RUTAN LONG-EZ

Issue 4 Correction of material for O-320 engine mounting attachments. dated 17.04.08

1. USA contact

Rutan Aircraft Factory no longer in operation although a web site http://www.rutanaircraft.com is still running providing some limited information. Drawings no longer available. Electronic copies of most of the Canard Pushers, electronically searchable by keywords, and much other useful information is also available from the web at http://www.cozybuilders.org/ref_info/, Another source of useful information is the EZ Squadron's web site http://www.ez.org.

2. Description

The Long-EZ is a small tandem two seat aeroplane designed by Burt Rutan, with a canard wing configuration and a pusher engine installation, and a tricycle undercarriage with a fixed main gear and manually retractable noseleg. The airframe is of mouldless composite construction and details were supplied by the Rutan Aircraft Factory in the form of comprehensive instructions and full size template drawings. The Long-Ez was a development of the Varieze, Burt Rutan's first composite aircraft, the main differences being the fact that the Long-Ez was designed to use the heavier, more powerful Lycoming 0-235 engine (the Varieze was designed for Continental engines ranging from the A65 to the 0-200) and was provided with wings of greater area to lift a greater weight and to reduce the landing speeds. The drawings were available from 1980 until 1985 when RAF ceased supplying plans to the the homebuilt market, however support for the type continued until 2002 via the RAF newsletter, the Canard Pusher (CP). The last edition of the CP received by the LAA was 109.

The main wings are swept and tapered and at each wing tip is a winglet which also acts as a fin, each with independently operated rudders. An un-swept foreplane, or canard is fitted which has full span elevators.

The aircraft is designed around the Lycoming 0-235 engine. The engine model must be fitted with a mechanical fuel pump. Slick magnetos must be used, as Bendix magnetos won't fit in the available space. Only fixed pitch wood propellers may be used.

3. Fast Build Kit 51% Compliance

Not applicable - the Long-Ez is built from drawings rather than a kit.

4. Build Manual

The Build Manuals provided by RAF consisted of the following sections;

Section 1 Manufacturing Manual
Section 2 Engine installation
Section 2C Lycoming 0-235 Engine installation
Speed brake drawings
MK II rudder drawings

5. Build Inspections

Build inspection schedule 11 (Vari-Eze and Long-EZ aircraft).
Inspector approval codes A-A or A-C. Inspector signing off final inspection also requires 'first flight' endorsement

6. Maintenance Manual

RAF supplied a manual title ' Long-Ez Owners Manual' which includes maintenance instructions and a maintenance schedule.

7. Flight Manual

Flight Manual information is provided in the Long-Ez Owner's Manual.

A number of flight manual amendments have been issued via the Canard Pusher, including the following:

Aft C of G limit moved to F.S 103" CP 37
Spinning warning CP 36
Generous application of carburettor heat required at low throttle setting
Greater risks of homebuilts compared to certified aircraft
Warning about fatal accidents during over-exuberant flying near the ground CP 57

8. Mandatory Permit Directives

None applicable specifically to this aircraft type, but note

MPD: 1998-019-R1. Flexible Fuel Tubing. Applies to all aircraft.

9. LAA Mandatory Modifications

All of the following items from the Canard Pusher are considered mandatory for the issue or renewal of a Permit to Fly by the LAA:

1. Due to problems with fuel boost pump failing due to seals deteriorating in Avgas, replace Facet fuel pump types 480616, 489615, 40023 with type 40108 which has appropriate seal material for Avgas as discussed in CP 57, 58, 60. See also CP 47 re importance of correct fuel pump pressure.

2. Due to the risk that in the event of an engine fire the aluminium AN fittings in the fuel system in the engine bay could melt and release fuel, feeding the fire, it is mandatory to replace all aluminium AN fuel system fittings between the gascolator and the carburettor with the equivalent AN steel fittings per CP 31. See also fuel system fireproofing – inspection CP49.

3. Due to failures of original design of aileron bellhorn, and to avoid a risk of aileron flutter, before next flight it is mandatory to replace aileron bellhorns of original design with bellhorns of improved design per CP 58, and rebalance ailerons per CP58

4. Due to failures of the -3 size rod ends in service, it is mandatory to replace any -3 size rod ends on the aileron pushrods with the stronger –4 size rod ends before next flight, per CP102 and 103. The -3 size rod ends can be identified by the fact that the thread size is 10-32, compared with ¼-28 on the -4 size. With a lathe, it may be possible with care to drill out the existing 10-32 threads in the pushrod inserts and re-tap ¼-28 threads – alternatively the inserts can be removed and replaced with new inserts already tapped ¼-28.

5. Due to the possibility of the original aileron pushrods which were of aluminium construction melting in the event of an engine fire in flight, before next flight it is mandatory to replace the aileron pushrods which enter the engine bay with ½” OD x 0.028” or 0.035” wall steel tube pushrods with steel CS-50 threaded inserts. If 1/2” x 0.035 tubing is used, the CS-50 steel inserts will need the outside diameter turning down to suit. (CP 49 and CP 95).

6. Due to cases of the rudder cable attachment to the rudder pedals failing through cracking, it is mandatory to fit reinforcement brackets to the cable attachment to the rudder pedals as shown in CP 30 before next flight.

7. Due to cases of the nylon brake lines becoming embrittled and failing due to brake heat, it is mandatory to either fit aluminium heat shields between the brakes and the brake lines or to replace the nylon brake lines with conventional brake lines per CP 45, 47, 48, 99, 100.

8. Due to a manufacturing error with the Brock-supplied canard lift tabs part number NC-CLT, before next flight these parts must be replaced with correctly made lift tabs (CP47)

9. Due to the extra lift available from the Roncz canard there is a possibility of departures from controlled flight in stall type manoeuvres. To prevent this, if the Roncz canard is fitted it is mandatory to fit wing vortilons per CP 47 and CP 48 before next flight. Vortilons are recommended but not mandatory with the GU type canard fitted.

10. To prevent the nose undercarriage collapsing on landing due to bouncing off the over-center stop, spinning the retraction handle and overloading/stripping gear teeth, it is mandatory to fit either a friction device or other system at the retraction handle on the instrument panel to stop the handle turning, such as a bungee cord loop around the handle. See CP42, 46. If the nose gear ratchet supplied by Dr Curt Smith or Bill Theeringer is used to fulfil this requirement, check that UP/DOWN selector is not of plastic construction as this may break in operation leaving gear stuck in up or down position. Replacement levers are of metal construction. CP94

The headrest on the Long-Ez is not designed to act as a roll bar (CP 30, 44 and 65). The improved roll over protection available from the RAF composite rollover bar or the Bill Allen welded steel tube roll over bar as described in CP 102, 103 are recommended but non-mandatory for LAA aircraft.

10. Service Bulletins

A great deal of service information was provided in the Canard Pusher newsletter (CP). RAF considered it mandatory for owners to subscribe to the Canard Pusher as this was the means of promulgating important safety information and drawing updates. All owners should get access to back-issues of the Canard Pusher. The vital Canard Pusher information is referenced in this TADS under LAA Mandatory Modifications, Flight Test and Special Inspections Requirements. A summary of other Canard Pusher service information is provided in Appendix A of this TADS.

11. Standard Options

- Original GU aerofoil section canard or later Roncz R1145 MS canard (RAF drawings)
- Vortex generators on GU Canard to prevent nose down pitch in rain
- High performance rudders for increased rudder authority (RAF drawings)
- Speedbrake (RAF drawings)
- Alternative resin systems instead of Safe-T-poxy: a. EZ-Poxy, b. Schueffler L285 available from PRF Composites (tel 01202 680077) or c. West System 105 resin and either 205 (fast) or 206 (slow) hardener.
- Continental O-200 or O-240 engine instead of Lycoming O-235
- Lycoming O-320/IO-320 engine subject to caveats re weight and balance and replacement of engine mount attachment extrusions with 2” x 1” angles per G-WILY. See CP26 and CP28.
- 6” propshaft extension on Lycoming 0-235 (3” on Continental engines) See CP 37.
- Bob Davenport improved nose gear shimmy damper
- Nose gear crank ratchet supplied by Dr Curt Smith or Bill Theeringer
- Spring shock absorber for nose leg per drawing in CP 25
- B+C Spin on oil filter adaptor
- B+C Lightweight starter
- B+C Lightweight alternator CP 25, 34
- 6 ply 11” x 4.00 x 5 ribbed tyre. CP 29
- 5.00 x 5 aircraft tyres rather than low profile Lamb tyres
- 5.00 x 5 wheel pants from Featherlite, Aircraft Spruce or Wicks. CP 28, 34, 44
- Heavy duty Cleveland and Matco wheel brake options per CP 49, 51, 52
- Stewart Warner 8406J oil cooler, CP 28
- Featherlite, Aircraft Spruce or Wicks lightweight graphite or Kevlar cowlings CP 27, 28
- NACA duct cowling air inlet from Wood and Gelres inc Orlando CP 29
- Alternative Melvill cowling design with armpit intakes rather than NACA intake to avoid engine cylinder head and oil cooling problems associated with NACA duct type cooling inlet, CP 86, CP93
- Newton fuel cap assemblies

- Andair fuel selector valve
- One magneto (not both) may be replaced by a Lightspeed or Electoair electronic ignition.
- Task Research or Featherlite prefabricated fuel / baggage strakes CP 28
- Relief tube CP 31
- Throw-over canopy stay CP 30

12. Special Inspection Points

A thermometer and hygrometer located near to the working area to monitor conditions is necessary. During the manufacture of composite parts, typically the workshop temperature should be between 65°F and 95°F and, ideally, between 75°F and 85°F. Humidity levels are also important; the relative humidity should be maintained below 70% maximum and below 60% for best results. Refer to the data sheet for the particular resin used for any variation to the above values.

Because the Long-Ez was developed in the dry atmosphere of the Mohave desert, the original manuals did not address corrosion protection of aluminium components. This has caused widespread problems particularly in maritime climates like those in the UK. For aircraft in build, it is very important to protect aluminium parts, including those which are subsequently embedded into the composite structure, using Alodine. Anodising structural parts is not recommended due to the possibility of affecting the structural properties of the material. This cannot occur with the Alodine process. Advice is to treat all aluminium parts with Alodine 1201, after pre-cleaning with Alumiprep 33, prior to installation. Brackets should then be sealed in pure epoxy prior to bonding them into the canard. CP 86

Due to variation in the thickness of the spar cap ply lay-up, it may be found that with the specified number of spar plies the spar caps are not as thick as specified on the drawing. In that case it is essential that further plies are added to build the spar cap up to the thickness shown on the drawings. To avoid seriously under strength spars, inspect and check spar cap thickness meets drawing requirements per CP 25, 28, 29.

Wing angle of incidence must be set to 0° ±0.5° using the wing incidence board attached during wing manufacture (inst. manual page 19-8). In addition, the maximum difference between wings is 0.3°.

Canard angle of incidence must be set using canard incidence templates B and C from page A13 with a tolerance of ±0.3°.

It is essential that the elevators are within the elevator weight tolerances and balance tolerances stated in the manual, per CP 21, 57, 106, 107. To avoid risk of disastrous elevator flutter, unless this has already been established before next flight the elevators must be removed and weighed to check that they fall within the limits stated in the build manual. Elevator mass balance is critical to flight safety and must be checked after final paint is applied. When hung upside down with fine wire through the pivot bearing holes, the GU canard elevator must hang 12° to 20° leading edge down measured from the chord centreline. The unpainted GU canard elevators must weigh no more than 3.25 Lbs (starboard) and 3.5 Lbs (port). The painted GU canard elevators should weigh approximately 3.3lb (starboard) and 3.6lb (port). A maximum of 0.3lb balance weight may be added, to the outboard mass balance horn only, to achieve correct balance. An absolute maximum permitted weight of the painted GU canard elevators is 3.6 Lbs (starboard) and 3.9 Lbs (port), including the total elevator balance weight. Instruction manual page 11-4 and CP 106 refers. Note the range of balance angles stated on the drawings are more open than the later CPs, therefore you must work to the tighter limits stated in CP 106, as above. See CP 21, 57 and CP 106. The balancing of the Roncz canard elevators is described in the instructions and also in CP 107. For the Roncz canard elevators it is permissible to sand up to 50% of the outermost ply only of the top and bottom elevator skins and a maximum of 0.3lb balance weight may be added, to the outboard mass balance horn only, to achieve correct balance. The range of balance angles do not apply to the Roncz canard elevators, due to the location of the hinge line on these elevators the elevators must simply be checked to balance trailing edge up rather than trailing edge down. An absolute maximum weight of the painted Roncz canard elevators is 3.4 Lbs (starboard) and 3.8 Lbs (port), including the total elevator balance weight.

The chord of the elevators of both the GU and Roncz canard must be 4.6 inches +/- 0.2 inches and must be flat on the undersurface and slightly curved on the upper surface, exactly per the profile on the drawings. See CP 106.

Aileron mass balance is critical to safety and must be checked after final paint is applied.
When hung with a wire through the hinges, the aileron must hang between the angle that makes the top surface level and the angle that makes the bottom surface level. It is acceptable to add a maximum of 0.3lb of lead behind the steel leading edge weight to achieve correct balance. Instruction manual page 19-9 refers. See also control surface balancing CP 51, balancing of ailerons CP 31 and clarification that ailerons must be finally balanced after painting in CP 36.

Numerous problems have been experienced in service with degradation and de-lamination of foam core structures such as are used in the Long-Ez, and this has lead to some airframes, having had major repairs or having to be scrapped. Problems can occur due to delamination of the bond between the foam core and the glass, or due to the foam core dissolving in solvents (including petrol) or through the ingress of moisture into the structure. It is essential to carry out regular and thorough inspections for delamination and degradation of the structure, including coin-tapping techniques. See CP CP 71, 72. Repair methods for minor delaminations are described in CP 47. The problem of fuel leaks in strake tanks allowing fuel to permeate into outer wing and melting foam cores is discussed in CP 38. Essential to investigate any signs of fuel staining and cure any leaks before damage to foam cores occurs.

Corrosion in aluminium parts embedded in the composite airframe has caused major problems with early Rutan designs where aluminium parts have not been treated with Alodine corrosion protection. Particular areas that must be checked include the aileron and elevator torque tubes CP 66, 106. These and all other embedded aluminium parts must be checked very carefully for signs of corrosion swelling the interface between the aluminium and the composite material, if corrosion is found this must be investigated and corroded parts replaced. See also CP 87 regarding replacement of canopy hinge with a stainless steel equivalent due to corrosion of aluminium canopy hinge. Corrosion in elevator hinge brackets have been found in the GU canard. The corrosion is very hard to see externally, the corrosion took place inside the canard where moisture had wicked up in the flox/foam and trapped it in contact with the 2024-T3 bracket. Advice is to treat all aluminium parts with Alodine 1201, after pre-cleaning with

Alumiprep 33, prior to installation. Brackets should then be sealed in pure epoxy prior to bonding them into the canard. CP 86

Numerous problems have occurred with nosewheel shimmy. Nosegear shimmy damper problems are discussed in CP30, 33, 38, 42, 51. Important to fit new shimmy damper spring per CP 30, Check also no ovalling or bending of the NG 17, and check that the NG17 is the later thick wall (0.125" plus) item.
The improved Bob Davenport design of shimmy damper is described in CP57.
Operational techniques to minimise risk of shimmy are described in CP 34.

To avoid nosewheel shimmy, it is important that the angle of castor is 0-5 degrees forward rake as on the drawing. Rearward rake leads to severe shimmy CP 32. Also ensure friction damper is always adjusted to require 2-4 lbs force to turn nosewheel about the steering axis.

As discussed in CP 30 nose leg shimmy causes destructive forces which can fail the nosewheel fork. Nose gear can be attached to composite gear leg more strongly using AN3-14A bolts CP 51, 54.

Numerous problems have been experienced with Nylaflow brake lines deteriorating due to embrittlement with age, with the effects of heat from the brakes or exposure to UV. CP 48. Inspect and replace brake lines if embrittled per CP 45, 47, 48. Alternatively 1/8" OD stainless steel tubing can be slid up the middle of the existing Nylaflow tubing, which then becomes merely a conduit, per CP 99, 100. Alternatively use Stratoflex brake lines per CP 99, CP 100.

Serious brake fires have occurred due to heat generated by brakes setting fire to brake fluid, wheel spat and gear legs, and it is recommended that a dry type fire extinguisher is carried in the cockpit to put out any fires, per CP 34, 47, 50. It is also recommended to replace the standard red Hydrol type brake fluid which is flammable by Dot 5 silicone brake fluid, however first check compatibility of the Dot 5 fluid with your seals in cylinders, O-rings etc. See CP 73, 79 and 90.

It is essential to regularly inspect all polyurethane fuel pipes for signs of cracking, crazing, going hard or brittle as per CP 65. If in doubt, replace with new.

Main undercarriage fixing tabs may come loose on aluminium bushes, allowing gear to move fore/aft. Check gear for looseness in fore and aft direction, if any looseness found reposition and use flox pads as spacers to prevent further movement, see CP 48. Another cause of main gear coming loose is improper torquing of attach bolts, leading to wear in the bushes, see CP 46 and CP47.

With the simple fuel selector valve called up on the drawings, widespread problems were found with stiff and sticking fuel valves. It is important to check that the force required to operate a brass or Delrin fuel valve is no more than 10 Lbs force, otherwise ground it for the problem to be sorted out, see CP 25 and 29. Ideal solution now available is to substitute the high-quality Andair fuel valve.

It is essential to regularly inspect both the welded engine mount frame and the extruded aluminium angle engine mount attachment brackets for cracking, as several complete failures of these components have been reported over the years. Upper aluminium extrusion was found cracked right through just forward of the firewall, in a place where the crack was not visible but found by movement. CP73, 74, 75, 80, 86, 88 refer.

Check for signs of wear in aileron hinge pins over time, usually indicated by grey aluminium stains on wing and aileron surfaces in vicinity of hinges. Putting a slight S bend in hinge pins prior to installation helps prevent looseness. CP 28

Inspect throttle and mixture control systems including return springs for per CP 51 and CP 65

Numerous problems have been experienced with cracks in the exhaust system. Exhaust stub failures can lead to engine compartment fires or lost prop blades therefore it is particularly important to check regularly for signs of cracks developing. In one case loss of a prop blade ripped the whole engine from the aircraft. CP 34, 52, 59, 60, 61, 62, 63, 67, 77, 82, 86. Exhaust brace cracking CP 43.

Wood propellers, in-flight blade failures due to high propeller temperatures. Some exhaust staining is inevitable but there must be no signs of over heating. Repair any damage to finish at once. Do not fly if there is any evidence of heat distress on the propeller blades. Very important to repair any damage to the propeller's finish immediately, as bare wood exposed to the elements will quickly absorb moisture and oil, affecting their structural integrity On a Lycoming engine, clock propeller at one o'clock / 7 o'clock position as cylinder number 1 is at top dead centre. If in doubt, fit temperature sensor strips to your prop blades – should not exceed 150 degrees F. See also CP 85 Propeller damage due to exhaust pulses over propeller blades. Fit the propeller so the blades have just passed the exhaust pipes when the exhaust valves open.

Also heat damage to propeller has occurred inside the Klaus Savier type spinner causing delamination of composite propeller sheathing inside spinner. Remove spinner from time to time to check condition of propeller inside.

Several problems have occurred with loss of props due to incorrect prop bolt torques see CP 33, 49, 51 60, 76. With 3/8"-24 size bolts the torque must be 200-250 inch lbs with 5 laminate wood props and 300 inch lbs with multi-laminate type props. Check prop bolt torque frequently in service as specified in the operators manual, per CP 29. Be careful to check that prop bolt pre-load is not being compromised due to crush plate bottoming out on bolt shanks (CP 52). or on blend radius of flange on propshaft extension contacting edge of central hole in spinner backplate (CP 32). This problem caused prop to be lost in flight.

Prop damage often occurs to propellers due to the ingestion of FOD thrown up by wheels. Nicks, abrasions etc in the prop must be repaired immediately top prevent further damage through water soakage. CP 47,77. Use of mud flaps on wheel spats to minimise prop damage through FOD is described in CP 34.

Any repairs to the composite airframe must be carried out in accordance with Rutan book 'Mouldless Composite Homebuilt Sandwich Aircraft' page 3-21.

13. Operating Limitations and Placards

Maximum number of occupants authorised to be carried: Two
The aircraft must be operated in compliance with the following operating limitations, which shall be displayed in the cockpit by means of placards or instrument markings:

Aerobatic Limitations
Intentional spinning is prohibited
Aerobatic manoeuvres are prohibited

Loading Limitations
Maximum Total weight Authorised: 602 Kg (some examples cleared with Max take off weight of 647 Kg, when max landing weight remains 602 Kg)
CG Range: 97.0" to 103.0" aft of datum.
Datum Point is: A point 18.6" forward of Leading Edge of Canard

Engine Limitations
Maximum Engine RPM: 2800

Airspeed Limitations
Maximum Indicated Airspeed: 220 mph (190 kts)

Other Limitations
The aircraft shall be flown by day and under Visual Flight Rules only.
Smoking in the aircraft is prohibited.

Additional Placard
"Occupant Warning - This Aircraft has not been Certificated to an International Requirement"

14. Special Test Flying Issues

Advice on preparations for first flight is contained in CP 35 and CP 52.
Due to brake heat problems with extended taxiing, CP 31 advises leave wheel spats off for taxi testing.
For first flight, limit maximum weight to 1100lb and CG between 99" and 101.5" AOD.

The issue of pitch down in rain with GU canard is discussed in CP 35, while the Roncz canard pitch trim in rain is discussed in CP 43 and 44.

Engine overheating problems are a common feature of the Long-Ez, especially with NACA duct type cooling intakes. Cooling problems are discussed in CP 42, 47, 50, 51, 52, 62, 72,79. Use of an ASI to measure pressure drop across the cooling system as a check on cooling system airflow is discussed in CP 47. The critical importance of the correct mixture strength on cooling is discussed in CP 83.
The benefit of alternative Melville cowling design with armpit intakes on engine cylinder head and oil cooling is discussed in CP86 and CP93.

Check that there is no aileron vibration in flight which can lead to rapid wear in aileron hinges and aileron control system rod-ends. See CP 58, 59, 60.

Deep stall risk with excessive aft cg is discussed in CP 37, 56, 68, 76. CP 87 describes a deep stall experienced in a Cozy due to an error in cg calculations through weighing the aircraft with ballast weight in the nose and forgetting to calculate the effect of the ballast weight on empty cg.

Problems with the canopy opening in flight and the importance of the canopy latch warning system are described in CP 52 and CP 57.

Trimming the aerodynamics of the aircraft during at flight test is discussed in CP30
Calibrating your ASI with a water manometer is discussed in CP 53.

Engine handling issues are discussed in CP 49. Safe fuelling procedures are discussed in CP 63.

15. <u>Control surface deflections</u>

Ailerons	Up:	2.1” ± 0.3” measured between wing and aileron trailing edges (= 18 - 23.5 degrees)
	Down:	2.1” ± 0.3” measured between wing and aileron trailing Edges (= 18 - 23.5 degrees)
Elevators	Up:	18 - 22 degrees
(GU canard)	Down:	20 - 24 degrees (total 38-46 degrees)
Elevators	Up:	15 degrees (R1145MS canard)
	Down:	30 degrees (total 45 degrees)
Rudders		6.0” ± 0.5” measured between rudder top and winglet trailing edges (original design)(= 26 - 30 degrees)
	Note:	Each rudder operates independently and outboard only
Rudders		4.0” – 4.5” measured between rudder base and winglet trailing edges.
(Mk II)		(22 – 26 degrees)
	Notes:	Each rudder operates independently and outboard only There is conflict between dimensions and angles quoted in the instructions. The 4” dimension is stated in the plans text as equating to 23 degrees. The 4.5” dimension equates to 27.5 degrees.

Approved :

F.R.Donaldson
Chief Engineer

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<u>APPENDIX A TO TADS 074A</u>

<u>SUMMARY OF CANARD PUSHER SERVICE INFORMATION NOT INCLUDED IN THE MAIN TEXT OF THE TADS</u>

<u>Use of composites</u>

Alternative foam specifications are discussed in CP 27. Where Klegecel foam is called up on the drawing it is acceptable to substitute Divinycel foam per CP 34. Where urethane foam core is called up on the drawings it is essential not to replace this with blue foam as the blue foam dissolves in petrol, per CP 49

Cutting method for glass cloth are described in CP 35. CP 51 describes a method of cutting fibreglasss cloth neatly using masking tape to prevent fraying. A combined cabinet / cutting table for storing rolls of BID and UNI is described in CP 32. A clarification of what is meant by BID tape is provided in CP 29, with advice on cutting 2” BID tapes in CP 38.

Choice of type of epoxy resin systems and the problems of skin rashes, allergic reactions and other health issues with Safe-T-Poxy are discussed in CP 28, 31, 32, 37, 74, 77, 84. Safe working temperatures with Safe-T-Poxy are discussed in CP 23 and 29. 77-95 degrees F is ideal. As low as 65 degrees F is possible for quick lay-ups but the thicker consistency of the resin will increase working time and increase the weight of the lay-up. When working in cooler than ideal temperatures, it helps if the un-mixed epoxy is pre warmed to 85-90 degrees F in the pot. Humidity issues with Safe-T-Poxy are discussed in CP 28.

Storage of resin and hardener is described in CP 29, including storage temperature limits, crystallisation problems and how to remove crystallisation by gently warming the un-mixed epoxy in the pot to 160-190 degrees F until the crystals disappear. Sediment in epoxy hardener not acceptable, as described in CP 32. Shelf life of epoxy is discussed in CP 43. Safe handling of epoxy and microballoons is discussed in CP 42

Only use glass and epoxy supplied by RAF recommended suppliers. A substitute type of UNI glass supplied by another outlet (under the same part number) was found to be significantly lower in strength than the genuine UNI. Scrap any parts made from materials supplied other than through Aircraft Spruce or Wicks, per CP 37.

Essential not to use WD40 or any silicone based lubricant or polish on composites as the silicone permeates the lay-up at a molecular level and forever degrades the ability to bond successfully to the surface with any subsequent repair lay-ups.

Anodising aluminium parts to prevent corrosion is discussed in CP 38, however this is not recommended for structural parts as incorrect anodising process can adversely affect the strength properties of the aluminium.

Don’t paint foam with latex house paint prior to glassing, as this degrades the bond strength between the glass and the foam, as discussed in CP 29. All foam must be micro-slurried before glassing as per reminder in CP 31.

Fibreglass lay-up quality is discussed in CP 27. Don’t peel ply entire surface as this leads to excess weight and starves lower down plies of resin, only peel ply where subsequent plies to be added and over ply edges as discussed in CP 27.

Never wipe paint thinners on glass components as the thinners may wick through pin holes and melt underlying foam, causing de-laminations as described in CP 25

Contrary to popular opinion it is not good practise to lay-up directly onto a composite surface freshly exposed by removing a peel ply, as the surface may well be contaminated by release agents in the peel ply cloth, especially if the peel ply material used is normal commercial Dacron rather than aerospace peel ply cloth which is manufactured for the purpose. Always sand a peel plied surface lightly to remove any contamination prior to making any subsequent lay-up on top.

Airframe

PV foam and weight control are discussed in CP 25. Avoiding weight growth is discussed in CP 28. List of weights of parts / assemblies on Mike Melvill's project is provided in CP 26. Weights of complete Mike Melvill aircraft included in CP 27.

The importance of repairing any composite damage immediately to prevent water absorption or UV damage to glass structure is discussed in CP 28.
Trailing edge closeouts must be trimmed flush to minimise risk of delamination, see CP 28 and 32. Minimum acceptable overlap dimensions on trailing edges and flanges given in CP 32.

Fibrefax firewall instead of asbestos CP 25

Conflict between centre section spar and seat back – how to deal with it. Triangular piece of seat back bulkhead to be removed to fit c/s spar if conflict occurs. CP 25

Colour of aircraft must be white to minimise solar heating CP 57

Safe-T-Poxy fuel tanks, see CP 24. Leaks in fuel tanks – important to paint inside of tanks thickly with epoxy using squeegee to fill any pin holes CP 37.

Crash-worthiness improvement CP 29

Modify LB-9 and add doubler on seat b'head CP 68

Front seat brace reprofile CP 29

Long nose not approved CP 46

2024-T3 can be substituted by 2024-T4 or-T351 CP 42

1200 Versatube is equivalent of 3003-0 tubing., CP 42

Cowling stiffeners should be taped over not just floxed in place, for extra security CP 37

Technique for mounting the wings CP 53.

Wing attach bolts coming loose allowing play in wing fixings CP 52

Addition of ventilation hole to wing attach fittings CP74

When installing Task Research pre-made baggage strakes, important to remove all peel ply CP 32.

Centre section spar fitting clarification CP 32

Building tips for wing and wing attachments CP 25

Lift tabs for Roncz 1145 MS canards were supplied by Brock with three bolt holes pilot drilled 0.213" diameter but must be opened up to ¼" diameter for AN4 bolts on assembly as shown on the canard drawings. A 'D' size drill bit recommended for best fit. CP95

Plexiglass hints CP 29

Fitting the baggage strakes to the main wings to profile properly CP 30.

Reinforcement of speed brake due to failure of urethane foam CP 43

Firewall protection application CP 50
Problems with blisters in paint on composite assemblies CP 78

Shop air lines as source of delamination.

Cracks found in base of winglet at leading edge above nav light. Must be repaired before next flight. CP95 describes repair method. CP95

Accident due to engine failure caused by fuel contamination by strands of glass fibres and white powder which collected in the carburettor inlet screen (filter). CP 98

Wheels and brakes

Main landing gear brake – clearance CP 30

6 ply tyre pressure CP26

Wheel balancing CP 61

Wheel brake disc runout CP 63

Heavy duty brake option CP 49, 51, 52

Brakes sticking on CP 42

Brake disc wobble CP 31

Bleeding the brakes CP 52.

Brake maintenance CP 78

Problems with main gear 'walk' on brake application. Substitution of Matco dual calliper brakes for Clevelands previously fitted solved the problem on DickRutan's aeroplane. Matco recommended, buts spacer required to adapt Matco axles. Matco p/n W5OLD. Aircraft Spruce 06-01860 (D for dual callipers) CP 99. Main gear walk may in other cases be corrected by attention to tyre and wheel balance, CP 31.

Main undercarriage

Overheating of wheel brakes leading to brake heat melting composite gear legs. Advice to fit aluminium alloy heat shields between brake and leg. CP 57, 58, 70.

Correcting incorrectly made main gear mouldings, mismatch CP 29

Main axles must be perpendicular to WL, not to gear legs. CP 30

Long-Ez may operate from smooth grass runway if it has 500x 5 tyres and Brock spring nose shock strut CP 25

<u>Nose Undercarriage</u>

New design of noseleg shock strut, drawing in CP 25, strongly recommended in CP30.

Don't leave nosegear part extended when parked as it overloads the retraction gear teeth. CP48.

Nose gear spring settles over time leading to flat ground angle, delayed takeoff CP 51

Nose gear crank systems – NG14 heavy wall aluminium tubes must be installed per plans, even though Brock don't supply them with this sub-kit. CP 31.

Chatter in nose gear retraction gear teeth when raising nose on ground – prevention CP 30.

Nose wheel turning on bolt not bearings CP 42

Brock nose gear, inspect for signs of castor castings cracking CP 55

Nose gear chattering CP 43

Wear in noseleg bronze bushings. Drop the wheel and fork assembly off the NG15A casting to check for wear. CP 44.

<u>Controls and Control system</u>

Rigging of flight controls CP 65. Freeedom from friction in controls CP47, 55. Obtaining correct range of travel with Roncz canard elevator – CP47. Importance of correct setting of elevator stops on GU canard – excess movement must be avoided. CP 48. correct positioning of hinge inserts on Roncz canard CP48.

Wear in aileron control system rod-ends, see also CP 58, 59, 60. 83

If control stick pivot sloppy, substitute close tolerance bolt AN174-20 bolt for standard AN 4-20 CP 30. CP # 30 p9 Rod and attachment to bell horn

Elevator profiles – templates too big CP 30

Correct elevator profile CP 47. Elevator quality, balance, lay-up CP21, 57

Minimum friction in elevator, otherwise degraded handling CP 33

Elevator disconnected due to clevis pin falling out – pre-flight item CP 35

Max landing brake extension speed 95 kts CP 28

Ailerons freezing in flight CP55

Aileron/wing clearance minimum 1/8" clearance between aileron leading edge and its shroud CP 43

Leading edges of ailerons must be rounded per plans page 19-14, not sharp, or vibration occurs with full deflection at 90-120 kts. CP 25, 37

Aileron vibration problems CP 58, 59, 60 Improved design of hinges to prevent wear CP 78. addition of Teflon spaghetti tubing to rudder and aileron hinges to prevent wear CP 51

Problem with aileron travel being restricted in flight due to inadequate end clearance between wing and aileron, causing interaction as wing bends under positive g loading. Minimum 1/8" clearance recommended. CP99

Importance of correct nicopress swaging technique when using cheap type swaging tool CP 37
44

Rudder cables can snag inside cowlings if rudders are moved manually or by wind gust when a/c parked, add guards to cable run to prevent. CP 49. Varieze loss of control possibly due to rudder cable eye hooking behind rudder horn, causing uncommanded rudder deflection. CP 103

Avoiding rubbing of rudder cables on aileron pushrods CP 27.

Suggestion to add safety holes to rod ends to check thread engagement CP 2

<u>Engine Installation</u>

Part of cowling came off, went through prop, engine fell off. CP89

Engine oil pressure gauge line must be fitted with small diameter orifice at engine end to limit potential for leakage. CP 31.

Engine vibration due to contact between intake manifold hose clamp and dynafocal mount with engine under torque reaction. Cp 35

Security of engine throttle and mixture controls and need for a spring at carb end to open throttle in the event of a cable failure. CP 51, 61, 65.

Drawings of a suitable Lycoming 0-235 exhaust system are provided in CP 25. Details of an alternative exhaust system used successfully by Mike Melville are shown in CP 83.
The importance of avoiding painting exhaust systems inside heat muffs is discussed in CP34, after paint chips from heat muff blocked carburettor and stopped engine when carb heat selected.

A six inch propshaft extension was found satisfactory on the 0-235, and reduced the propeller noise noticeably but at the expense of the engine cooling efficiency, see CP 30. Propshaft extensions must be accurately made, free of scratches and machining marks and have blend radii at all changes in section to minimise the risk of fatigue cracking. Failures of 8"propshaft extensions are discussed in CP 59 and CP 79

Engine failure due to oil breather icing up. Include whistle slot in breather inside cowl to act as emergency vent in case end of breather ices over, per CP 103.

To avoid confusion over magneto switch selection, be sure to clarify which magneto is right and which is left, on the pusher engine as the normal 'right hand' position on the engine becomes on the 'left hand' side of the aeroplane with the engine mounted back to front. See CP 32.

With Continental engines, it is particularly important to have adequate intake air temperature rise when carb heat is selected. Check it is at least 90 degrees F above ambient when measured at carburettor throat, see CP 32.
To reduce the risk of a fuel fire on start-up, it is important to include a drain hole at the lowest point in the intake induction hose and cowling where fuel could otherwise collect after over-priming. CP 82.

The common 0-235-L2C moderl as fitted to the Cessna 152 is not suitable for the Long-Ez as it has no fuel pump. If trying to use the backpplate of an 0-320 to fit a fuel pump to an 0-235-L2C, watch out as while outwardly similar, the oil drillings are different and may not line up. See CP 32.

Problems with B+C starter solenoid sticking in 'engaged' position, with risk of battery fire occurring. Recommendation to fit a starter warning light and advice about corrective action should solenoid stick. CP 99

Propellers

Seal the central hole in the propeller with a coat of epoxy to keep moisture out. Always park aircraft with propeller level to minimise the risk of moisture sinking to the lower prop blade, un-balancing the propeller.

Do not thin down the blades of wood propellers in search of greater performance, they will not be strong or stiff enough and will fail. With thin and / or thin blade sections (eg Warnke or Performance Propeller props), watch out for evidence of blade flutter in the form of sudden harsh roughness or vibration at high propeller rpm. Any prop that has fluttered should be discarded and not flown. See CP 83, CP 84 and CP 85.

Problems with retaining screws fretting through composite spinners are discussed in CP 51

Fuel system

The fuel system in the Long-Ez requires an engine driven pump, as gravity feed won't work in this installation, see CP 25.

The importance of carrying out fuel flow checks, and the risk of fuel line blockage with resin particles from moulded fuel tanks are discussed in CP 54, 62, 79, 80, 81.

The importance of internally coating the fuel tanks with epoxy during build to avoid fuel tank leaks is discussed in CP 62

A common problem is with sticking or stiff fuel selector valves as discussed in CP 24, 46, 50, 57, 58, 59, 60. A lubricant for fuel valves is discussed in CP50. The best solution these days is to substitute the greatly superior Andair fuel valve.

Following the fatal accident which befell John Denver, probably due to fuel management problems, CP 93 included a reminder to calibrate and mark fuel sight gauges with quantity levels, to placard fuel selectors clearly, to avoid relocating fuel selectors where they are not easily accessible to the pilot, and to ensure that fuel selector lever orientation is consistent with tank selected i.e. lever right for right tank.

Proper care of AC mechanical fuel pumps to avoid leaks is discussed in CP 50, while CP 24 describes the importance of safety wiring the Bendix fuel pump bottom cup to prevent it coming loose.

CP 76 advises that the fuel tank filler caps be secured to the filler neck to avoid the risk of a fuel cap coming adrift and going through the propeller disc. CP 26 discusses the possibility of the fuel venting on the ground when parked nose-down, and possible solutions to the problem. The risks of water in the fuel are discussed in CP 78.

The importance of not connecting the fuel vent pipes together is discussed in CP 48, separate fuel tank vents are fitted to provide a degree of redundancy i.e. should one vent get blocked, the other tank can still be used.

CP 34 states that Mogas should not be used in composite fuel tanks due to the risk of degradation of the composite tank material when exposed to the additives in Mogas.

Preventing refuelling fires with composite aircraft is discussed in CP 52 and 53 while CP 55 recommends static grounding the fuel filler to further minimise the risk of fire.

CP 56 57, 63, 75 discuss how the engine oil breather ‘Gardner’ mod with anti-backfire valve can cause low fuel pressure indications due to effect of modified crankcase pressure on the engine driven fuel pump.

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