mandatory compliance with this MAAN (except where an alternative modification has been approved by BMAA or CAA) and to increase the maximum permitted empty weight to 199kg. In addition a new maximum continuous RPM value of 6,000 with an associated requirement for placarding is to be introduced.

- 12.5 I recommend that all Shadow TADS are amended to show Appendix A to this MAAN as an amendment to the operators manual for each type.
- 12.6 I authorise withdrawal of BMAA SB 1193.1 and recommend to CAA that it withdraw MPD 2004-002 CFM, which mandates compliance with that Service Bulletin.



G B Gratton  
Chief Technical Officer  
British Microlight Aircraft Association

Initial Distribution:

BMAA: MAAN File 1762  
NCR File 19

Crosbie Engineering: Phil Snowden  
(Also for Danny Crosbie and distribution with new undercarriages)

CAA: Light Aircraft Certification Section (Gatwick)  
Applications and Certifications Section (Gatwick)

PFA: Head of Engineering

Skydrive: Nigel Beale

## Appendix A

### Addendum to Section 16.2 of Shadow Maintenance Manual.

(To be applied at 50 hour and annual checks).

#### Actions required:

1. Place the aircraft on level ground, and drain all fuel.
2. With a person of average weight (between 77 Kg and 90 Kg) occupying the front cockpit, and rear seat empty, check visually that the nosewheel suspension is on the stop i.e. there is no deflection of the noseleg suspension from the fully extended position.
3. Check visually that when an additional weight of 10-20 Kg is applied to the top of the nosecone, in the vicinity of the top of the instrument panel, the nosewheel suspension comes just off the stop.
4. If the noseleg is off the stop at stage 2 above, or does not come off the stop at stage 3 above then the noseleg bungee is incorrectly installed or has deteriorated in condition, and must be replaced in accordance with the CFM instructions, setting the pre-tension so as to satisfy the criteria of stage 2 and 3 above.
5. Inspect the noseleg in the vicinity of the noseleg suspension stop cable. If there is evidence of wear of the noseleg through contact with the cable, more than 5 thousands of an inch deep, then the noseleg must be replaced, checking on completion that the bungee pre-tension has been set such that the criteria of stages 2 and 3 above are complied with.
6. Inspect the bungee for signs of fraying, or rotting of the outer braid, or necking/failure of the internal rubber cords. If any of these conditions exist then the bungee must be replaced in accordance with the CFM instructions and complying with the criteria of stages 2 and 3 above.
7. Refill fuel tank as required, to avoid condensation forming in fuel tanks.





Appendix C – Installation Worksheet and Certificate of Conformity

**BMAA WORKSHEET & CERTIFICATE OF CONFORMITY  
Crosbie / Shadow Undercarriage Modification**

AIRCRAFT REGISTRATION: \_\_\_\_\_

ENGINE TYPE: \_\_\_\_\_

PROPELLER TYPE: \_\_\_\_\_

TOTAL AIRFRAME TIME: \_\_\_\_\_

CUSTOMER/OWNER/OPERATOR \_\_\_\_\_ DATE STARTED: \_\_\_\_\_

Undercarriage serial number: \_\_\_\_\_

	WORK/INSPECTION/DETAILS ETC.	Carried out by (initials):
1	Decide where you intend to carry out the fitting of the new Undercarriage. Remember you are bonding with Araldite so a dry atmosphere is essential – maximum 60% humidity.	
2	Remove the wings of the aircraft, remove the elevator and tail plane, store in a dry secure area.	
3	Move fuselage to hangar/workshop where you intend to fit new Undercarriage.	
4	Remove the Slipper Tank, Fuel Lines and disconnect Sender Unit where applicable. Disconnect the Brake Cables at the Wheels.	
5	Put a weight in the front of the aircraft, chock the nose wheel. Acquire a piece of straight grained timber 3” x 3” four feet long. Place the timber behind the Undercarriage on the area where the Slipper Tank bolts on.  Lift the aircraft with a trolley jack or similar in the centre of the wood in the centre of the fuselage. Jack up aircraft until the wheels are about 1” off the ground making sure the fuselage is balanced on the timber by moving the jack. Support the ends of the timber with stable axle stands/blocks etc. Lower the jack making sure the wheels are clear of the ground. Ensure the aircraft is stable at all times, get help if necessary.	
6	Removing the old Undercarriage  Release the drag struts where they meet the Undercarriage by removing the nuts and bolts. Remove the two U bolts. Drop old Undercarriage.	
7	The old Undercarriage is mounted on small aluminium plates, these must be removed. First drill out pop rivets on the plates. Next <u>carefully</u> chisel a small void between the aluminium plate and Fibrelam, to enable a screwdriver to be inserted as a gentle lever, take care to avoid damaging the Fibrelam. Next heat the aluminium plate with an electric hot air gun, while gently levering the plate until it falls	

	WORK/INSPECTION/DETAILS ETC.	Carried out by (initials):
8	<p>off. Use careful and progressive heating, shielding the exposed Fibrelam areas not to be heated. Repeat above procedure on the other side. Also remove the top U bolt plates on the inside in the same manner. Save the four aluminium spacers, you will need these later.</p> <p>Fitting new Base Plates</p> <p>Your new base plates are a lot bigger than the old ones. Position the plates so they pick up the rear ½” Fibrelam vertical firewall and the ½” Fibrelam vertical sidewall. When you are happy with the position mark around the plate with a felt pen, repeat procedure on other side. Position and trim the 1mm packer in accordance with Addendum 1. Next drill four 1/8” holes near the corners of the plates. Offer up the plates on their marks and drill through the 1/8” holes in the plates, packer and the bottom skin of the Fibrelam.</p> <p>Next test the plates and rivets – make sure they fit. Do not rivet at this point. Repeat procedure on the other side. Next abrade aluminium plates, packer and Fibrelam with 180 grit rubbing down paper or similar. This should only be performed with great care as it is extremely easy to remove a significant amount of structural Fibrelam skin by abrading, the skins are very thin. Degrease with acetone.</p>	
	<p style="text-align: center;"><b>THIS IS INSPECTION STAGE ONE</b>      Inspectors signature</p>	
9  10	<p>Mix 30g of Araldite A with 30g of Araldite B in paper cup. Spread evenly over Fibrelam, packer and the plates. Press together making sure you have a good bond line. Rivet the plates in position. Clean off excess Araldite. Leave to cure for 8 hours.</p> <p>Fitting New Undercarriage</p> <p>Your new Undercarriage is secured with four ¼” x 2 ½” bolts between the tubes. Firstly measure the distance between the furthest holes on the new Undercarriage. This should be the same distance as the forward holes for the old U bolts. If they are slightly different re-align them equally from the inside of the fuselage.</p> <p>When this is done, drill through the Fibrelam on the inside and through the aluminium base plate. Test fit the Undercarriage with two bolts. When happy with the fit, remove Undercarriage.</p> <p>On the inner floor draw a straight line on the centre line of the two furthest holes just drilled. Measure the Undercarriage, mark the inboard holes on the inner floor and drill a ¼” hole vertically down through the Fibrelam floor and the aluminium base plate. Test fit the Undercarriage again. When happy – remove. Next enlarge the holes in the Fibrelam to accept the aluminium spacers previously saved. Position over the holes in the base plate. Rapid Araldite may be used to position these (NOT PROVIDED). Then fit top plate (Please Note. The spacers fit flush with the top plate so the holes need to be the same diameter as the outside diameter of the bushes. Dry fit when happy. Prepare, abrade and degrease as bottom plates, then bond. No need for</p>	

	WORK/INSPECTION/DETAILS ETC.	Carried out by (initials):
	rivets as gravity will hold them in place.	
	Undercarriage Final Assembly	
11	Loosely fit Undercarriage with the four ¼” bolts. Make sure to fit the penny washers on the inner plates, then the nuts. Next connect the drag struts using two spacer washers provided on each strut. It may help if you loosen or even disconnect the drag strut where it meets the fuselage. When all bolts are connected, tighten them up. Remove the nuts and washers on the location brackets at the front of the drag spar on inside of the fuselage. Remove the aluminium plate with hot air gun and screwdriver. As previous, prepare, abrade and degrease new thicker plate supplied. Bond as before. Refit washers and nuts. The nuts may be tightened before Araldite is set.	
	Wheels and Brakes	
12	Remove wheels from old Undercarriage – re-assemble on new Undercarriage. Follow CFM’s laid down procedure in the Build Manual/Maintenance Manual. Connect brakes and adjust. Refit slipper tank, fuel pipes, sender etc.	
	<b>THIS IS INSPECTION STAGE TWO</b>	
	Inspectors signature	

**INSPECTORS’ DECLARATION**

I CERTIFY THAT THE ABOVE AIRCRAFT HAS BEEN MODIFIED I.A.W. MAAN 1762 ISSUE 2

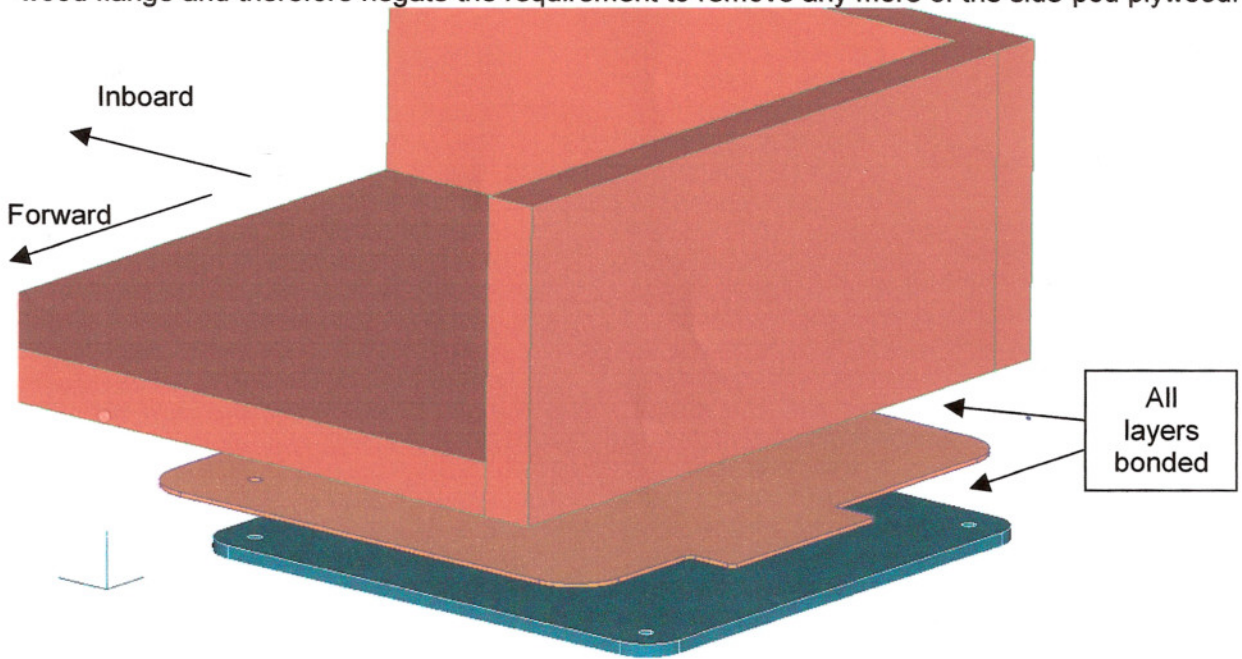
A new weight and balance sheet is to be prepared (form BMAA/AW/028) showing the addition of 1.2kg at 51.2” aft of datum, OR a new weighing may be carried out (recorded on the same form). Re-weighing is not mandatory unless the aircraft has not been reweighed within the last 5 years.

AIRCRAFT LOG BOOK HAS BEEN ANNOTATED ACCORDINGLY.

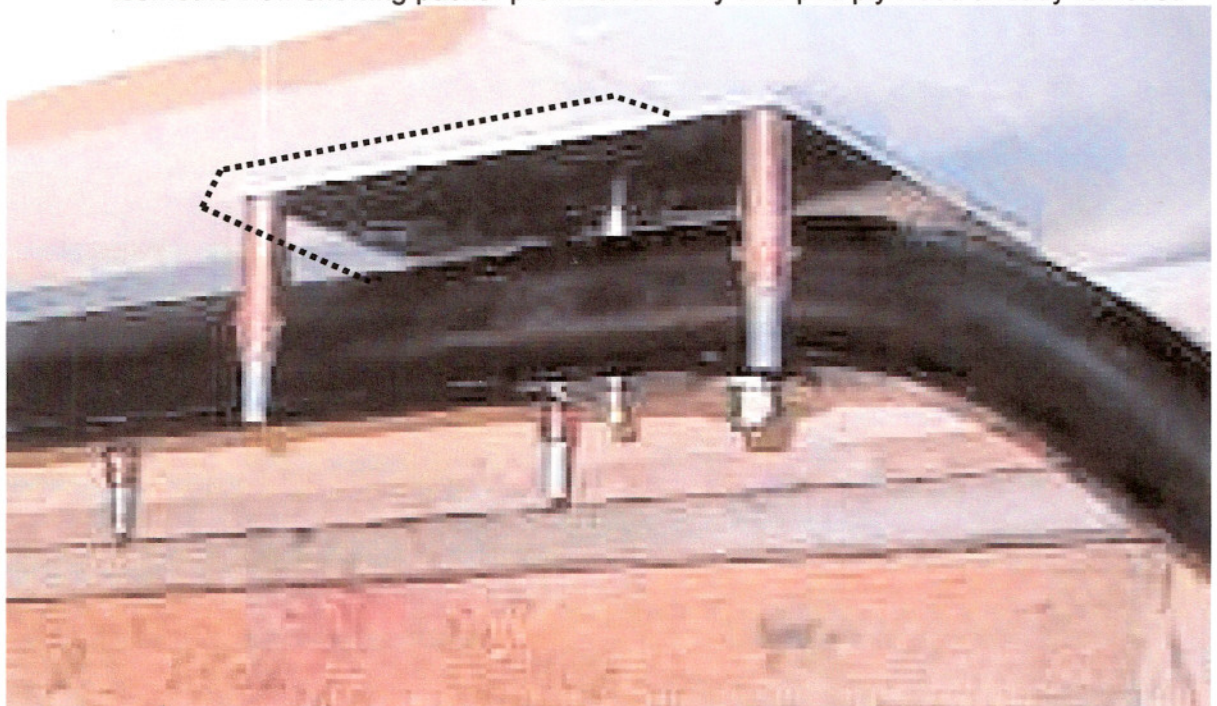
**NAME                      SIGNATURE                      AUTHORITY                      DATE**

\_\_\_\_\_

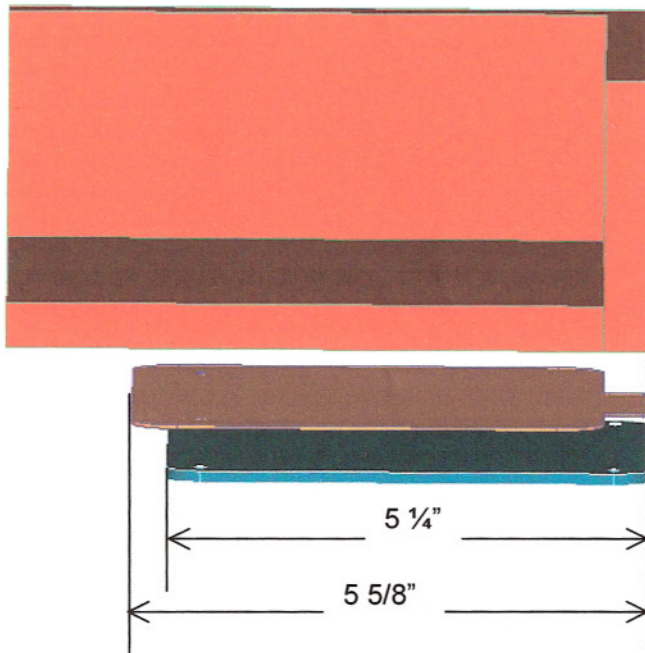
This addendum to the original worksheet requires that a 1mm aluminium packer is fitted, between the new 5.25" square plates and the fuselage floor, allowing the bottom plates to sit over the side-pod ply wood flange and therefore negate the requirement to remove any more of the side-pod plywood.



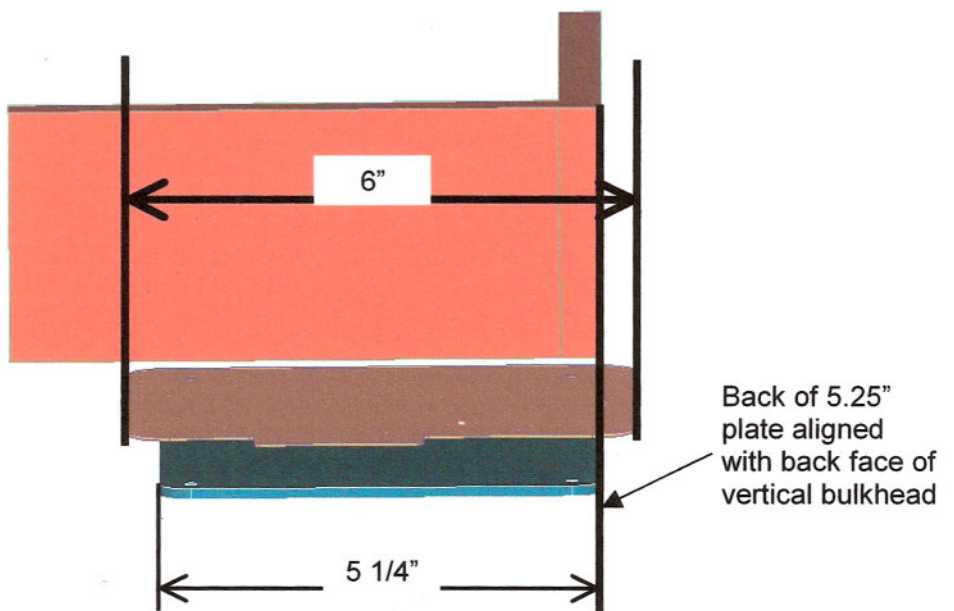
Isometric view showing packer profile to suit any side pod ply wood already removed



Packer shown dotted



Exploded view looking aft



Exploded view looking inboard