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# Finger Brake System

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<b>Classification:</b>	Optional
<b>Applicability:</b>	Trigear Europas with XS cockpit modules
<b>Compliance:</b>	N/A

## Introduction

This modification introduces hand or “finger” operated main wheel brakes to the Trigear aircraft in place of the foot operated brakes currently in use.

The system uses a twin cylinder casting for the master cylinders, which is positioned on the right hand side of the central tunnel. A portion of the tunnel is cut away to enable a pre-manufactured fibreglass platform to be mounted; a cover is then fitted which replaces the section of tunnel removed.

The system includes a hydraulic parking brake.

## Action

### Step 1 - Removal of redundant parts

If you have not fitted the foot brake system, go to step 2.

Drain the hydraulic fluid from the existing brake system by unscrewing the bleed nipple on each main wheel brake and pumping the brake pedal to eject the fluid into a suitable container. You’ll retain some of the lines and different brake fluid will be used in the new system so try to get as much of the original fluid out as possible. DOT 5 Silicone brake fluid will be used as it is compatible with the seals in both the master cylinder and the brake callipers.

Disconnect the hydraulic lines from the master cylinders and draw them back to within the centre tunnel; they will be repositioned later.

Remove and discard the master cylinders and their associated operating levers, the mounting brackets B01P and B01S, and the top plate B05.

### Step 2 - Marking the tunnel cut-out

Remove any upholstery from the centre tunnel. Position the cover moulding, F29, in place against the starboard side of the central tunnel as shown in figure 1. You may need to trim the portion at the rear of the throttle spine to clear the choke knob.



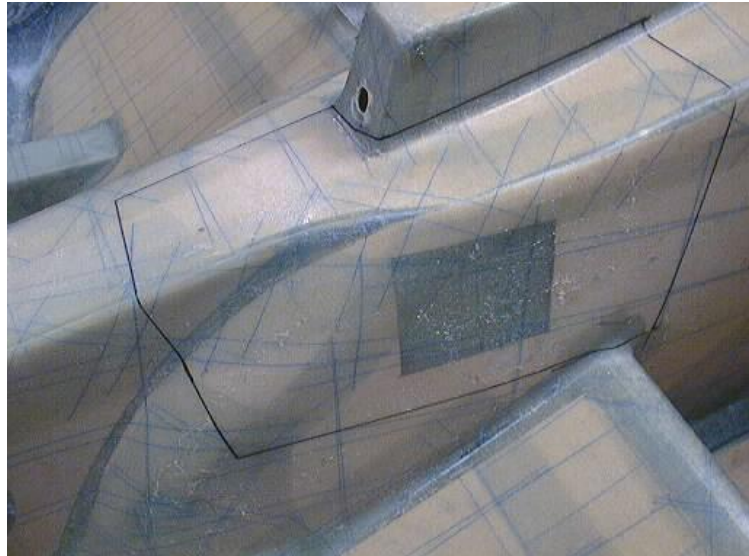
Mark around the edge with a felt pen type marker. At the top corner of the thigh support, continue the line through as shown on the photo, - don't follow the lug.

Also, mark around the base of the throttle spine, instead of following the locating flange.



*Fig 1. Cover moulding in position.*

After removing the cover moulding you're cockpit module tunnel should look like the photo in fig 2. This is the initial marking out only, and is **NOT** to be used for cutting out.



*Fig 2. Initial marking lines.*

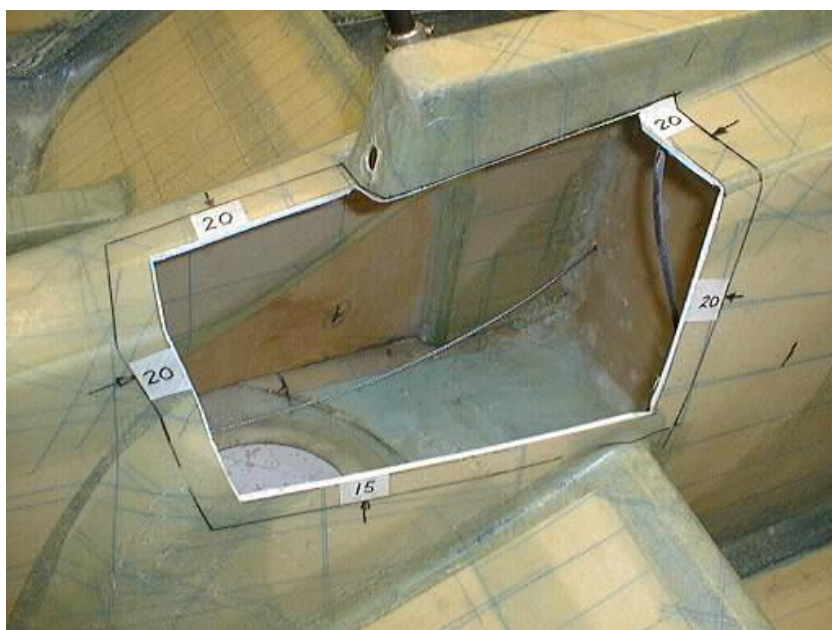
Now mark out a second set of lines inside the originals - these should be 15mm (5/8") inside along the bottom and 20mm (3/4") inside along the top and sides. Keep the original line around the throttle spine. See figure 3.



*Fig 3. Cutting lines.*

### Step 3 - Cutting out

Now cut out the portion of the tunnel marked by the inside cutting lines, and the line around the base of the throttle spine. See figure 4.



*Fig 4. Tunnel after cutting.*

### Step 4 - Exposing flange

Using the original outside lines, cut through the **outer skin only**, then scrape away the foam core, leaving the inner skin intact. This skin is quite thin, so be careful!

Where there is no foam core, you should remove the skin altogether - notice the gaps which can be seen in figure 5.



*Fig 5. Inner skin exposed.*



## Step 5 - Cover bolt holes

Eight bolts are used to secure the cover in place as it serves as a structural part.

Before making the bolt holes though, initially trim the edges of the cover such that it fits within the recessed flange of the platform moulding. Initially drill the eight 3mm (1/8") pilot holes into the cover moulding having marked their centres according to the dimensions shown in figure 6.

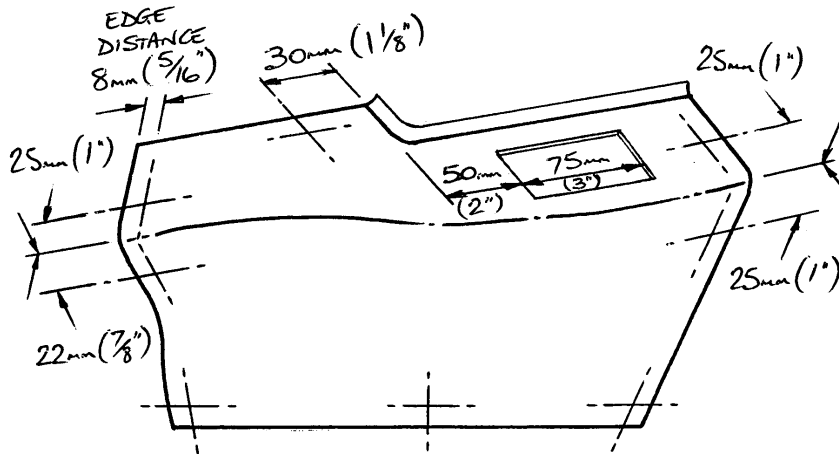


Fig 6. Cover bolt hole centres.

Next, position the platform moulding (F28) into the cockpit module and secure it from moving by drilling two or three 3.3mm(1/8") holes through its outer flange and using Clecos.

Now position the cover onto the platform moulding, locating it within the recessed flange. Hold it in place using adhesive backed tape and drill right through the eight small holes with a 4.8mm drill before removing all the parts from the cockpit module. The flange of the cockpit module is very flexible so do not apply too much pressure as you drill through. Although not essential, you may reinforce this flange with a ply of 'bid'.

Using an MS21051-3 single leg anchor nut as a drill guide, drill the two 2.4mm (3/32") rivet holes for each hole into the thin glass fibre flange. Set the anchor nut at an angle so that at least one of the rivets will have a good edge distance.

Rivet each anchor nut to the underside of the flange using TAPK33BS rivets and EUR063 washers to prevent them pulling through the glassfibre. Don't try to countersink the flange as it is too thin. There will be an adhesive filled gap between the platform moulding and the flange so the rivet heads being proud is not a problem.

A rectangular shaped hole is required in the top of the cover to allow the levers through. Covering this hole will be a metal slotted plate onto which the 'BRAKES - PULL ON' placard is to be mounted. Cut the hole into the cover according to the dimensions shown in figure 6. The opening is to be wide enough to allow approximately 3mm(1/8") clearance outside of the levers so you'll have to have the master cylinder assembly fitted, therefore this is what is to be done next.

## Step 6 - Master cylinder platform

The rear vertical face of the platform F28 has a curved slot trim line marked on it - cut out on this line to form a slot for the hydraulic lines to pass through. There are also three hole centres marked on to the base of the platform. Drill through these with an 8mm (5/16") diameter drill, starting with smaller drill bits first to avoid splintering the glassfibre.

Temporarily assemble the master cylinder onto the platform using EUR062 countersunk screws and MS21047-5 anchor nuts. Orientate the anchor nuts to keep the lugs over the plywood insert. Drill part way through one of the lugs of each anchor nut with a 3.3mm drill, then insert a TLPK435BS pop rivet into each hole thus made, and drill the other lugs.

Remove the master cylinder and complete the drilling of the holes for the anchor nut rivets. Lightly spin a drill bit of at least 1/4" diameter, (or a 120° countersink bit) in your fingers in the top surface of each hole until the countersink produced allows the rivets to sit flush with the top surface. Rivet the anchor nuts in place, using the TLPK435BS rivets.

## Step 7 - Master cylinder assembly

Working on the master cylinder unit, remove and discard the three hydraulic union fittings. Fit three 268-04x02 fittings to the hydraulic ports.

Remove and discard the black 5/16" U.N.C. socket head screws which are positioned at the lever pivot point. Cut off part of the thread of the two EUR061 bolts so that they measure 26mm (1") from under the head. Referring to figure 7, assemble the levers B06 and B07 onto the master cylinder, using the cut down EUR061 bolts as the pivot pins, with one EUR012 washer between the lever and the centre portion of the body to stop the levers from rocking sideways too much; you will need to file off part of these washers so that they don't protrude below the master cylinder base.



*Fig 7. Platform / master cylinder sub-assembly.*



Install the bolts with Loctite 243 and do not over tighten them, as it is possible to cause the levers to bind in the slots.

Place an AN960-516 washer between the lever and fork to take up the gap here.

Fit the handles B08 and B09 using AN525-10R10 bolts.

Finally assemble the master cylinder to the platform with the EUR062 bolts as shown in figure 7.

## **Brake Levers Cover Plate**

The double-slotted cover plate for the brake levers is to be held in place using rivets. With the glassfibre cover bolted down, place the cover plate over the brake levers (remove the handles to do this) and position the front of the slots about 3mm (1/8") ahead of the levers. Move the levers fore and aft to ensure that the slots are correctly aligned, then drill through the holes with a 3.2mm drill for TAPD46BS rivets. Attach the plate with the rivets, using EUR 011 washers to prevent them pulling through the glassfibre.

**NOTE:** *Before riveting the plate to the cover, bear in mind that you might wish to add upholstery first.*

## **Parking Brake Valve installation**

The parking brake valve provides a means of retaining hydraulic pressure in the lines between each wheel brake caliper and the valve. When the park brake is set to "on" a check valve allows further pressure to be applied by pulling on the brake levers. A lever on the park brake valve, which operates in the same sense as the brake levers - rearwards for "on" - operates the parking brake. This lever, which emerges through a slot in a cover plate that is on the top of the central tunnel behind the brake levers, is held in the "off" position by a detent in the forward end of the slot.

The orientation of the parking brake valve is such that the lever is on the starboard side and uppermost. The two ports that have hexagon section fittings screwed into them, point downwards. The other two ports face forwards. This allows the two lines that run between the rear of the master cylinder and the front of the parking brake valve to be reasonably direct.

## **Step 8 - Parking Brake Lever**

When operating as required, the parking brake valve lever should point approximately 23° above and below the directly forward position. See figure 8.

The location of the parking brake valve requires the addition of a lever extension. To ensure that the lever and extension maintain their orientation with each other two bolts are necessary. The parking brake valve lever has only one hole in it so, to drill a second one first fit the lever extension using one AN525-10R8 bolt and MS21042-3 nut. Orientate the lever as shown in figure 8. Drill a second hole through both levers using a 4.8mm drill using the pilot hole in the lever extension as a guide and install another nut and bolt.

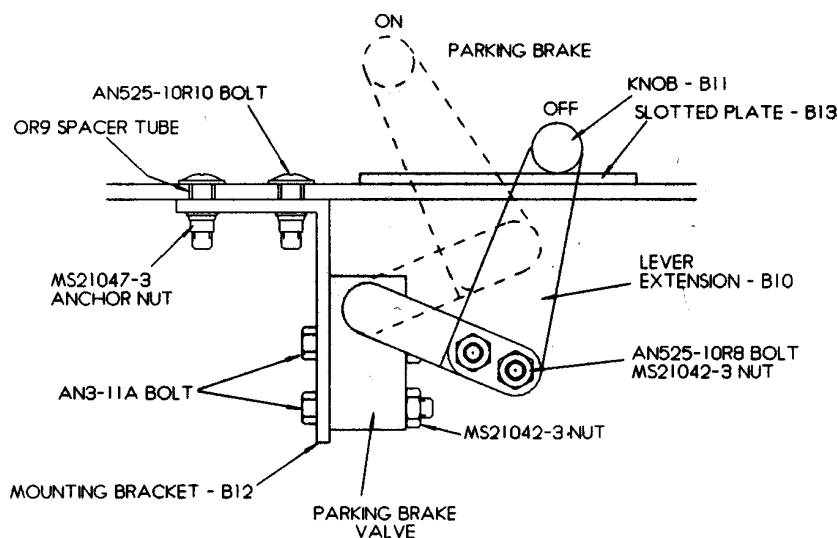


Fig 8. Parking brake valve lever.

### Step 9 - Parking Brake Valve installation

Working on top of the tunnel, mark the centre of the rear hole for the parking brake valve mounting bracket, part number B12, according to the dimensions in figure 9. Drill through with a 1/4" drill.

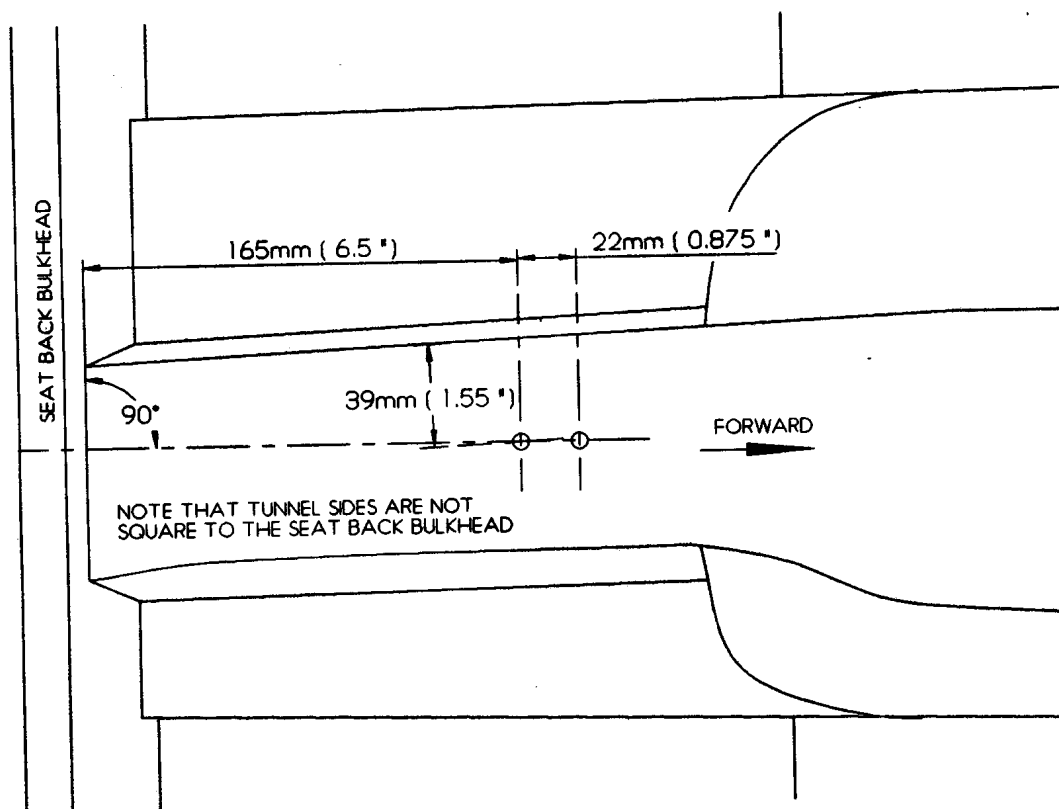


Fig 9. Drilling holes for parking brake valve mounting bracket.



The second mounting hole is directly forward of the first, the centre line through both being at 90° to the seat back bulkhead, rather than parallel to the tunnel sides. Mark out and drill the second hole 22mm (7/8") forward of the first hole.

Next cut a slot through the top face of the tunnel for the lever extension to pass through. The dimension in figure 10 will aid in positioning it. A slotted plate, part number B13, will later cover this slot.

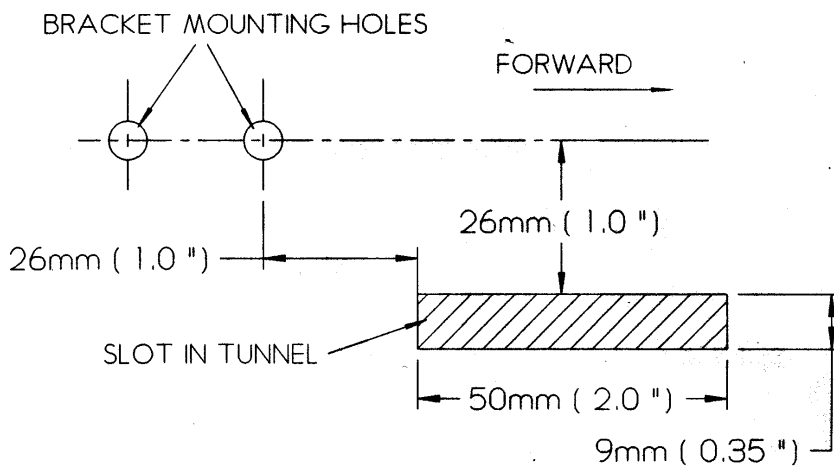


Fig 10. Dimension for parking brake valve lever extension slot. Not to scale.

Now attach the two MS21047-3 anchor nuts to the inside face of the shorter flange of the mounting bracket using TAPK36BS rivets. Drill the rivet holes to 2.4mm diameter and countersink the outer face of the flange with a drill.

Before bolting the mounting bracket to the underside of the tunnel, fit it to the parking brake valve. With the valve oriented as described earlier, bolt the bracket to its rear face, with the short flange pointing rearwards. Use AN3-11A bolts and MS21042-3 nuts. Also install 268-04x02 unions into each of the four ports of the valve.

Cut two short pieces of the hydraulic line. Approximately 17cm (6.5") will do. Fit one line each to the fittings that will point forwards. To fit the line, first slide the nut and olive onto the line, push the line onto the spigot of the union, slide forward the nut which will push the olive with it, and screw tighten it.

Next you will install the parking brake valve assembly to the underside of the tunnel, with the lever extension protruding through the slot as you do so using AN525-10R10 bolts. To prevent the foam core from being crushed though, insert an OR9 spacer tube into each bolt hole first and secure them in with rapid epoxy when you're sure that the holes are correctly spaced from each other.

Place the platform, complete with its master cylinder, in place feeding the short hydraulic lines from the parking brake valve through the slot. Cut these lines to length ready for final fitting, then remove the platform.





## Step 10 - Brake lines from disc callipers

If you have already run the brake lines from the wheels into the fuselage centre tunnel area go straight to the next paragraph, otherwise refer to the build manual for the relevant instructions.

It is not crucial which wheel brake is connected to which park brake valve port, however for ease of maintenance, or trouble shooting a sticking brake, for example, it would be sensible to connect the starboard brake to the starboard side of the valve and vice versa.

Cut the lines to the appropriate length such that they tend to continuously rise from where they emerge through the baggage bay. Avoid loops if at all possible to ease the bleeding of air from the system later on. Connect the lines to the bottom ports of the park brake valve ensuring that the knurled nuts are tight.

## Step 11 - Parking Brake Lever Cover Plate

Place the slotted plate B13 over the parking brakes extended lever oriented with the detent portion forwards. Next, bolt the knob B11 onto the lever using an AN525-10R8 bolt and then push the lever forward until it contacts the plate. Slide the plate rearwards as far as it will go and check that the lever can fit into the detent. If not, a small amount of filing will be required.

**Note:** *The detent part of the slot provides a means of locking the lever in the “off” position. To set the parking brake, the lever needs to be sprung inboard before it is moved aft. Slide the lever fore and aft to check that the plate is correctly aligned then, with the lever fully forward and in the detent, drill the two mounting holes with a 4.8mm drill.*

Drill two 4.8-5.0mm holes through the “Park Brake” placard and then secure the placard and plate using two AN525-10R10 bolts, MS21042-3 nuts and AN970-3 Washers.

## Step 12 - Reservoir installation

The reservoir is fitted in the engine bay to enable easy access for fluid level checking and replenishment. Its precise position is up to you, but avoid placing it where any spilled hydraulic fluid could drip onto anything and do damage.

Screw a 268-04x02 union fitting into the bottom port of the reservoir, ensuring that it is fully tight.

Two AN3-4 A bolts are used to install the reservoir with an AN970-3 washer each side of the firewall. These screw directly into the threaded holes in its body.

Bolting through the firewall does mean that you should have access to the rear face of the firewall. If you do not wish to remove an already fitted instrument panel the following method of fitting the reservoir may be used. The parts required are not supplied however.

From a flat strip of steel, size approximately 1.5mm (1/16”) thick and 2.5cmx12.5cm (1”x5”), joggle the central 70mm(2 3/4”) to be offset from the ends approximately 6-7mm (1/4”). Drill four



4.8-5mm holes into your new mounting bracket, two in the central part to match the holes in the reservoir, and one in each lug to bolt it to the firewall with. Hold the bracket against the firewall in the position you want the reservoir to be mounted and drill through the two end mounting bolt holes. Enlarge the holes in the firewall to be ¼” then install MS21047-3 anchor nuts from the front face but with their body protruding into the firewall. Rivet them in place using TLPD419BS rivets.

Mount the bracket to the reservoir first, then bolt the assembly to the firewall using AN3-3A bolts.

### **Step 13 - Routing hydraulic lines**

The hydraulic lines between the central inlet to the master cylinder is to be connected to the reservoir. From the master cylinder, curve the line to the port side (rather than down and underneath the platform), looping it around to route forwards, trying to avoid curves or loops that may cause air traps.

Find a suitable exit point through the steel firewall and, having cut it to length, fit the line to the bottom of the reservoir. Check that the line will not chafe against the anything, and secure it at regular intervals using cable ties or similar.

### **Step 14 - Bonding platform in place**

To prevent adhesive getting into the threads of the anchor nuts when the platform is bonded into place, fill them with plasticine (modelling putty that doesn't set hard) ensuring that you don't contaminate the flange surface when you do so.

Before the platform is bonded into place, scuff sand the bonding areas thoroughly. The platform has a joggle in its bonding flange; the outer part bonds to the tunnel outer skin, and the inboard area bonds to the inner skin of the tunnel. Mix up a quantity of epoxy with flox (Araldite 420 may also be used). Feeding the short hydraulic lines through the slot and attaching them to the two outer fittings of the master cylinder, bond the platform in place, holding it with weights, Clecos, or any other suitable means. Scrape away excess adhesive and allow to cure.

### **Step 15 - Installing the fluid**

**Caution: Use only Silicone DOT 5 fluid.**

It is important that a fluid is used that will not adversely affect the seals in either the master cylinder or the brake callipers. The seals in these components differ from each other: the calliper seals are compatible with aviation type hydraulic fluid, and the master cylinder seals with automotive type brake fluids DOT 3 or DOT 4. It is therefore important that only SILICONE DOT 5, which is compatible with both types of seal, is used.

It is probably best to install the hydraulic fluid from the wheel callipers, so that it pushes the air up and ahead of it.



If you have access to a proper brake fluid pump, then use this to inject the fluid from the bleed nipple on the brake calliper. Otherwise you may find that an empty and thoroughly clean plastic bottle, similar to those used for washing up liquid, will do the job just as well. After fitting the bottle with fluid, attach a small bore flexible pipe (ideally transparent) to the bottle, squeeze fluid into the pipe and, before it comes out of the end, connect it to the bleed nipple.

Ensure that the parking brake valve is set to "OFF" and that the plug or lid is off the reservoir. Open the bleed nipple about  $\frac{1}{4}$  -  $\frac{1}{2}$  turn and gently squeeze the fluid into the brake system. Close the nipple before you stop pumping to ensure that you don't draw the fluid back out. Continue until you see fluid start to enter the reservoir. Pump just enough in to fill the reservoir approximately  $\frac{1}{4}$  full. Repeat the exercise for the other calliper and fill the reservoir to about  $\frac{3}{4}$  full.

There is bound to be some air remaining in the master cylinder and the brake callipers, so to remove this you will need to pump the brake levers back and forward. As you pull the lever back, open the bleed nipple. Only allow the lever forward after you have closed the nipple. To avoid ejected fluid going all over the floor, connect a short transparent tube and direct it into a container for disposal.

You may not see air bubbles initially as the line from the calliper to the master cylinder is probably free from air, but persevere.

### **Step 16 - System check**

With the aircraft chocked, first check that the parking brake valve is in the 'OFF' position. When the braking system is fully purged of air, you should find that each brake lever moves aft a similar amount for a given effort. Any significant difference would indicate that air may still be present. The levers should also return to their fully forward position as you release them. Do not attempt to taxi the aircraft until the levers behave correctly as described above.

Set the parking brake to 'ON' and pull on both levers to pressurise the system. Remove any chocks and try to move the aircraft by hand, pulling on the lower part of the door surround. You should not be able to move the aircraft. Set the parking brake to 'OFF' and try to move the aircraft again. It should be free to move.

After all the above, go through the entire system, checking for leaks at any of the joints, and top up the reservoir as required.

### **Step 17 - Taxiing trials**

Before conducting taxiing trials, please refer to the Owners Manual Chapter 9. The relevant revised pages for insertion into your Owners Manual are included with this kit.



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