FLIGHT TEST REPORT

STEWART MUSTANG

G-CGOI

D Griffith BSc(hons), TP, FRSA

1 September 2014

1 INTRODUCTION

This Flight Test Report covers a series of test flights performed to investigate the performance and handling qualities of a Stewart Mustang, G-CGOI (S/N 144).

The tests were conducted from Benwick Airfield between 5 June 2014 and 7 August 2014 by DV Griffith (Test Pilot). The total blocks time was 7 hours, 0 minutes.

This was the first of Type to come on to the British Register and it was fitted with a Chevrolet V8 engine of 500 hp and a 4-bladed Hartzell variable pitch propeller. The aim of the testing was to confirm acceptable handling and performance characteristics to allow the aircraft to gain a full CAA Permit to Fly.

The CAA have proposed a staged route to full approval, in order to allow some flying pending better assessment of compliance in certain areas. Initial clearance will therefore be restricted to non-aerobatic flight with a single occupant only. These conditions and limitations may be further relaxed under later Permits to Test, subject to further justifications being completed to the satisfaction of the CAA

2 AIRCRAFT DESCRIPTION

The Stewart S-51D Mustang replica was a two-seat amateur built aircraft built from a kit to resemble the P-51 Mustang but at 70% scale. It was a single engine aeroplane of conventional configuration, largely manufactured from aluminium alloy. The aircraft was built by Sheridan L Owens in the USA to a design by Jim Stewart, a professional aircraft designer with Pratt & Whitney. The aircraft was designed to include 2 seats in tandem and to be aerobatic with limit manoeuvring load factors of +6/-3 g at a weight of 3026 lbs, with a Vne of 300 knots.

The aircraft was powered by an aero-conversion of the automotive liquid cooled Chevrolet V8 engine delivering 400-500 hp at 4700 rpm (limited by prop rpm limit) to drive a 91” diameter Hartzell 4 blade hydraulically controlled constant speed propeller via a custom designed 2.13:1 reduction gear. The steel hub and cropped paddle shaped blades was not a certificated engine prop combination. However, Hartzell had carried out a strength review and vibration survey and stated that it was likely to be satisfactory regarding strength and vibration. The engine fitted to G-CGOI had the same crankshaft and reduction gear as that evaluated by Hartzell.

The elevators and ailerons were push-rod operated; the rudder was cable operated and the rudder and elevators had trim tabs. All control surfaces were mass balanced. The flaps were electrically powered.

All three wheels retracted, powered by hydraulics. The tail wheel was un-locked by pushing the stick fully forward. Conventional hydraulically operated disc brakes were fitted (toe brake control).

3 ADDITIONAL INFORMATION

3.1 Certification Basis

There was no specific Certification Basis identified for this Assessment; however, FAR 23 (change 26) was used as guidance material.

3.2 Weight & Balance

The take-off weights and associated centre-of-gravities for the flights are recorded in Appendix B.

3.3 Aircraft Flight Manual

The only definitive data for the aircraft was given on the aircraft's Permit to Test. However, there were various American Flight Manuals/Pilots Notes for the Type and these were used for guidance.

3.4 Instrumentation and Data Recording

There was no flight-test specific instrumentation or data recording equipment fitted to the aircraft. Hand-held equipment and the standard aircraft systems were used to gather data.

3.5 Aircraft Condition

The aircraft was in excellent condition.

4 TEST CONDUCTED

A specifically designed Prototype Schedule was used that covered the CAA AFTS 233 plus other data collection requirements. A climb performance assessment, limited spinning assessment and a pressure-errors evaluation were also carried out. A copy of the completed test programme and the raw data collected is given in Appendix A.

5 RESULTS AND DISCUSSION

5.1 Cockpit Assessment

The cockpit layout and markings were relatively conventional and acceptable. All the instruments and controls were well placarded and easy to reach. View from the cockpit was good for this class of aircraft.

The instrumentation and control of the Chevrolet V8 engine and the ignition system was acceptable throughout the flight-testing period.

The Air Speed Indicator (ASI) was still placarded in with the original speed limitations and this will need to be changed to limit the airspeed to 250 KIAS. The flap limit speed will also need to be reduced from 137 KIAS to 130 KIAS.

With the ASI changes, the cockpit layout and placards were acceptable.

5.2 Handling

The handling of the aircraft was good for this class of aircraft over the CofG range tested. The lateral and directional stability was reasonably good for all conditions tested. The roll forces were high compared with the pitch forces, replicating the original aircraft.

Spiral stability was neutral to slightly positive and the phugoid and Dutch roll were both stable. The aircraft's roll rate was reasonably quick but predictable.

Overall, the handling qualities of the aircraft were considered acceptable.

5.3 Stalling

A standard stalling package was completed (straight, turning and accelerated at idle power and 75% power [4000 rpm, +25" MAP]). The stall handling was benign, including turning and accelerated stalls. There was an amount of judder/buffet stall warning in all configurations. During turning and accelerated stalls, the aircraft generally tried to turn out of the turn. There was no tendency to spin.

The stalling characteristics for the aircraft were considered acceptable.

From the stall-speed assessment the following approach-speed minimums are recommended at maximum all up weight:

Approach speed	-	95 KIAS
Touchdown speed	-	80 KIAS

These figures can be reduced by 5 KIAS as weight is reduced to 3,100 lb.

If flapless, add 5 KIAS

For continued-airworthiness check-flight purposes, the following MTOW stall speeds are expected:

Stall Clean	-	77 KIAS
Stall Flaps 20	-	73 KIAS
Stall Flaps full	-	69 KIAS

The stall speeds can be reduced by 1 KIAS/100 lb reduction in aircraft weight.

5.4 Spinning

A limited spin assessment was made to establish the spin qualities should the aircraft accidently enter a spin, with recovery being initiated within the first full turn of the spin. Various recovery techniques were tested, including standard recovery, reverse recovery, controls central recovery, controls release and the Muller recovery (full opposite rudder and stick fully back). There was very little difference between all the spin recovery techniques, except the controls released technique, which took around 30 per cent longer to recover. The most benign recovery was found to be with the Muller recovery technique. In general the spin and the recovery took around 700 ft. The spin rate was reasonably slow at around 180 degrees per second. The spin to the right was slightly more hesitant in nature than the spin to the left.

As centralizing the controls worked almost as well as the 'Standard' and Muller recovery techniques, it is recommended that in the case of an accidental spin (when someone might be so disoriented) that the first recovery action should be to centralise the controls. Should this technique not afford a recovery within one turn, the Standard recovery technique should be used.

The spinning characteristics of the aircraft were considered suitable for a non-aerobatic aircraft.

5.5 Climb Performance

A climb and descent assessment was made using the saw-tooth technique. From this assessment the following indicated air speeds are recommended):

Best Angle of Climb	-	93 KIAS	
Best Rate of Climb	-	108 KIAS	(ROC - 2557 fpm @ SL)
Best Range Climb	-	128 KIAS	

The Best Rate of climb performance is expected to reduce by approximately 109 fpm/1000 ft above Sea Level (SL)

The engine remained within limits for all the climb speeds tested.

5.6 Descent Performance

Glide data were collected with the engine at idle and not shutdown; therefore, descent rates with a shutdown engine could be higher than those given below.

Best Range Glide Speed - 95 KIAS ROD - 1995 fpm @ 2000 ft MSL

The best rate of glide speed was at 75 KIAS, which gave a descent rate of 1633 fpm @ 2000 ft MSL. However, this was below 1.2 times the stall speed in the clean configuration and is therefore not recommended for normal use.

5.7 Forced Landings

During all simulated gliding operations, the aircraft remained very controllable. At 95 KIAS, there was plenty of elevator authority to produce a good flare, where the rate of descent could be reduced to zero, if required.

At a rate of around 2000 fpm, the descent rate in the forced landing configuration is reasonably high. However, there are many other aircraft on the British Register with a similar descent rate in the same condition, including the original Mustang aircraft. When this is combined with the good handling qualities of the Stewart Mustang, this descent rate is considered manageable and therefore acceptable for this class of aircraft. At no time was manœuvring during a simulated engine failure considered difficult.

To allow a managed descent, it is recommended that the flaps be lowered only when landing is assured and be used to ‘bleed’ the speed from the clean glide speed of 95 KIAS to the full-flap touchdown speed of 80-75 KIAS.

5.8 Engine Propeller Combination

The Chevrolet V8 engine and the 4-bladed Hartzell variable pitch propeller combination seemed to work very well. Throughout the flight testing, no form of vibration or overheating issues were seen. The engine appeared to cope very well with the propeller fitted, without any noticeable labouring or stagnation at any rpm setting and including engine bodies from idle to max to idle and max to idle to max.

The aircraft fitted with a Chevrolet V8 engine of 500 hp and a 4-bladed Hartzell variable pitch propeller, was considered acceptable.

5.9 Engine Maximum Boost

AAN29320 gave the maximum manifold air pressure (MAP) for the engine to be 25 inches of pressure. This has subsequently found to be incorrect and that the maximum MAP for the engine is 30 inches of pressure.

It is recommended that the maximum Manifold Air Pressure be redefined to 30 inches of pressure.

5.10 High-speed Handling

A Vdf assessment was carried out to 286 KCAS, which equated to Vne of 250 KIAS. There were no handling, flutter or engine issues experienced up to 286 KCAS indicated air speed.

With the tested pitot-static system, a Vne of up to 250 KIAS would be acceptable for this aircraft.

5.11 Centre of Gravity Envelope

Due to the geometry of the aircraft, only part of the centre-of-gravity (CofG) range could be tested. The tested range was from 86.1 inches aft to 90.85 inches aft. The given CofG range for aircraft was 83.2 to 92.5 inches aft of datum. During the testing, it was noted that there was plenty of elevator authority throughout the speed range; although the aircraft could only just be trimmed at a speed of 1.3 times the stall speed and idle power (95 KIAS), the pitch control forces were sufficiently light to accept some extrapolation of the CofG envelope. The accepted flight testing tolerance level for CofG specific testing is up to plus or minus 1 inch of the range tested. Therefore, a CofG range of 85.1 to 91.8 inches aft of datum is recommended for the aircraft.

A Centre of Gravity range of 85.1 to 91.8 inches aft of datum is recommended for the aircraft.

5.12 Pressure Error Corrections

A pressure-error-correction (PEC) evaluation was completed. This showed that the indicated airspeed was generally slightly below the Calibrated airspeed for all configurations tested by between 1-6 knots. During the Vdf and stalling exercises, the flight-test PECs were used to accurately give a Vne value and the correct approach speeds. PEC Graphs are given in Appendix A

5.13 Electric Trim

The rate of the electrical trimmers was found to be slow enough not to cause a concern in a predicted runaway situation. This combined with the pitch and yaw control forces was considered acceptable should such a runaway occur. The trim circuit breaker was easy to locate on the left-hand end of the bottom row of circuit breakers.

The electrical trim runaway failure is considered acceptable.

5.14 Further Development

The testing has shown the aircraft to be solid and robust. Some of the initial concerns about the aircraft have been dispelled with the testing to date. It is therefore recommended that the next Phase of testing could be embarked upon, to increase the

Vne, consider two occupants and to potentially include an aerobatics clearance, with the correct justification and substantiation being submitted to the CAA.

5.15 Development Items

During the testing phase the following items were identified and fixed before testing was finished. However, they are included for completeness.

5.13.1 Slight Coolant Leak

Found to be a leaking union and fixed.

5.13.2 Front Ignition Number 2 Unserviceable

Replaced, with no further problems.

5.13.3 Roll Control Heavy

On the first flights, the roll control was very heavy and there as an out of trim force build up as speed was increased. Cured by re-rigging.

5.13.4 High Oil Spillage

The oil was found to be over-filled and was be vented overboard. Experimentation was required to get the ideal oil level.

5.13.4 Water Gauge

The water gauge was initially intermittent but this was found to be due to a faulty connector.

5.13.4 Fuel Gauge

One of the fuel gages was intermittent and this was found to be due to a faulty connector.

6 CONCLUSION

The aircraft was responsive, with satisfactory control forces that made it pleasant to fly. Stability in all axes was good, with positive stability being exhibited for the majority of points tested. The aircraft demonstrated good performance, for its class.

The aircraft systems and operation were benign. Landing, take-off and ground handling were all benign. Crosswinds up to 20 kt were also found to be benign.

The stall qualities were benign. Recovery from one-turn spins was good using the standard technique, the Muller technique, reverse technique, centralization of the controls or even by releasing the controls. It is recommended that the inadvertent spin recovery should initially be to centralise the controls and if recovery is not apparent within one turn then the Standard Spin Recovery technique should be used.

The cockpit assessment concluded that the labelling and general layout was acceptable, except for the Air Speed Indicator, which needed to be corrected.

The Chevrolet V8 engine in combination with a 4-bladed Hartzell variable pitch propeller was considered acceptable and exhibited no vibration or overheating tendencies. The maximum engine manifold air pressure was found to by 30 inches of pressure instead of the AAN29320 value of 25 inches.

During all simulated gliding operations, the aircraft remained very controllable. At the recommended glide speed, there was plenty of elevator authority to produce a good flare, where the rate of descent could be reduced to zero, if required. Although the descent rate was reasonably high, the good handling qualities of the Stewart Mustang meant that the descent rate was considered manageable and therefore acceptable for this class of aircraft. At no time was manœuvring during a simulated engine failure considered difficult. To allow a managed descent, it is recommended that the flaps be lowered only when landing is assured and be used to ‘bleed’ the speed from the clean glide speed down to the full-flap touchdown speed.

With the tested pitot-static system, a maximum speed of 250 knots indicated airspeed is recommended for the aircraft.

A Centre of Gravity range of 85.1 to 91.8 inches aft of datum is recommended for the aircraft.

The electrical pitch trim and rudder trim system runaways were considered acceptable by analysis.

Some minor issues were seen during the testing and were fixed before the last test flight.

Once the Air Speed Indicator was corrected, G-CGOI was considered suitable for a CAA Permit to Fly, with a maximum take-off weight of 3,400 lb, when fitted with a Chevrolet V8 engine in combination with a 4-bladed Hartzell variable pitch propeller.

APPENDIX A Flight Test Data (Not in flight order)

STEWART MUSTANG CARDS NON-SPECIFIC CofG

1. Aircraft Details

Type	Stewart Mustang	**Registration**	G-CGOI	**Serial N°**	144
Engine Type	Aero-conversion of the automotive liquid cooled Chevrolet V8 engine delivering 400-500 hp at 4700 rpm (limited by prop rpm limit)	**Propeller**	91” diameter Hartzell 4 blade hydraulically controlled constant speed propeller via a custom designed 2.13:1 reduction gear		
Speed Units	Knots	**Height Units**	Feet		
Temp Units	°F	**Pressure**	PSI		
Weight Units	lb	**MTOW**	3400		

2. Initial Tests

Check full and free travel and correct operation.

Elevator	Sat	Aileron	Sat	Rudder	Sat
Elevator Trim	Sat	Canopy/door	Sat	Rudder Trim	Sat
Flaps/slats	Sat	Coolant door	Sat	Throttle	Sat
Propeller	Sat	Mixture	Sat	Friction	Sat
Harness	Sat	Seat	Sat		

3. Engine Run

Carry out the engine checks crosswind unless safety dictates run into wind, eg., cooling/tail lifting, etc.

Run Crosswind / into wind (delete as necessary)

Mag test rpm	2000	Max Drop	150	Max Split	50
Drop mag 1		Drop mag 2		Hot air drop	
Prop test rpm	2000	No Times	3		SAT
Full/max power tested				Idle RPM	
RPM	4700	BST	30	CHT	160
Oil Pressure	40	Oil Temp	180	Fuel Press	15

4. Taxying

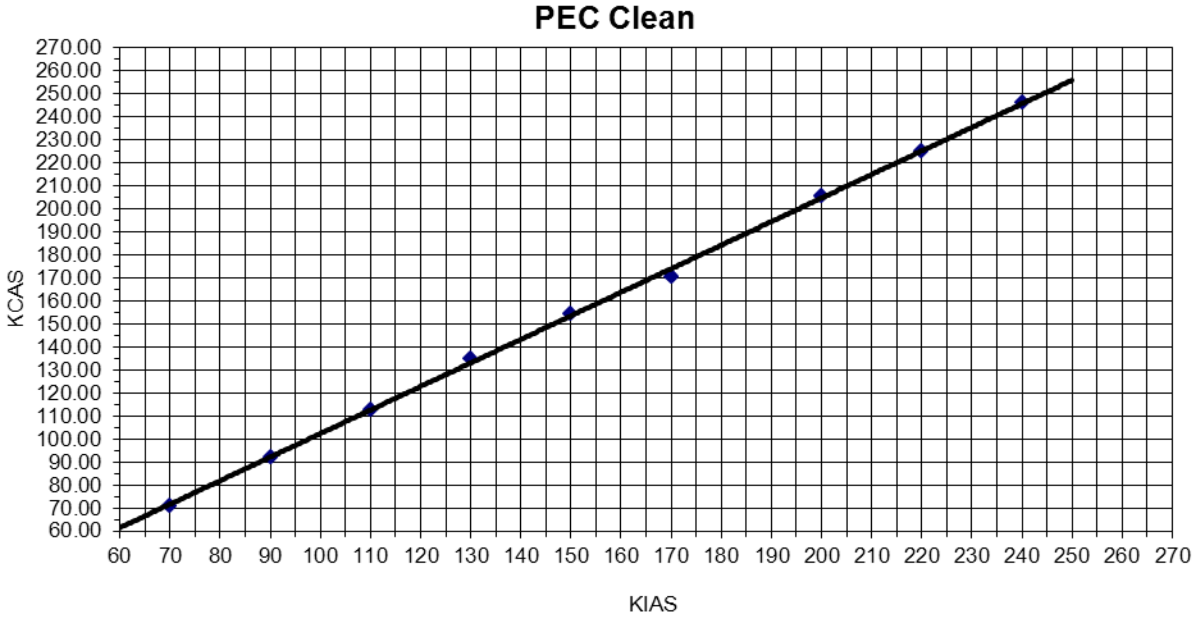
Brake operation	SAT	Lockable tailwheel	SAT
Directional control comment SAT			

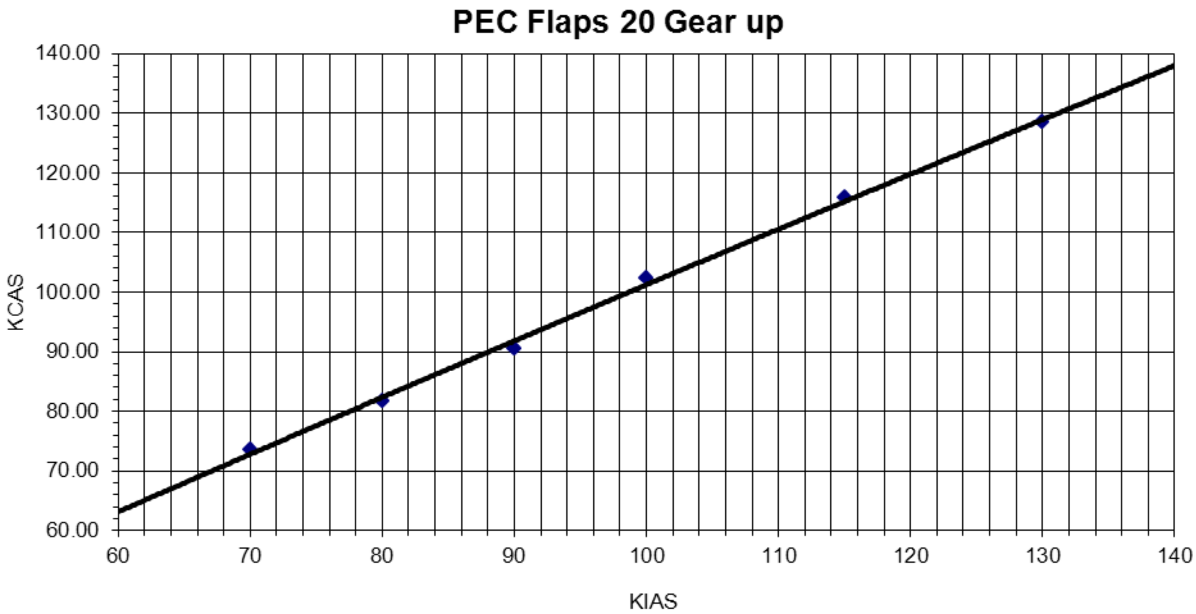
5. <u>Pressure Error Correction Evaluation (if not already completed)</u> (>500 ft agl)

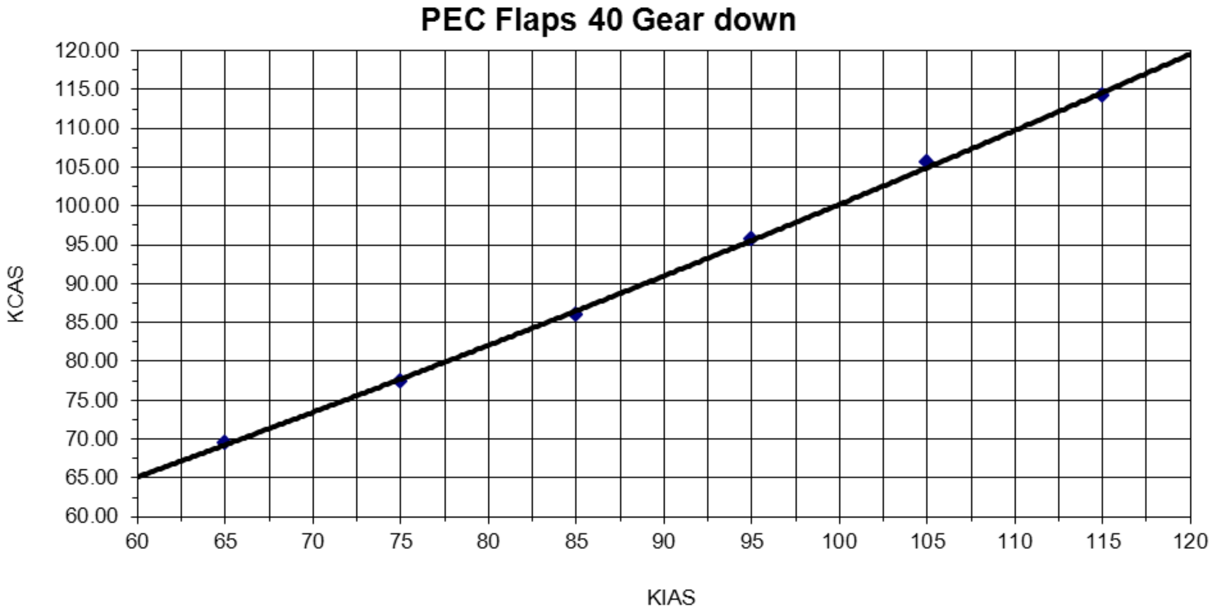
Configuration	Flap	Up							
Altitude	1000	1000	1000	1000	1000	1000	1000	1000	1000
IAS	70	90	110	130	150	170	200	220	240
Speed1	67.8	91.9	108	129	151	166	202	220	244
Track1	326	336	341	338	346	314	326	331	343
Speed2	77	98.7	123	146	167	184	217	236	255
Track2	86	81	89	90	87	85	84	83	109
Speed3	73.2	92.7	117	140	156	171	207	228	254
Track3	214	209	203	207	210	209	220	219	196
IOAT	20	20	20	20	20	20	20	20	20

Configuration	Flap	20				
Altitude	1000	1000	1000	1000	1000	1000
IAS (Actual)	70	80	90	100	115	130
Speed1	68.8	77.7	86.6	97.1	112	123
Track1	327	330	325	322	321	319
Speed2	83.6	90.2	101	112	126	141
Track2	79	84	88	88	88	87
Speed3	73.5	84.3	90.6	105	117	129
Track3	199	195	202	206	207	208
IOAT	20	20	20	20	20	20

Configuration	Flap	Full	Gear	Down		
Altitude	1000	1000	1000	1000	1000	1000
IAS (Actual)	65	75	85	95	105	115
Speed1	61.9	73.2	80.6	90.4	103	109
Track1	333	335	335	336	350	355
Speed2	75.5	84.3	93.3	103	113	125
Track2	64	69	73	74	81	90
Speed3	73.1	79.9	90.2	101	111	121
Track3	200	200	199	196	194	196
IOAT	20	20	20	20	20	20


PEC Clean
KCAS
KIAS
270.00
260.00
250.00
240.00
230.00
220.00
210.00
200.00
190.00
180.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270


PEC Flaps 20 Gear up
KCAS
KIAS
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
60 70 80 90 100 110 120 130 140



6. Dive to VDF to establish VNE

This test must only be done in smooth air conditions. Accelerate the aircraft in level flight at full throttle (fixed pitch) or max permitted MP + RPM - 200, and record:

IAS (Vh)	190	RPM	4500	MP	25
Pitch trimmer setting	N			Book Vdf	288

Recovery must be demonstrated – closing the throttle to idle
– while maintaining max allowable power.

Achieved VDF	288
Is an increasing control force in the nose down sense required throughout the acceleration?	YES
Are longitudinal, lateral and directional control forces and responses over small angles normal?	YES
Are short period oscillations heavily damped with controls fixed and, if able to trim, with controls free?	YES
Is there excessive vibration or buffeting?	NO
Maximum RPM	4500

Regain cruising flight by gradually raising the nose.

Any unusual behaviour in the recovery power off:	Sat
Any unusual behaviour in recovery with power on:	Sat
Engine behaviour on closing throttle:	Sat

7. Baulked Landing

From the landing approach configuration recommended above, can a safe transition be made to a positive climb at the 15m point with application of full power, wing flaps maintained in the landing position?

YES

8. Demonstrated Crosswind Landing (if done)

Fuel:

landing strip QDM	180°M	Wind direction	100°M	Wind speed	20 kt

Observations, inc. technique required and whether full directional/lateral control capability used. Wing-down technique Satis

9. FUNCTIONING CHECKS

During the flight, check the following:

a. Flying Controls

	Friction	Backlash	Are control forces normal?
Elevator	Sat	Sat	Sat
Aileron	Sat	Sat	Sat
Rudder	Sat	Sat	Sat
Elevator Trimmer	Sat	Sat	Sat
Rudder Trimmer	Sat	Sat	Sat

During normal cruise, check that aeroplane:

(a) can be trimmed to fly level	YES
(b) has no tendency to fly one wing low	YES
(c) flies straight with slip indicator central	YES

b. Fuel System

During the flight, feed from each fuel tank in turn for not less than 3 minutes.

Record:

System functioning on each tank (identify which)	Left	Right		
Fuel selector	Sat	Sat		
Fuel gauges	Sat	Sat		

c. Electrical System Check all electrical equipment for satisfactory operation:

Remarks: 14.2 V satis

d. Gyro Instruments Check behaviour of gyro instruments:

Remarks:

N/A

e. Other Instruments Check for satisfactory functioning:

Remarks: Satis

f. Radio/Transponder Test

	Model	S/N°	Ground Station	Freq or Code	Brg from Stn	Nm from Stn	Alt	Tx	Rx
								ATC Registered Ht	
VHF 1	Garmin GNS 430		Peterborough	129.725	100	20	2000	5	5
IFF	Garmin GTX 327						2000	Satis	

To be acceptable, a VHF Communication test must establish a minimum range of 20 nm from a height of 2000 ft above the ground station.

g. Emergency Extension of Landing Gear

If it is possible to retract the Landing Gear after an emergency system extension then perform an emergency extension.

Time from initiation to full extension	

Remarks: Not resettable in the air.

h. Cruise Checks

Vibration

Check for signs of vibrations or buffeting throughout the rpm range and in all phases of ground running as well as in flight. This may result if the natural frequency of vibration of the engine on its mount rubbers, or the tail surfaces or fuselage, or of the engine/reduction drive should happen to couple in an unfortunate way with the resonant frequency of the propeller blades in bending, or the aerodynamic buffet coming from the slipstream. It may also indicate that the propeller is out of track or out of balance.

SAT	Remarks:

Fast Cruise Condition in Level Flight

At a constant altitude not above 2000 feet, after at least 2 minutes at each of the throttle settings required (provided that this has no detrimental effect on the engine), record:

Power Setting	RPM	MAN PRESS	IAS	OIL T	OIL P	CHT	EGT	FUEL FLOW
Wot or Max RPM	4700	28	220	185	42	175	1395	23.0 usgph
MCP or Cruise	4000	25	200	180	40	170	1300	15.6
Economy Cruise	3500	20	170	180	40	160	1280	11.0

i. ENGINE BODIE TESTS

High RPM/BST	Low RPM/BST	High RPM/BST	Low RPM/BST
4700/26	Idle	4600/25	Sat
4700/26	Idle	4600/25	Sat

j. ENGINE SIDESLIP TESTS

RPM	MAP	Result
4700	28	Engine hesitated after around 25 seconds. Recovered when sideslip removed
Idle	Idle	Satis

k. Cockpit Assessment

Assess the cockpit for ease of function and use, including Placards, Baggage Space, external placards, Lighting (internal & external), Emergency egress, etc

Remarks: Satis except ASI

10. Spinning (if appropriate mainly for aerobatic clearances)

NE = Normal Entry TL = Turn Left TR = Turn Right ML = Muller Recovery
NR = Normal Recovery RS = Release stick CC = Controls Central Recovery

Fuel

Spin	Entry Ht	Recovery Ht	IAS in Spin	Comments (No of turns to recover)
1TL NE NR	8500	7800	65/75	Reasonably slow rate 180 deg/sec recovery in 90 deg
1TR NE NR	8500	7650	65/75	Hesitations to the spin slightly quicker rate than left
1TL NE ML	8500	7800	65/75	Smooth recovery in 50 deg
1TR NE ML	8500	7700	65/75	Smooth recovery in 50-60 deg
1TL NE CC	8500	8600	65/75	
1TR NE CC	8500	8700	65/75	
1TL NE RS	8500	7400	65/75	Took longer to recover, around 1 turn
1TR NE RS	8500	7300	65/75	Took longer to recover, around 1 turn

STEWART MUSTANG CARDS FWD CofG

11. Take-off

Flap position	20 deg	Power setting	Max		
Elevator Trim	N	Rudder Trim	N		
T/O RPM	4650	BST	29	CHT	160

Actual Take-off speeds

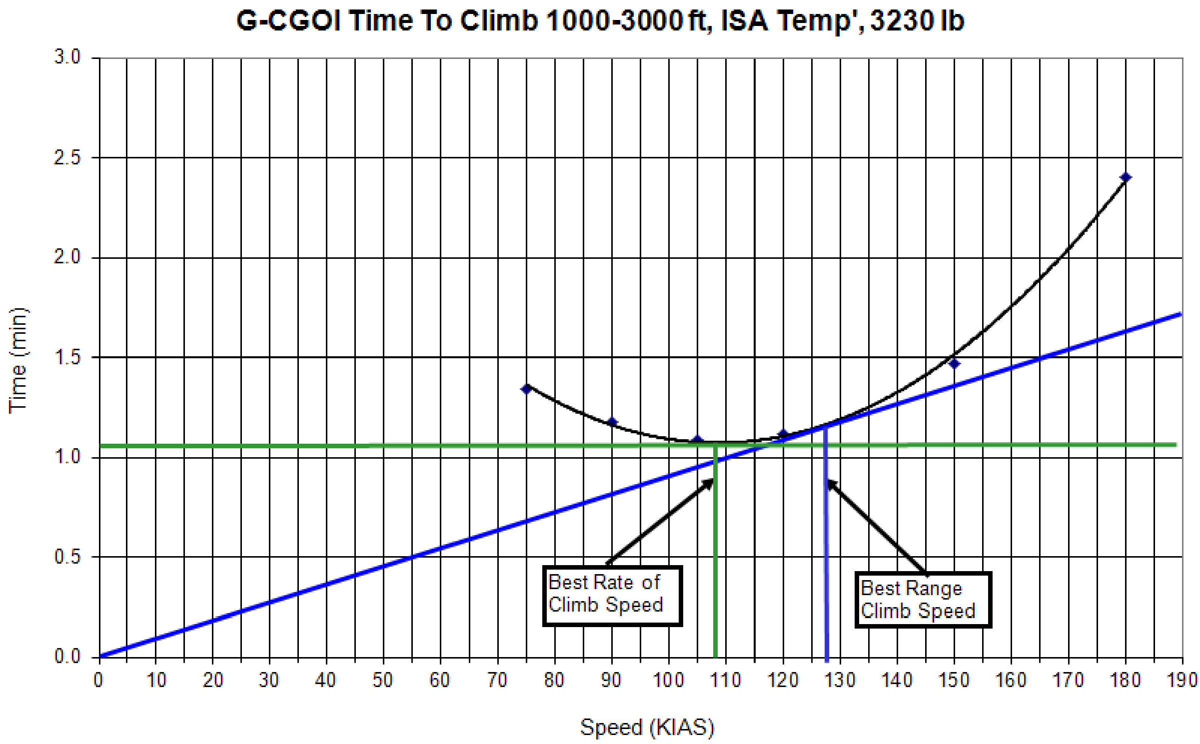
Vr/tail up	55	Vu	80
Time to unstick (sec)	16	Estimated ground roll	270m

Comment – directional control/swing, difficulty raising the nose/tail, was stall warning triggered, forces after take-off, etc: Satis

12. Climb & Descent (for aircraft without known performance) [F]

CLIMB DATA AT ISA +7 From 1000 To 3000 Band 2000 Mid 2000 **ISA Comparison** 7

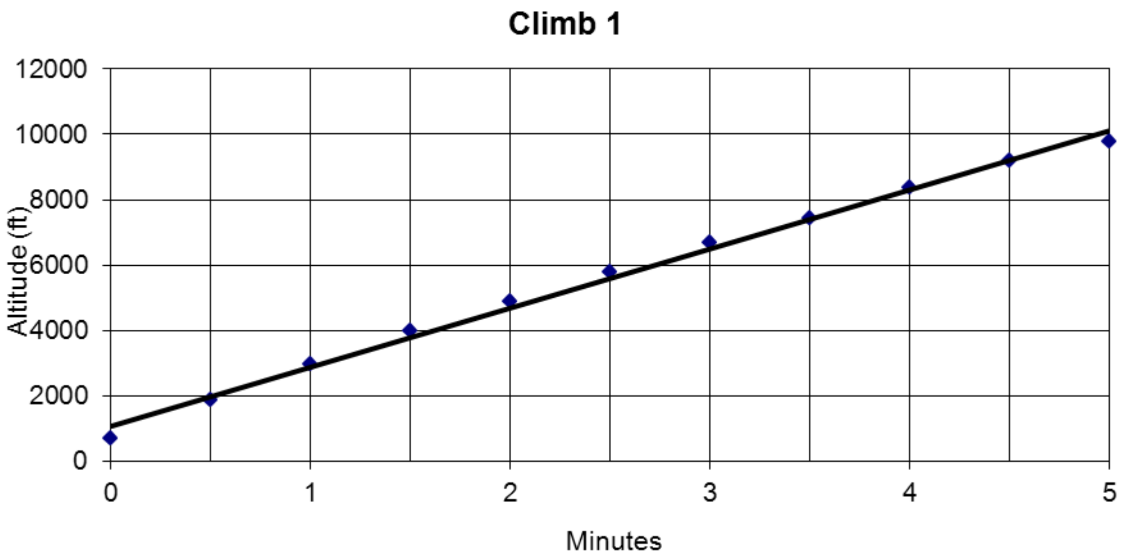
Speed	Time min	Time sec	Time min	Time sec	Ave Time	ROC1	ROC2	Ave ROC	ISA ROC	S/L ROC	ISA Time	TAS	Gradient%
75	1	24.0	1	19.8	1.4	1429	1504	1467	1495	1674	1.3	78.6	18.79405
90	1	13.5	1	10.0	1.2	1633	1714	1674	1702	1906	1.2	94.3	17.83025
105	1	6.0	1	6.5	1.1	1818	1805	1812	1840	2061	1.1	110.0	16.52224
120	1	8.0	1	8.2	1.1	1765	1760	1763	1791	2006	1.1	125.7	14.07196
150	1	29.5	1	30.5	1.5	1341	1326	1334	1362	1525	1.5	157.1	8.561033
180	2	34.0	2	24.0	2.5	779	833	806	834	934	2.4	188.5	4.368516



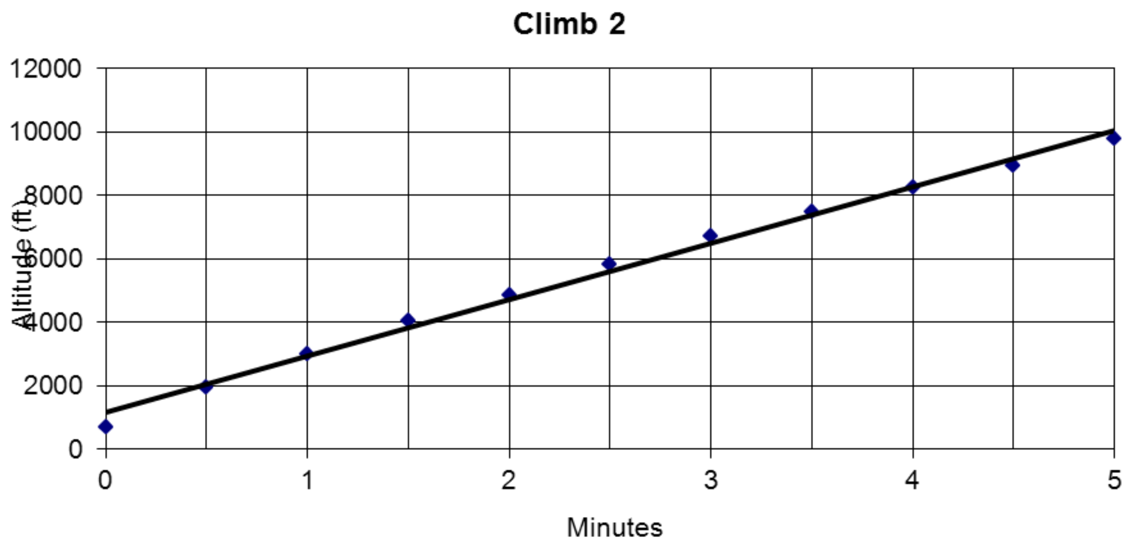
13. Reciprocal Climbs (for aircraft with known performance or with optimum speed from 10A) [F]

Power Setting: Max

Climb 1	**Clean**					Mid Wt	3375	**lb**			
No of minutes for climb			5								
Minutes	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Altitude	700	1850	2950	4000	4900	5800	6680	7440	8360	9180	9780
Temp	31		26		22		19		15		13



Climb 2	**Clean**					Mid Wt	3375	**lb**			
No of minutes for climb			5								
Minutes	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Altitude	700	1950	3020	4060	4850	5850	6720	7480	8240	8960	9780
Temp	31		26		22		19		16		13



Clean		% of MTOW
Mean Weight	3375	99.29%
Mean Altitude	5602	
Mean Temperature ºC	20.99	
Comparison to ISA	17.09	
Temperature correction *	68	
Weight Correction **	-13	
Actual Rate of climb	1795	
Corrected Rate of climb	1850	
Climb Speed	90	
Average TAS	101.5	
MSL Rate of Climb	2557	
Expected variation per 1000 ft	-109	

Manifold pressure	25”	EGT	
RPM	4700	Fuel Pressure	15
Oil pressure	40	Coolant temperature	160
Oil temperature	180	Coolant door position	Mid
Elevator Trim	N	Rudder Trim	2R

14. Wings Level Stall Flaps Up, Gear Up

Trim speed 1.5 Vs1		98		
Pitch Trim	4 UP	Rudder Trim	1R	
Stall warning	76	Type of warning	Natural Buffet	
Stall speed	71	Was full nose up control achieved?		No
Sequence of nose and wing drop (if any)			N/A	
Angle of wing drop (deg)		N/A		

Can roll and yaw be controlled by unreversed use of the roll and yaw controls up to the time of nose dropping?	YES
Was it necessary to add power to recover from the stall?	NO
Is it possible to prevent the roll by use of the roll control alone?	YES
Can 1.3 Vs1 be regained promptly at any speed just above the stall by pitching the nose down?	YES

15. Wings Level Stall Flaps Take-off, Gear Up (If applicable)

Time Flaps from Up to Take-off @ Vfe-5 (if applicable)	3.5 s

If, in the case of power operated flaps, the flap does not move to the full down position at the limiting speed:

(a) Record angle at which flap stops	N/A

(b) With flap selected Down, reduce speed until flap reaches full down position. Record IAS	N/A

Trim speed 1.5 Vs1		96		Fuel	
Pitch Trim	Full Up	Rudder Trim		Aileron Trim	
Stall warning	72	Type of warning	Buffet		
Stall speed	68	Was full nose up control achieved?			NO
Sequence of nose and wing drop (if any)			N/A		
Angle of wing drop (deg)		N/A			

Can roll and yaw be controlled by unreversed use of the roll and yaw controls up to the time of nose dropping?	YES
Was it necessary to add power to recover from the stall?	NO
Is it possible to prevent the roll by use of the roll control alone?	YES
Can 1.3 Vs1 be regained promptly at any speed just above the stall by pitching the nose down?	YES
Sequence of nose and wing drop (if any)	N/A

16. Wings Level Stall Flaps Full, Gear Down

Time Gear from up to Down '@ Vlo-5 (if applicable)	5.0 s
Time Flaps from Take-off to Full @ Vfe-5 (if applicable)	3.0 s

If, in the case of power operated flaps, the flap does not move to the full down position at the limiting speed:

(a) Record angle at which flap stops	N/A
(b) With flap selected Down, reduce speed until flap reaches full down position. Record IAS	N/A

Trim speed 1.5 Vs1		93		Fuel	
Pitch Trim	Full Up	Rudder Trim		Aileron Trim	
Stall warning	70	Type of warning	Buffet		
Stall speed	65	Was full nose up control achieved?			NO
Sequence of nose and wing drop (if any)			N/A		
Angle of wing drop (deg)		N/A			

Can roll and yaw be controlled by unreversed use of the roll and yaw controls up to the time of nose dropping?	YES
Was it necessary to add power to recover from the stall?	NO
Is it possible to prevent the roll by use of the roll control alone?	YES
Can 1.3 Vs1 be regained promptly at any speed just above the stall by	YES

pitching the nose down?

Time Flaps from Full to Take-off @ (if applicable)	1.3Vso	80 kt	3.5 sec
Time Flaps from Take-off to Up @ (if applicable)	1.3Vs1	82 kt	3.0 sec
Time Gear from Down to up @ (if applicable)	Vlo-5	65 kt	7.0 sec

Check landing gear unsafe warning. With landing gear retracted, select pitch control fully fine, close throttle until warning sounds, record:

RPM	N/A	Manifold pressure	

17. Stick Force Changes [F]

Config	At	Speed	Config change	Stick Force	Trim Change		
Clean, Cruise power	0.9Vh	180		Long Yes	Lat Yes	Dir Yes	Trim
	Cruise	120	Set idle		Up/Down		
	1.4Vs1	90		Long Yes/No	Lat Yes/No	Dir Yes/No	Trim
Clean, idle power	1.4Vs1	90	Set T/O power		Up/Down		
Clean, T/O power	1.3Vs1	84	95 kt min trim	Long No			Trim
			Sudden engine failure and transition to glide	Long sat	Lat sat	Dir sat	General Forces
Gear down, flap up, Idle,	1.4Vs1	84	Full flap, decel to 1.4Vso	5	Up		
Gear down, Full Flap, idle,	1.3Vso	80	Pitch trim No	If not what speed can trim	94 kt		Trim
			T/O Power, flaps up, accel to 1.3Vs1 .... (gear up climbing)	4	Up		
Gear down, flap up, Idle	1.3Vso	84	Descent and flare for landing	Long sat	Lat sat	Dir sat	General Forces
Gear down, flap up, App Power	1.3Vso	84	Descent and flare for landing	Long sat	Lat sat	Dir sat	General Forces
Gear down, Full Flap, PFLF	1.1Vso	70	Flaps to gate or up, keep level, accel to 1.1Vs1................. (use up to MCP)	2	Up		
Gear down, flap up, Idle	(Vfe or Vlo) - 5kt	110	Full Flap		Down		
Gear down, Full Flap, Idle	Trim at Vref	70-115	Speeds between 1.1Vso............. & 1.7 Vso or Vfe or Vlo	Within limits Yes	Down		

Gear up, T/O Flap, T/O power	(Vfe or Vlo) - 5kt	125	Raise flaps	3	Up

18. Landing

Recommended speed at height of 15 m, (which shall not be less than 1.3 Vso)	95
Recommended flap setting	Full
Is an approach speed of 1.3 Vso satisfactory?	YES
Can a power-off landing be made without brakes needing to be used to maintain directional control?	YES
Can a power-off landing be safely carried out using the recommended configuration as above but an approach speed 5 kts below the figure recommended?	YES

Comments: Satis

STEWART MUSTANG CARDS AFT CofG

19. Take-off

Flap position	Up	Power setting	Max		
Elevator Trim	N	Rudder Trim	N		
T/O RPM	4700	BST	30	CHT	160

Actual Take-off speeds

Vr/tail up	50	Vu	80

Estimated ground roll: 300 m

Comment – directional control/swing, difficulty raising the nose/tail, was stall warning triggered, forces after take-off, etc:

Satis

20. Stall Flaps Up, Gear Up Power 75% (4000/+22)

a. Wings Level Stall

Trim speed 1.5 Vs1		97		Wt	3375
Pitch Trim	2 Up	Rudder Trim	1 L		
Stall warning	65	Type of warning	Buffet/Judder		
Stall speed	58	Was full nose up control achieved?			NO

Sequence of nose and wing drop (if any)	N/A
Angle of wing drop (deg)	
Can roll and yaw be controlled by unreversed use of the roll and yaw controls up to the time of nose dropping?	YES

Is it possible to prevent the roll by use of the roll control alone?	YES
Can 1.3 Vs1 be regained promptly at any speed just above the stall by pitching the nose down?	YES

b. Turning Stalls **Power 75%***

Direction of turn	Left	Right
Stall warning	70	70
Type of warning	Judder	Judder
Stall speed	64	65
Did the aircraft roll more than 60º into the turn, or more than 60º out?	NO	NO
Were uncontrollable rolling and spinning tendencies encountered?	NO	NO

c. Accelerated Stalls **Power 75%***

From a 30º co-ordinated banked turn, speed 1.5 Vs1 decelerate at between 3-5 kt per second by a progressive aft movement of the pitch control until the aircraft stalls. Contain the wing drop (±60 deg CS VLA203(b)(4)), +30, -60 Section S, with rudder and ailerons (unless departure).

Direction of turn	Left	Right
Stall warning	80	80
Type of warning	Judder	Judder
Stall speed	75	73
Did the aircraft roll more than 60º into the turn, or more than 60º out?	NO	NO
Were uncontrollable rolling and spinning tendencies encountered?	NO	NO

21. Stalls Flaps Take-off, Gear Up

a. Wings Level Stall

Trim speed 1.5 Vs1		95		Weight	3375
Pitch Trim	3 Up	Rudder Trim	3 R		
Stall warning	65	Type of warning	Judder		
Stall speed	60	Was full nose up control achieved?			NO
Sequence of nose and wing drop (if any)			N/A		
Angle of wing drop (deg)					

Can roll and yaw be controlled by unreversed use of the roll and yaw controls up to the time of nose dropping?	YES
Is it possible to prevent the roll by use of the roll control alone?	YES
Can 1.3 Vs1 be regained promptly at any speed just above the stall by pitching the nose down?	YES

b. Turning Stalls **Power 75%***

Direction of turn	Left	Right
Stall warning	70	73
Type of warning	Judder	Judder
Stall speed	63	66
Did the aircraft roll more than 60º into the turn, or more than 60º out?	NO	NO
Were uncontrollable rolling and spinning tendencies encountered?	NO	NO

c. Accelerated Stalls **Power 75%***

From a 30º co-ordinated banked turn, speed 1.5 Vs1 decelerate at between 3-5 kt per second by a progressive aft movement of the pitch control until the aircraft stalls. Contain the wing drop (±60 deg CS VLA203(b)(4)), +30, -60 Section S, with rudder and ailerons (unless departure).

Direction of turn	Left	Right
Stall warning	85	83
Type of warning	Judder	Judder
Stall speed	75	75
Did the aircraft roll more than 60º into the turn, or more than 60º out?	NO	NO
Were uncontrollable rolling and spinning tendencies encountered?	NO	NO

22. Stalls Flaps Full, Gear Down

a. Wings Level Stall

Trim speed 1.5 Vs1		90		Weight	3375
Pitch Trim	3 Up	Rudder Trim	1 R		
Stall warning	65	Type of warning	Judder		
Stall speed	58	Was full nose up control achieved?			NO
Sequence of nose and wing drop (if any)					
Angle of wing drop (deg)					

Can roll and yaw be controlled by unreversed use of the roll and yaw controls up to the time of nose dropping?	YES
Is it possible to prevent the roll by use of the roll control alone?	YES
Can 1.3 Vs1 be regained promptly at any speed just above the stall by pitching the nose down?	YES

b. Turning Stalls **Power 75%***

Direction of turn	Left	Right
Stall warning	63	61
Type of warning	Judder	Judder
Stall speed	60	60
Did the aircraft roll more than 60º into the turn, or more than 60º out?	NO	NO
Were uncontrollable rolling and spinning tendencies encountered?	NO	NO

c. Accelerated Stalls **Power 75%***

From a 30º co-ordinated banked turn, speed 1.5 Vs1 decelerate at between 3-5 kt per second by a progressive aft movement of the pitch control until the aircraft stalls. Contain the wing drop (±60 deg CS VLA203(b)(4)), +30, -60 Section S, with rudder and ailerons (unless departure).

Direction of turn	Left	Right
Stall warning	83	85
Type of warning	Judder	Judder
Stall speed	75	75
Did the aircraft roll more than 60º into the turn, or more than 60º out?	NO	NO
Were uncontrollable rolling and spinning tendencies encountered?	NO	NO

23. Roll Rate

Reverse turn from 30º left to 30º right and vice versa.

Gear & Flaps up, PFLF @	Va/Cruise	170	L-R	2 sec	R-L	2 sec
Gear up, Flaps T/O, MCP @	1.2 Vs1	76	L-R	3 sec	R-L	3 sec
Flaps & gear down, Idle @	1.3 Vso	78	L-R	3 sec	R-L	3 sec
Flaps & gear down, MCP @	1.3 Vso	78	L-R	3.5 sec	R-L	3.5 sec

24. Adverse Yaw

Hold rudder fixed and apply max aileron and note degree of adverse yaw:	Negligible

25. Static Longitudinal Stability Weight 3340

a) Pitch control forces required to deviate from the trimmed airspeed must be in the correct sense and detectable by the pilot. This must be shown in speed variations down to speeds approaching the stall and up to the maximum allowable speed for the configuration up to 40 lb stick force.

b) Pitch control forces required to deviate from the trimmed airspeed must have a stable slope within a range of airspeeds as quoted.

c) Following a longitudinal disturbance as in (a) above the speed must return within 10% to the trimmed speed on release of the pitch control.

These criteria must be demonstrated under the following conditions:

		Sense ± 15%	Slope ± 15%	Return ± 10%
Gear down, Full Flap, Power idle, 1.3 Vso	78	YES	YES	No Trim
Maximum power, Flaps up, Climb at 1.3 Vs1	85	YES	YES	YES
75% power, Cruise speed	200	YES	YES	YES

26. <u>Elevator Control Forces in Manoeuvres</u>

From the trimmed condition in cruise at 0.9 Vh measure the stick force required to produce the following positive vertical accelerations or max 'g' if less:

Weight	3340	0.9 Vh		Stick force in:	lbf
1.5 g		2.0 g	6 lb	2.5 g	
3.0 g	10 lb	3.5 g		4.0 g	15 lb

27. <u>Control Harmonization</u>

Manœuvre the aircraft below Va and estimate the relationship of control forces, taking the elevator forces as the baseline; ie, 1.

Weight	3340		Va		
Speed	150	RPM	4000	MP	22
Elevator	1/2	Aileron	1	Rudder	2

28. <u>Lateral and Directional Stability</u> Weight 3330

Lateral & Directional Stability 23.177 >3000 ft agl

*In straight steady flight with roll and yaw controls gradually applied in opposite directions to produce a steady heading sideslip, does sideslip angle correspond with increased deflection of the lateral control and do control forces increase progressively with no tendency towards force reversal at high angles (at speeds from 1·2Vs1 to Va the rudder pedal force must not reverse)?

†When the aircraft is yawed at angles up to the <u>maximum appropriate</u> is there a positive tendency for the rudder to return to neutral when released? Is there a tendency for the low wing to rise when the stick is released during a sideslip with no less than 10º of bank?

Config	Plan Speed	Flown Speed	Direction	Forces Progressive	Rudder return	Wing rises
†PFLF, gear up, Flap	170		Left	Yes	Yes	Yes

up, Cruise speed			Right	Yes	Yes	Yes
*Power idle, gear up, Flap up, 1.2 Vs1	78		Left	Yes	Yes	Yes
			Right	Yes	Yes	Yes
†MCP, gear up, Flap up, 1.2 Vs1	78		Left	Yes	Yes	Yes
			Right	Yes	Yes	Yes
†MCP, gear down, Flap down, 1.2 Vso	76		Left	Yes	Yes	Yes
			Right	Yes	Yes	Yes
*Power 50%, gear & Flap down, 1.2 Vso	76		Left	Yes	Yes	Yes
			Right	Yes	Yes	Yes
*Power 50%, gear down, Flap down, (Vfe or Vlo) - 5kt	110		Left	Yes	Yes	Yes
			Right	Yes	Yes	Yes

29. Spiral Stability Weight 3300

Spiral Stability (if the dihedral effect above appears weak or negative) 27.177(b)

At each trimmed condition, bank the aircraft to 20 deg (or less if required) and release the stick. Time to double the AOB. (> 20 sec)

Condition	Lnd, idle, 1.3Vso	Takeoff, T/O, 1.2Vs1	PFLF, clean, cruise
Speed	74	78	170
Time	Sat	Sat	Sat

30. Dynamic Stability Weight 3300

Dynamic Stability 23.181(b) FL100 Clean

Safety:

1. Any rudder inputs must be of small magnitude and applied with care.
2. Stop for buffeting, vibration or handling concern.
3. This test must not be carried out in turbulent conditions.

At each speed trim the aircraft ‘hands’ free, particularly in the lateral and directional axes. Apply a gentle rudder doublet and allow the resulting motion to decay without input on the controls. The amplitude of any oscillation should decay to one tenth of the amplitude within seven cycles.

Speed	100	140	180
Stable	YES	YES	YES
Cycles to Damp or 1/10	2	2	3

31. Longitudinal Stability Phugoid

Phugoid 23.181(c) (not in CS-VLA) FL100 (or normal cruising altitude) Clean

Any long-period oscillation of the flight path (phugoid) must not be so unstable as to cause an unacceptable increase in pilot workload or otherwise endanger the aeroplane

Establish a trimmed cruise condition at. Decel by 15% or 10 knots (whichever is greater), release – record speed & height at each reversal.		
Time	**IAS**	**Stable**
41 sec	170	YES

32. Landing

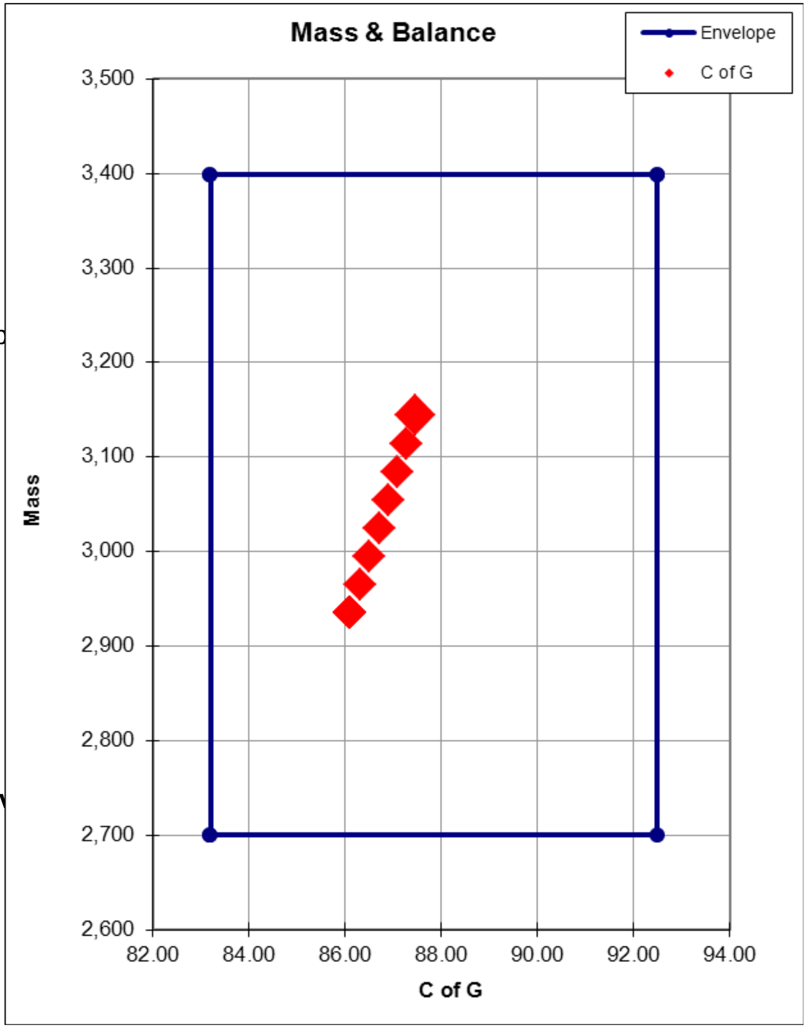
Recommended speed at height of 15 m, (which shall not be less than 1.3 Vso)	95 KIAS
Recommended flap setting	Full
Is an approach speed of 1.3 Vso satisfactory?	YES
Can a power-off landing be made without brakes needing to be used to maintain directional control?	YES
Can a power-off landing be safely carried out using the recommended configuration as above but an approach speed 5 kts below the figure recommended?	YES
Comments:	

APPENDIX B Weight & Balance

G-CGOI 05 June 2014

Enter Fuel in	US Gals	50	70	US Gals	Maximum
Fuel SG		0.72	15		Min Lnd Fuel

	Mass	(lb)	Arm	(in)	Mom	(lb
Calculated Basic Mass	**2,645**		**83.24**		**220,157**	
Mass of Pilot	200		114.9		22,980	
Pax			145.1			
Baggage (75)			164.3			
Total Fuel in lb	300		106.54	**MAC**	32,008	**O**
RM	**3,145**		**87.47**		**275,145**	
TOM	**3,142**		**87.46**		**274,825**	
ZFM	**2,845**		**85.46**		**243,137**	



First Flight, Second flight basic stalls

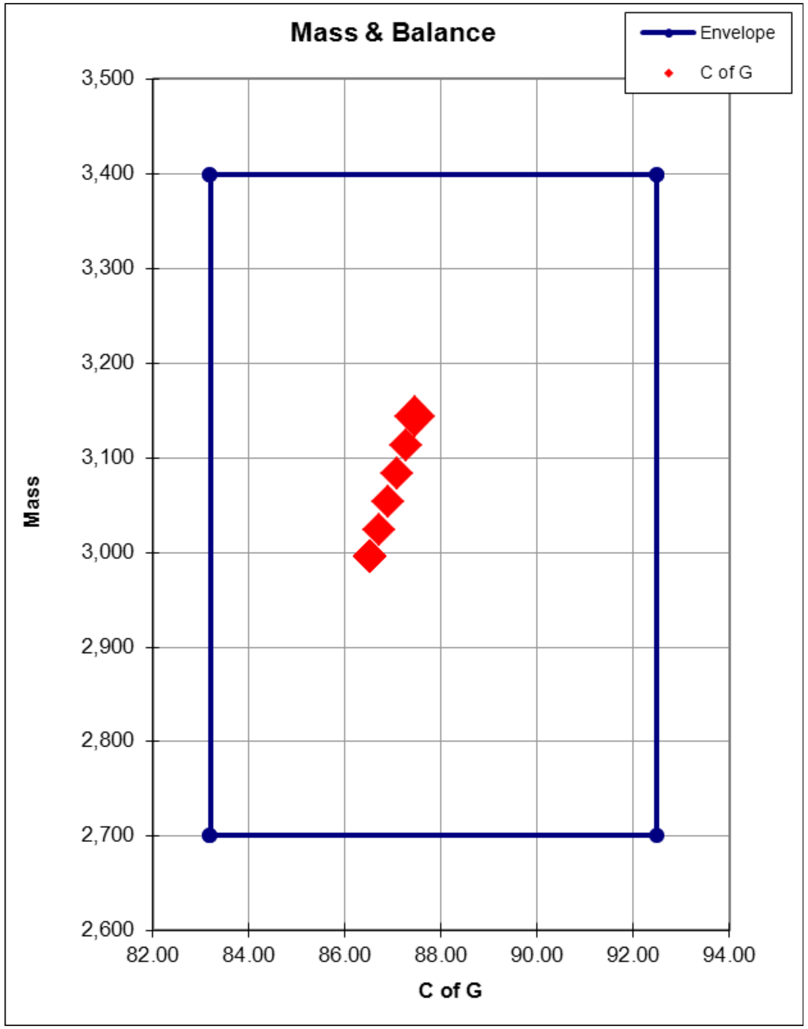
G-CGOI 15 July 2014

Sortie 1

Enter Fuel in	US Gals	50	70	US Gals	Maximum	
Fuel SG		0.72	25		Min Lnd Fuel	
		Mass (lb)	**Arm** (in)		**Mom** (lb/in)	
Calculated Basic Mass		**2,645**	**83.24**		**220,157**	
Mass of Pilot		200	114.9		22,980	
Pax			145.1			
Baggage (75)			164.3			
Total Fuel in	lb	300	106.54	**MAC**	32,008	**Over by**
RM		**3,145**	**87.47**		**275,145**	
TOM		**3,142**	**87.46**		**274,825**	
ZFM		**2,845**	**85.46**		**243,137**	

Off Blk	12:20	12:30	T/O
On Blks	13:50	13:40	Lnd
Blocks	1:30	1:10	Airborne

Pecs



G-CGOI

15 July 2014

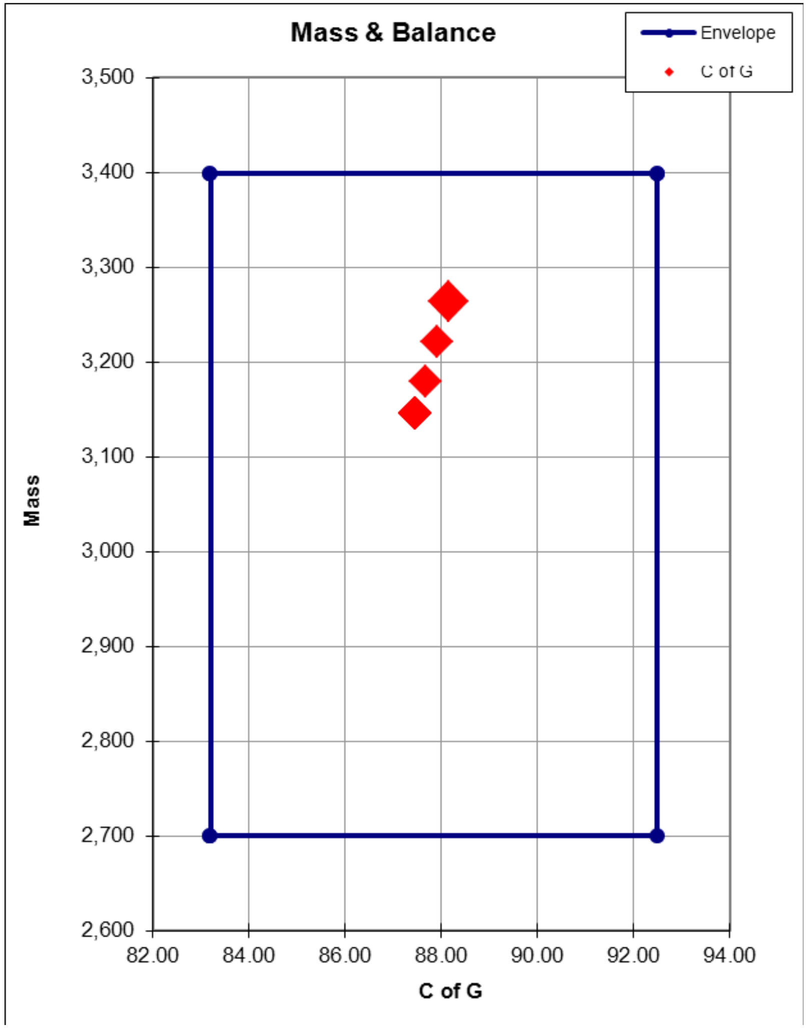
Sortie 2

Enter Fuel in	US Gals	70	70	US Gals	Maximum	
Fuel SG		0.72	50		Min Lnd Fuel	

		Mass (lb)	Arm (in)		Mom (lb/in)	
Calculated Basic Mass		**2,645**	**83.24**		**220,157**	
Mass of Pilot		200	114.9		22,980	
Pax			145.1			
Baggage (75)			164.3			
Total Fuel in	lb	421	106.54	**MAC**	44,812	**Over by**
RM		**3,266**	**88.18**		**287,948**	
TOM		**3,263**	**88.16**		**287,629**	
ZFM		**2,845**	**85.46**		**243,137**	

Off Blk	14:50	14:55	T/O
On Blks	16:05	15:55	Lnd
Blocks	1:15	1:00	Airborne

Saw-tooth climbs

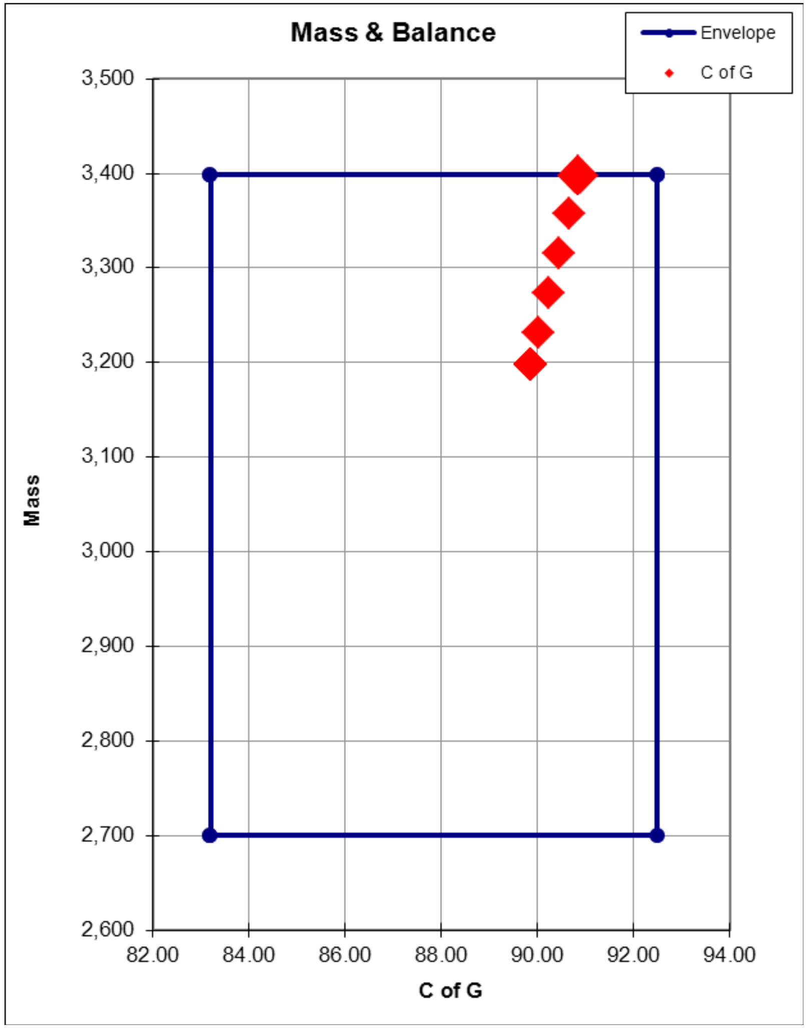


G-CGOI 07 August 2014

Sortie 1

Enter Fuel in	US Gals	70	70	US Gals	Maximum		
Fuel SG		0.72	36		Min Lnd Fuel		
		Mass (lb)	**Arm** (in)		**Mom**	(lb/in)	
Calculated Basic Mass		**2,645**	**83.24**		**220,157**		
Mass of Pilot		200	114.9		22,980		
Pax		60	145.1		8,706		
Baggage (75)		75	164.3		12,323		
Total Fuel in	lb	421	106.54	**MAC**	44,812	**Over by**	
RM		**3,401**	**90.86**		**308,977**		
TOM		**3,398**	**90.85**		**308,657**		
ZFM		**2,980**	**88.65**		**264,165**		

Off Blk	12:35	12:45	T/O
On Blks	14:20	14:10	Lnd
Blocks	1:45	1:25	Airborne



Perf climbs and Aft CofG per/handling

G-CGOI 07 August 2014

Sortie 2

Enter Fuel in	US Gals	55	70	US Gals	Maximum	
Fuel SG		0.72	30		Min Lnd Fuel	
		Mass (lb)	**Arm** (in)		**Mom**	(lb/in)
Calculated Basic Mass		**2,645**	**83.24**		**220,157**	
Mass of Pilot		200	114.9		22,980	
Pax			145.1			
Baggage (75)			164.3			
Total Fuel in	lb	330	106.54	**MAC**	35,209	**Over by**
RM		**3,175**	**87.65**		**278,346**	
TOM		**3,172**	**87.64**		**278,026**	
ZFM		**2,845**	**85.46**		**243,137**	

Off Blk	15:50	15:55	T/O
On Blks	17:10	17:00	Lnd
Blocks	1:20	1:05	Airborne

Fwd CofG perf and spinning and hard rwy landing