Torque Tube Pins - options for improvement

Reason for Change

The TP14C and TP14D pins that secures the TP12 and TP9 drive arms to the torque tube TP4 rely solely on press fit to transmit the pitch drive forces to the tail planes. Eventually the pins will begin to fret and the holes in all mating components will enlarge.

Builder find that is wear is present it is in the TP9 and TP12 fittings not the TP4 tube.

Some builder have criticised the TP4 tube and the TP12 fittings as not having interference fit holes. They found that fitting the pins through the assembled TP4 –TP9 and TP4 –TP12 gave a tight, seemingly interference, fit but this was due to miss alignment between the holes in the two components. If the TP4, TP9 or TP12 were checked individually the pin was a clearance fit. If this is the case with many of the units it could explain why wear is more rapid than expected.

Options

The options I have become aware of are as follows:-

1) Europa Mod 62, Enlarged (3/8th pins)
2) Gluing TP9 and TP12 to TP4
3) Replace the straight pins TP14C and TP14D by AN486 taper pins
4) Special Taper pins, Mod 11969
5) Bobs Harrison's blocks (PFA Mod 10623, applicable all of type)
6) Bolts with internal tube support.
7) Short bolts with saddle washers
8) Thicker walled tubing for TP4
9) Welding

Option 1 Europa Mod 62 (enlarged, 3/8$^{th\ pins}$)

Factory Option used by a number of builder. The bearing area of the tubes against the pin is increased by 30% making them more tolerant of the loads. While this has proved satisfactory for some builders other have found wear has begun to appear over time. A further complication of assessing this option is the unknown number fitted with Loctite (see below).

Option 2 Gluing TP9 and TP12 to TP4

Talking to builders, a surprising number have applied Loctite to the TP12 to TP4 joint. The principal reasons for this are:-

a) The joint is showing signs of wear and the builder wants to postpone the work of replacement as long as possible.
b) The builder is undertaking Option 1 and decides that Loctite can only further postpone the day when they have to do it again.

In both cases the builder is prepared to accept the increased difficulty in separating the joint in the future. With luck, the Loctite may mean it never has to be done again.

A further complication arises in that the grade of Loctite used is unknown.

Option 3 Replace the straight pins TP14C and TP14D by AN486 taper pins

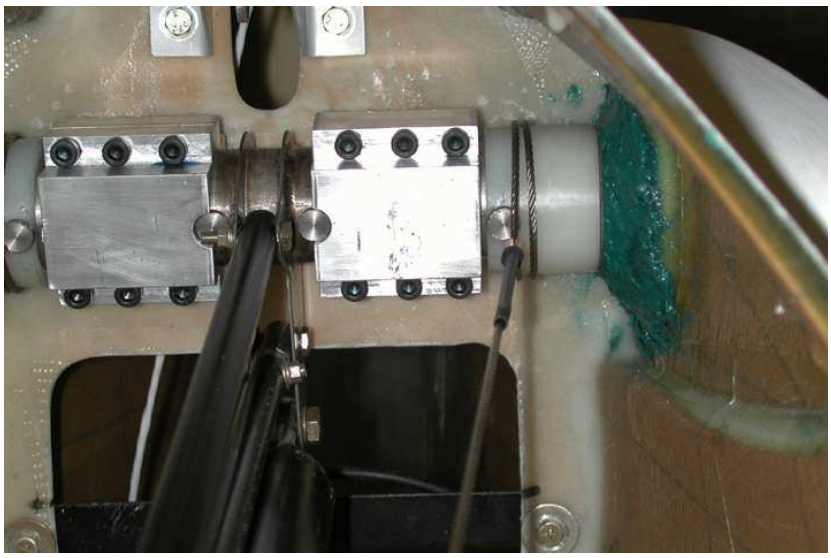
This option has been applied to a small number of aircraft. I am not aware of any reported wear after such an installation. The disadvantages of this installation are:-

a) The bearing surface is not significantly increased.
b) The required reaming is difficult for the untrained builder.
c) A radial load is applied to the bearing surface. This may increase wear.
d) With imperfect reaming a crushing load can be applied distorting the tube.
e) With the available taper pins lengths a spacer is needed under the nut. This needs a saddle shaped surface to distribute the loads to the tube. In one aircraft the spacer has necessitated the cutting of additional hole in the adjacent bulkhead.

f) The recommendation is that the head of a taper pin should extend 1/16th inch above the pinned material. While this is adequate in solid material, in tubular material with a significantly curved surface there is an increased risk of the taper pin being pulled through the hole.

Option 4 Replace the straight pins with specially made taper pins (Mod 11969)
Mod 11969 is in progress with the PFA proposing the use of specially made taper pins. These pins have a threaded shank at both ends one to draw the pin into the hole, the other to act as a safety and extractions device. Methods for non-engineers to ream the taper holes accurately and allow refitting the assembly without the use of a hammer have been devised (I do not have details of this proposal). This overcomes some of the disadvantages noted above).

Option 5 PFA Mod 10623 (Bob Harrison's mod)
This option involved bolting split blocks between the TP9 and TP12 fittings see picture below



The main criticism of this mod are:-

a) The limited grip the blocks have on the edges of the TP9 and TP12 components.
b) Weight
c) Cost £190 + VAT and intends to raise price on any new orders.

Option 6 Bolts with internal tube support
This solution is to replace the four stainless TP14 pins with AN bolts with castellated nuts and split pins, to clamp TP12 and TP9 to the torque tube TP4. To prevent the torque tube distorting, four steel discs with an OD equal to the ID of TP4 and 15.0mm wide are inserted into TP4.

To locate these discs and ensure that they can't become dislodged during bolt removal, they are secured using "bearing" grade anaerobic adhesive (Loctite) which runs into a semi-circular channel running around the perimeter of the discs after suitable de-greasing. The adhesive is introduced through the pin/bolt holes in TP4 and distributed around the circumference by gently rotating the discs.

To provide a suitable clamping contact area, eight "saddle blocks" sit under the bolt head and nut of each clamp. These are 25.00 mm long and 15.00 mm wide. One long edge is machined to match the OD of TP4. The narrowest point of the saddle block is about 5.00 mm at the tangent to the bolthole. Care needs to be taken to check the clearance between the bolt head and the rear bulkhead to avoid any interference with the free movement of the tailplane.

This system works by exerting a positive clamping force on TP12 and TP9. The resulting torsion damping will prevent any relative movement between the TP12/ TP9 with the TP4 torque tube.

These components are manufactured to a sufficiently close tolerance to prevent any possible distortion of the TP12 bushes resulting in them binding in the TP11 bronze bushes. Note that unlike the factory build, all four bolts are the same length.
The two TP10 sleeves control the lateral end-float of TP4 (and the whole tailplane). It is critical that this is accurately maintained. Since TP10 is made of nylon, it is not possible to clamp through this and therefore (slots are machined in the TP10 sleeves (two places each) to accept the saddle blocks).

This mod is low cost, simple, can be retro-fitted to any Europa and is tolerant of worn drive-pin holes.

Option 7 Short Bolts internal to the tube

From Stefan Ingemarsson, 25/06/07
Replace the TP14Ds with four A112/4-6 bolts with radius washers (home made) inside the tube. See picture. I weld a long about 500mm 5/16 ring wrench to hold the nut/special washer inside the tube TP4. Put some Loctite 648 at the special washer and put it together. It have to be so much space between the two bolts, one in the front and one from backside so it possible to take the wrench away inside the tube. We have to make the job from inspections hole

Option 8 Thicker walled tubing for TP4
Only a new build option.

Option 9 Welding
The suggestion was made seriously. The idea is to spot-weld TP9 to TP4 and TP12 to TP4.
The disadvantages are:-

1. Availability of welding equipment and operator
2. Future removal