

	Standard Modification Issue 1	Mod No. SM11789/11880
		Page : 1 of 10
		Compiled : A Draper
		Approved : F Donaldson

TITLE : Installation of Trio Pro Pilot Dual Axis Auto-pilot

APPLICABILITY : **All Tecnam Sierra variants**

Mod Type : **Retro-fit**

1. Introduction

The addition of a wing levelling and altitude hold auto-pilot to the aircraft provides the benefits of:-

- 1) Allowing the pilot to concentrate on airmanship and lookout.
- 2) Preventing unintended deviation from course and altitude while undertaking in-cockpit tasks such as map reading.

This Modification is specific to the Trio Pro Pilot dual axis auto-pilot although fitting only the wing leveller system is included in this standard modification. The roll servo is mounted under the seats and connects to the aileron control system at the joint between the port aileron push-rod to the central link-rod. The pitch servo is mounted in the fuselage underneath the baggage shelf and connects to the elevator control system at the idler bellcrank. General instructions are given below which must be read in conjunction with the auto-pilot manufacturer's instructions.

Before commencing work read the entire modification instructions and obtain a current copy of the LAA Inspection Checklists LAA/IC-APWL and LAA/IC-APAH (available from the LAA web site).

Both servos are controlled by a single controller. If you wish to deviate from these instructions including use of a different controller or servo to those detailed, you must consult LAA Engineering beforehand.

2. Parts List

Qty	Part No.	Description	Source
1	Trio Pro Pilot	Controller	Trio Avionics 1840 Joe Crosson Drive, Ste, A1 El Cajon California 92020 USA
1		Roll servo and push-rod assembly	
1		Pitch servo and push-rod assembly	
1	11789-1	Roll servo mounting tray	Excess material from Sierra kit
1	11789-2	Roll servo long, joggled crank	Aircraft Hardware supplier
1	11789-3	6mm OD x 5mm ID steel sleeve	Make from raw material
2	11880-1	30 x 30 x 1mm 6061 angle x 388mm long pitch servo mounting rail	Excess material from Sierra kit
4	11880-2	30 x 30 x 1mm 6061 angle x 30mm long bracket	Excess material from Sierra kit
30	Avdel 1663-0410	Rivet	Excess material from Sierra kit
1		6mm male rod-end and check-nut	Excess material from Sierra kit
8		4mm Rivnut	Excess material from Sierra kit

	Standard Modification Issue 1	Mod No. SM11789/11880
		Page : 2 of 10
		Compiled : A Draper
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8		4mm x 10mm Dome headed screw	Excess material from Sierra kit
8		4mm washer	Excess material from Sierra kit
4	MS21047-06	6-32 anchor nut	Aircraft hardware supplier
4	AN525-632R12	6-32 bolt	Aircraft hardware supplier
1	GPS unit	With NMEA output	Better than 1 output per second

See the manufacturer's documentation for recommended GPS units and connection details.

3. Action

- 3.1 Roll servo installation overview. The roll servo is mounted on a light alloy tray that is riveted in place just above the floor aft of the rear spar and between the aileron cable pulleys. For the general layout see figures 1, 2 and 3.
- 3.2 Roll servo tray. Manufacture the mounting tray in accordance with the drawing in figure 4. Due to slight differences between airframes, the flanges at each end of the long dimension should be folded only after measuring the distance between the centreline stringer and the adjacent stringer to port. Arrange for the tray to fit between the aforementioned stringers but don't install it just yet.
- 3.3 Roll servo installation preparation. The servo will be bolted to the tray with four 4mm diameter x 10mm long dome headed screws into 4mm Rivnuts. Precise positioning is not critical, but the servo should sit aft in the tray to ensure clearance between the servo push-rod and aileron link-rod and towards the aircraft centreline end. Refer to figures 1 to 3.
- 3.4 Servo Arm. It is necessary, to manufacture a new, 25mm longer servo arm from 1/8" thick 6061 aluminium to increase the throw. The arm also needs joggling 15mm away from the servo to allow the rod-end and pushrod, which are mounted on the servo side of the arm, to achieve proper alignment and clearance with the aileron controls. See drawing in figure 5. Make sure that you countersink the holes on the correct side. Install the new arm to the servo with it pointing upwards. The arm attachment countersink screws supplied in the Trio kit must be used as they have been pre-treated with a thread locking compound on the threads which is good only for one installation. If the screws have been used, even only once, fresh thread-locking compound such as Loctite 243 must be applied.
- 3.5 Push-rod. The Trio supplied rod-ends accept AN-3 sized bolts, but the long bolt between the aileron push-rod and the link-rod is 5mm; slightly larger than an AN-3 bolt. As it is not feasible to enlarge the bore of the rod-end, use a 6mm rod-end (there should be a spare from the Sierra kit) and make a steel sleeve to step down the bore from 6mm to 5mm. Drill out the 8-32 tapped hole of the push-rod's end fitting to 5mm and tap it to accept the 6mm x 1mm rod-end. The ball of the rod-end replaces the spacer that is used between the aileron push-rod and the link-rod in the standard assembly.
- 3.6 Trial fit. Before committing to drilling the servo mounting holes in the tray, place the servo on the tray and trial fit the servo push-rod to check clearances. You'll need to cut the push-rod to length and assemble the end fittings in accordance with the instructions. Adjust the position of the components as required and, when correct, mark the four servo mounting holes on the tray then remove the tray to drill the holes. Fit the four 4mm Rivnuts for the servo mounting screws to the tray.

	Standard Modification Issue 1	Mod No. SM11789/11880
		Page : 3 of 10
		Compiled : A Draper
		Approved : F Donaldson

- 3.7 Tray installation. Mark the rivet holes as shown on the drawing then place the tray in position in the fuselage. Check that these positions would place the rivets appropriately with the parts that they will attach to and adjust as necessary. Drill the rivet holes through both the tray and aircraft structure, placing a temporary panel pin in each hole to hold positioning before drilling the next one. Remove the tray, de-burr the holes and clean up the swarf before installing the tray with the Avdel rivets.
- 3.8 Roll servo installation. Install the servo using four 4mm dome head screws. Fit the push-rod to the forward face of the servo control arm using its end hole and inserting the bolt through the rod-end first and using a large area safety retaining washer under the bolt head. Attach the other end of the push-rod (6mm rod-end with the 5mm bore sleeve inside it) between the aileron push-rod and the aileron link-rod using the long 5mm bolt. Tighten the check-nut of each rod-end checking that the push-rod is free to rotate slightly on the rod-end balls.
- 3.9 Electrical connections. Make the electrical connections in accordance with the installation manual instructions.



Fig 1. View looking down on roll servo.

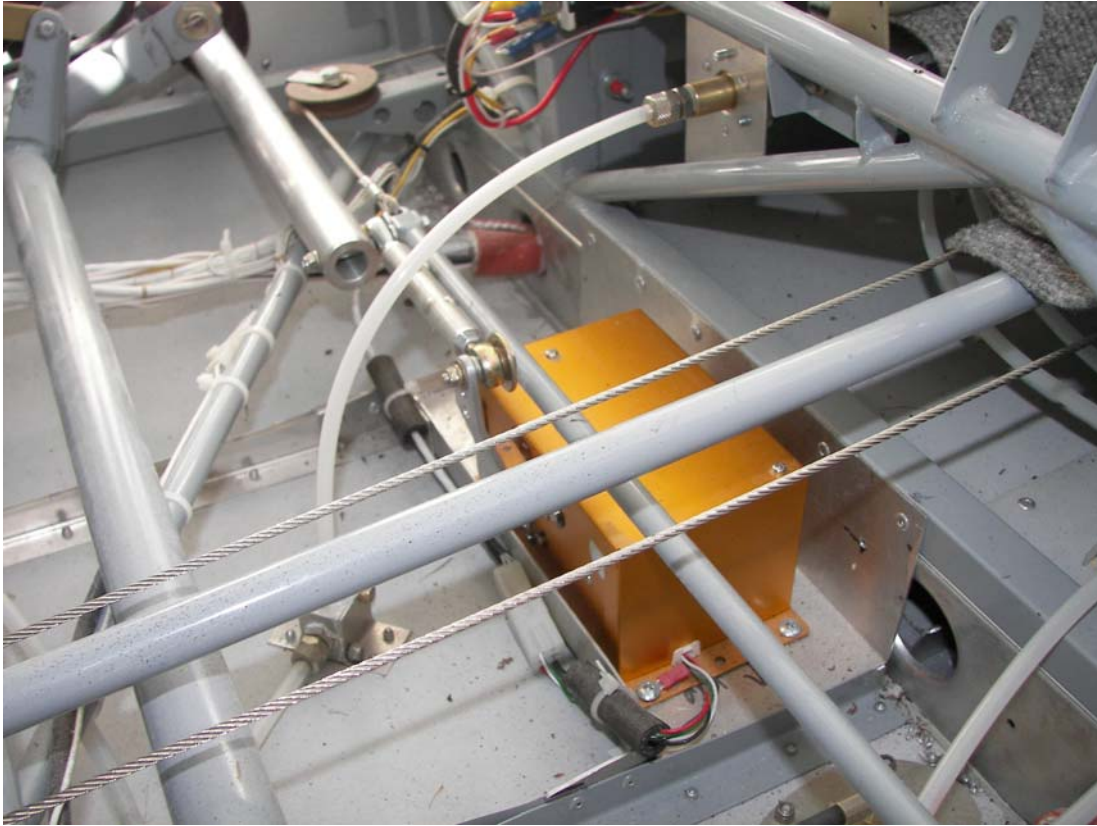


Fig 2. Roll servo installed.



Fig 3. Roll servo viewed from behind.

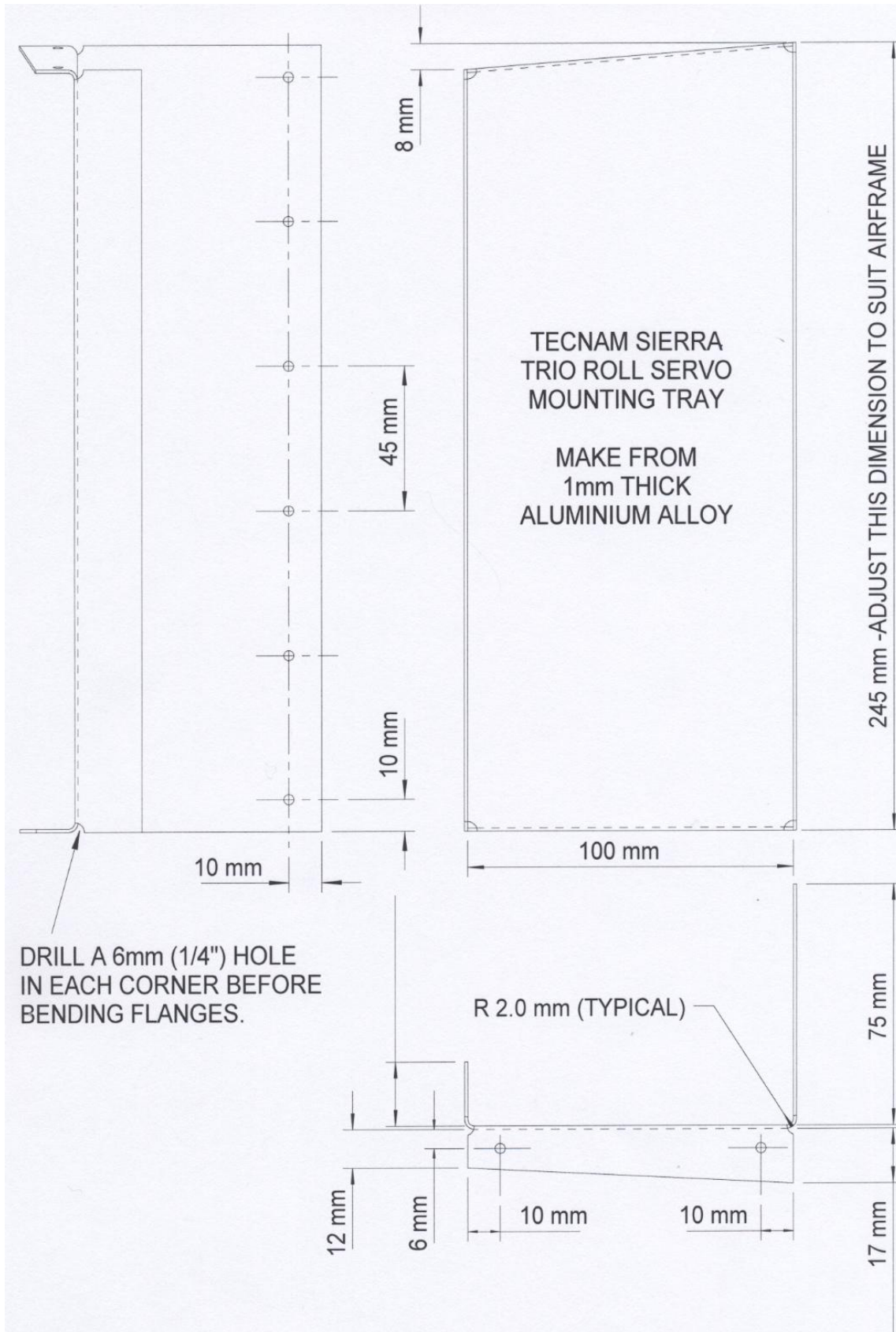


Fig 4. Roll servo mounting tray. (Do not scale)

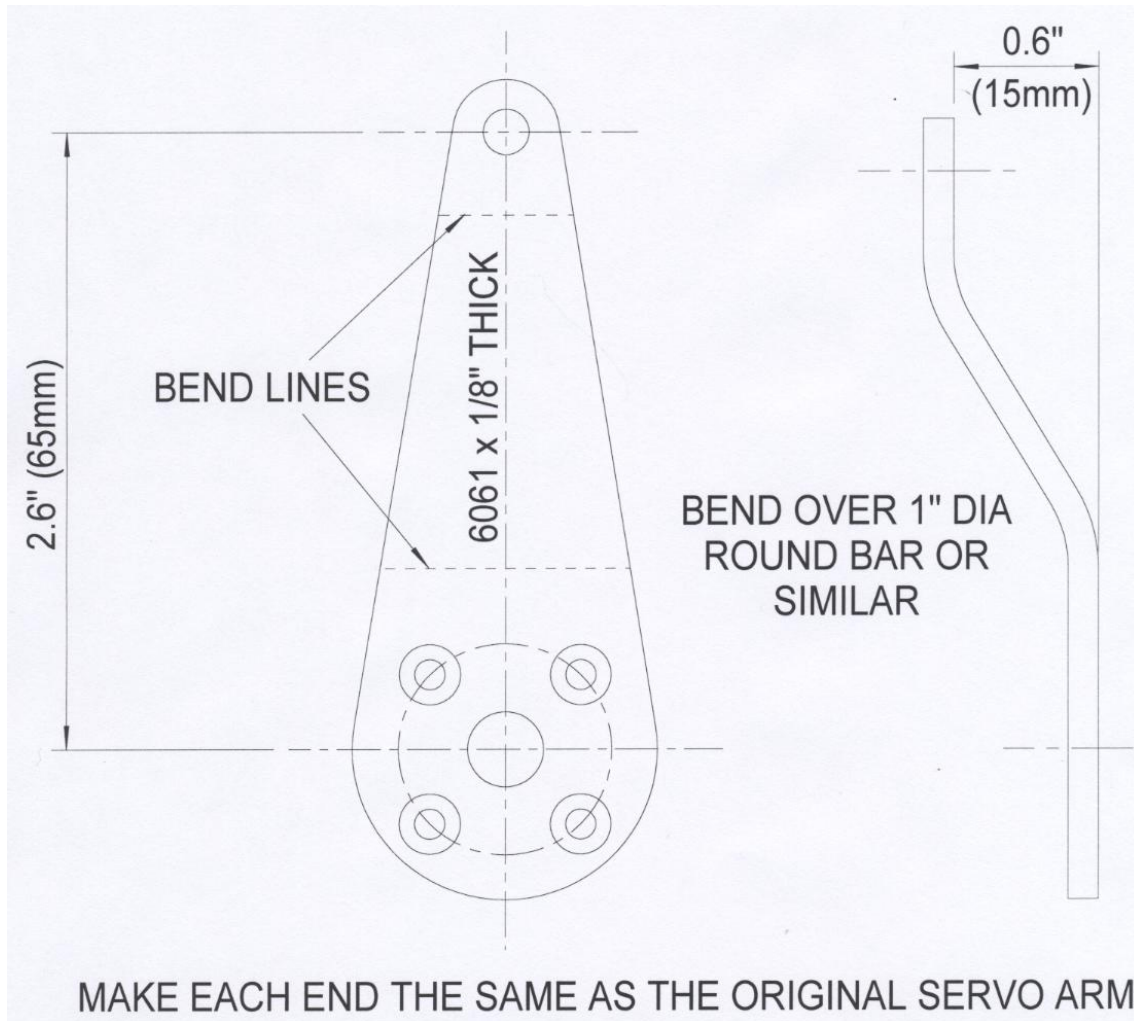


Fig 5. New arm for roll servo. (Do not scale)

- 3.10 Pitch servo installation overview. The pitch servo will be mounted to two aluminium angle rails secured between two frames in the rear fuselage with a short push-rod connecting the servo arm and the elevator control idler bellcrank. For the general layout see figures 6, 7 and 8.
- 3.11 Pitch servo mounting. Double check the dimension between the appropriate frames in the rear fuselage and cut two lengths of the 30mm x 30mm x 1mm aluminium angle.
- 3.12 Pitch servo installation preparation. Install the servo arm with the four Trio supplied retaining screws. They have locking compound already on the threads. If these screws have been used once already, however, fresh thread locking compound must be used.
- 3.13 Trial fit. Lay into the fuselage the two long lengths of aluminium angle rail with their horizontal flanges pointing towards each other between the frames aft of the elevator idler and just to starboard of pitch push-rod. Position the servo so that its forward-most face is 80-90mm from the forward frame. Next cut the push-rod to length and assemble the end fittings in accordance with the instructions.
- 3.14 Elevator idler bellcrank. For the push-rod attachment, the elevator idler needs drilling 3/16" diameter, 25mm down from the elevator tube attachment hole to allow clearance for the new pushrod. See figure 9. Using appropriate length AN-3 bolts as supplied in the Trio auto-pilot kit, with the bolt entering the bellcrank first, temporarily fit the push-

	Standard Modification Issue 1	Mod No. SM11789/11880
		Page : 7 of 10
		Compiled : A Draper
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rod to the 2nd hole from the end of the servo arm and to the new hole immediately below the elevator rear push-rod. Fit a standard washer between the rod-end and the bellcrank and a large area washer the other side of the rod-end for safety. Adjust the positions of the rails and the servo to optimise alignment with the pitch control system and clearances throughout the pitch system's range of movement.

- 3.15 Mountings and pitch servo installation. Without moving anything, drill holes for the Avdel rivets at the ends of both rails and rivet them into place. Reinforce the ends of the rails using the four angle brackets, securing each bracket to the rails and frames with two Avdel rivets through each flange. Finally, drill and rivet the rails to the aircraft skin approximately 20mm (3/4") from each end of the servo.
- 3.16 Pitch servo installation. Mark the four mounting holes for the servo and drill through the rails and the fuselage floor. Four 6-32 anchor nuts are riveted to the top face of the servo's base-plate at each corner. Next, replace the servo, securing them with 3/4" long 6-32 bolts (AN525-632R12) through the fuselage from the underside. Install the push-rod as described above. Lock off the rod-end check nuts ensuring that the push-rod is free to rotate slightly.
- 3.17 Electrical connections. Make the electrical connections in accordance with the installation manual instructions.



Fig 6. Pitch servo looking aft.



Fig 7. Pitch servo push-rod connection to elevator push-rod idler bellcrank.



Fig 8 Pitch servo on mounting rails.



Fig 9. Elevator idler showing where servo push-rod attachment hole needs to be.

4. Weight and Balance

It is acceptable to amend the aircraft's weight and balance schedule by calculating the changes as described below. Note that the datum and its reference on the -RG are different to the -EA version.

Sierra P2002-EA	Weight kg	CG mm	Moment
Existing A/C			
Weight increase	Controller inst. +0.4 Roll Servo inst. +1.0 Pitch Servo inst. +0.95	-110 mm (FOD) +560 mm AOD +1190 mm AOD	-44.0 560.0 1130.5
Post Mod A/C			

Sierra P2002-RG	Weight kg	CG mm	Moment
Existing A/C			
Weight increase	Controller inst. +0.4 Roll Servo inst. +1.0 Pitch Servo inst. +0.95	+1280 mm AOD +1950 mm AOD +2580 mm AOD	512.0 1950.0 2451.0
Post Mod A/C			

Amend the aircraft weight and balance schedule accordingly.

	Standard Modification Issue 1	Mod No. SM11789/11880
		Page : 10 of 10
		Compiled : A Draper
		Approved : F Donaldson

5. Flight Test and Special Instructions

Ensure all the requirements of Inspection Checklists (LAA/IC-APWL and LAA/IC-APAH) have been met.

Specific ground and flight test instructions are given in the manufactures documentation. These MUST be carried out fully. In particular: -

- 1) Make sure the servo is operating in the correct sense.
- 2) Ensure that auto trim if fitted operates in the correct direction,
- 3) Make sure the servo can be overridden manually.
- 4) Make sure that there is no possibility for the servo crank to reach an angle relative to the push-rod to cause over-centre geometric lock or otherwise jam.
- 5) Make sure that, should the servo arm become detached, the push-rod or servo arm cannot cause a control system jam.


LAA inspector to check the completed work, sign off the checklist, raise a log-book entry including reference to SM11789/11880, update weight schedule and issue PMR (Permit Maintenance Release).

Return to LAA Engineering the completed inspection checklists, a completed LAA/Mod 1 – Standard Modification Incorporation (available from the LAA web site) - with a letter requesting flight test authorisation. Note: Before receipt of flight test authorisation – PFRC (Permit Flight Release Certificate) - the modified aircraft may only be flown if the push-rods between the servos and aircraft control system are removed.

With a valid PFRC, conduct the flight test according to flight test schedules LAA/FT-APWL and LAA/FT-APAH.

Return to LAA Engineering the completed flight test schedule.

Notification of final approval will be sent to the applicant. Until this is received, the aircraft may only be flown if the push-rods between the servos and aircraft control system are removed.

Approved:	F Donaldson B.Tech C.Eng FRAeS Chief Engineer	Signed:	
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