CARSON HELICOPTERS INC.

S-61 Long Body Hover Performance Test Report

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Carson Helicopters Report, CHI 61-100

Prepared by:

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S-61 Long Body Hover Test Report

1. Introduction

A flight test program was conducted by Carson Helicopters to evaluate the improvement in hover performance of a long body S-61N when equipped with Carson composite main rotor blades. One objective of the tests was to provide flight data that could be used to develop new hover performance charts. Both in ground effect (IGE) and out of ground effect (OGE) tests took place at three different sites in order to obtain a range of density altitudes. The airports were Leadville, CO (LXV), Alamosa, CO (ALS) and Casa Grande, AZ (CGZ). Nominal density altitudes at these locations during the testing were 10400 ft, 7300 ft, 2400 ft, respectively. The aircraft used by Carson for these tests was a standard category S-61N, (line 25 of Sikorsky S-61 Configuration Summary), registration no. N15456 (C/N61826). The aircraft was equipped with Carson main rotor blades and optional fixed gear. The components of the aircraft are detailed in Appendix A. The aircraft is shown in Figure 1 taken at Casa Grande, AZ. In this flight program, a number of tests were conducted to evaluate the Category A and Category B performance in addition to the hover that are not discussed here. For some of the Cat A and B tests the retractable gear/sponson configuration was also flown. The hover performance was evaluated IGE at a 10 ft wheel height and OGE at a 100 ft wheel height. The IGE tests were conducted in free flight, using internal weights (400 lbs increments) that were off loaded to vary the weight of the aircraft. The OGE tests used the standard tethered hover technique. Note that because of safety concerns, the OGE hover testing is not conducted in the same manner as the IGE testing, in free flight with internal loading. Winds were monitored and test conditions used for chart development were those where the ambient wind was less than 3 kts. The nose of the aircraft was held into the wind, as is standard procedure for these tests.

All the hover performance tests were conducted with the aircraft in the fixed land gear configuration as shown in Figure 1. Primary data including torque of both engines and tether load cell reading were recorded via computer with record lengths of 6 to 8 seconds. Other variables of importance, e.g., fuel weight, were recorded on the pilot cards. Charlie Evans was the DER pilot. FAA personnel also flew a number of test points.

In the following, the following equivalents may be helpful:

1 % Torque (Q) = 24 HP at NR=100% and 1HP ≈ 5 lbs lift

Rotor speeds: (NR) = 100% = 203 rpm (tip speed = 659fps)
103% = 209 rpm (679 fps), 106% = 215 rpm (699 fps)

The complete test series took place during the period from 9/27/2006 until 3/08/2007.

2. Hover Test Schedule

The hover performance test schedule was as follows:

Leadville, CO

Flight #1 100 ft tether hover 9/27/06, time: 1646 to 1719
Flight #2 10 ft IGE hover 9/28/06 time: 0736 to 0918
Flight #7 10 ft IGE hover 9/30/06 (no data terminated due to wind)
Flight #11 FAA 10 ft IGE and OGE hover 10/02/06

Alamosa, CO

Flight #2 10 ft IGE hover 10/25/06 time: not recorded
Flight #6 100 ft tether hover 11/1/06 time 0735 to 0835
Flight #7* 100 ft tether hover 11/2/06 time: 1646 to 1719 (conducted at Leadville, CO, a repeat of Leadville #1)

Casa Grande, AZ

Flight #4 10 ft IGE hover 11/10/06 time: 1200 to 1254 (data invalid, repeated in #7 and #8)
Flight #6 100 ft tether hover 11/11/06 time: 0956 to 1050
Flight #7 10 ft IGE hover 01/18/07 time: 0801 to 0844
Flight #8 10 ft IGE hover 01/18/07 time: 1022 to 1120

* For Alamosa Flight #7 the aircraft was returned to Leadville, CO to repeat the OGE flight there (#1), due to concern about a discrepancy in the load cell readings. A replacement load cell of a different manufacturer had been installed prior to the Alamosa series of tests and was used for the remainder of the test program. Very good agreement between the data from these two flights, Leadville #1 and Alamosa #7 showed that the cockpit readout was in error and that the first load cell computer output was indicating the load correctly. The agreement between these flights is shown in Figure 2. The calibration problem was determined to be associated with the cockpit indicator. Cockpit

readings were not used in the data reduction process, although the readings are listed on the pilot cards. Note that computer recorded data were used for all data reduction and analysis.

3. Hover Test Results

The OGE tests were conducted at three rotor speeds (NR = 100%, 103%, and 106%). NR=100% corresponds to 203 RPM.

The data points obtained from each location during the OGE tests were (See pilot cards in Appendix B):

Leadville, CO #1	36
Alamosa, CO #6	54
Alamosa, CO #7(at Leadville)	44
Casa Grande, AZ #6	61

The total number of points is 195. The development of the OGE charts used a total of 96 of these data points. Since the new performance charts for the Carson blades charts were to be developed for NR = 100% and 103%, the NR = 106 % data generally were not included in the 96 points for the chart development. As the non-dimensional data did not show any significant trend with rotor speed as illustrated for example in Figure 3, the 100% and 103% data were combined to determine the power coefficient-weight coefficient (CP-CW) relationship. This result is to be expected due to the use of modern airfoils on the Carson rotor blades, the swept tip and the lower tip speed of the S-61 (Mtip = 0.59 at SLS conditions at NR=100%).

Points were selected from the total above based on the strength of the ambient wind (< 3 kts) and where the recorded time history of an event indicated a well established steady hover condition. Inconsistencies in the data sets and other relevant factors were used to eliminate some points from consideration. Figure 4 shows the 96 data points and the curve fit. As a check on the sensitivity of this result to the data point selection procedure, the 96 point (CP-CW) curve fit was compared to one using 186 points (9 from Leadville were not included). The difference was found to be 0.5% torque ($\approx$ 12 HP) or less depending upon the loading condition, well within the accuracy of the test measurements, and indicating that the selection did not introduce a significant bias in the result.

The IGE tests were also conducted at same three rotor speeds (Appendix B). Points obtained:

Leadville #2	60
Alamosa #2	39
Casa Grande #7	33

Casa Grande #8 30

Total points 162, with 132 used to develop charts.

Figure 5 shows the non-dimensional IGE results used to develop the corresponding IGE charts. As a consequence of the small effect of rotor speed illustrated in Figure 3, all three rotor speeds were used in the development of the IGE charts. This would tend to be conservative since any small effect of tip speed would tend to be unfavorable.

Comparing the IGE and OGE results, the increase in thrust at constant power IGE is consistent with other results reported in the literature.

4. Correlation with other sources

A recent hover flight test was conducted at the Carson Helicopters facility in August 2010. Both Sikorsky Aircraft (SAC) and Carson Helicopters made independent measurements of hover performance using a short body aircraft with land gear, N3173U, (C/N 61186) at the Carson Facility. This is a restricted category ex US Navy SH-3A, civil designation S-61A (line 2 of Sikorsky S-61 Configuration Summary), modified by AFC 314(Airframe Group-An Improved Tail Pylon and Tail Drive Shaft Group). This AFC modifies the pylon so the large tail rotor (10 ft 7.25 in diameter) can be incorporated and also replaces the small stabilizer (20 sq ft) with the large one (27 sq ft). AFC 314 was complied with via US Navy contract with Sikorsky and Carson installed the fixed landing gear via STC. Only hover OGE tests were made with this aircraft. The tests were conducted with an external load, rather than using a tether, the other alternative for hover OGE tests. Safety of flight considerations rule out the use of internal loading or other methods for OGE tests. Three different external loads were used (7260 lbs, 5198 lbs and 3160 lbs). The largest load was about 4 ft square in planform and suspended on a 105 ft cable. The aircraft was hovered such that the load was between 5 and 10 feet above the ground, so that the aircraft was at an AGL of 110 to 115 ft. With the external load in this location, no additional download would be encountered in hover.

This aircraft employed for these recent tests (N3173U) is very similar to the aircraft used by Carson for the flight tests that were used to develop the hover charts, described above (N15456). Both have fixed main gear and 10 ft 7.25 in. diameter tail rotors. The tail rotor moment arm measured from the main rotor shaft to the tail rotor shaft is 1 inch longer (FS 708.5) on N3173U than on N15456 (FS 707.5), the N model. The hub is at FS 267.5. One external difference may be noted, the vertical tail surface has a greater sweep angle on the modified A model (60°) than on the N model (45°). An aircraft similar to N3173U is shown in Figure 6. Component details for these two aircraft are provided in Appendix A. Two independent instrumentation packages were installed in the aircraft, one by SAC and the other by Carson. A tethered balloon flown at the altitude of the hovering aircraft was used to determine the ambient wind.

Three flights were made with Carson main rotor blades on the 9th, 10th and 19th of August 2010. One flight was made with metal blades, but the data was not considered satisfactory due to the wind conditions. An unconventional test technique was selected by SAC where each loading condition at evaluated at four relative wind angles (0°, 90°, 180°, and 270°. The standard technique is to conduct hover tests at one azimuth, 0° (nose into the wind).

A large number of data points were generated during the three days in which conditions were satisfactory for testing (ambient winds less than 3 knots). The use of all azimuth data tends to produce an apparent significant increase in power, even though the wind is less than 3 knots. This effect is shown in Figure 7 where the all azimuth data is shown with nose into the wind points identified. It can be seen that generally, the nose into the wind data indicates the lowest power. Restricting consideration to a comparison of nose into the wind data from this test program, using the data set recorded and reduced by SAC, excellent agreement with Carson long body data of Figure 1 is shown in Figure 8. The data of Figure 1 were of course taken by the standard method of hover testing with the aircraft nose into the wind.

4a. A Note on Fuselage Download

The long body fuselage planform area exposed to the main rotor downwash is increased by 29.5 sq ft (about a 10% increase) compared to the short body aircraft. In addition, the cockpit section is moved forward to a region of higher downwash. These changes would tend to reduce hover performance of the aircraft by increasing the fuselage download. Using an advanced rotor aerodynamics code to calculate the main rotor downwash distribution over the fuselage, and applying drag coefficients, the increase in download due to the increase in fuselage length is estimated by Carson to be 50-65 pounds (equivalent to roughly a10 HP increase) at SLS conditions at a gross weight of 20000 lbs. This result is similar to SAC download estimates.

Another organization, QinetiQ in the UK, has extensively tested the Carson blades for their use on Westland Sea Kings by the Royal Navy. Although they did little hover performance testing, they did report that the Carson blades produced 1760 lbs of additional lift in hover, comparable to that discussed below in the comparison section.

SAC/US Navy made a brief series of hover performance tests on a short body aircraft with Carson main rotor blades. This aircraft is an NVH-3A (Bu. no. 150614), modified to the VH-3D configuration (line 16 of Sikorsky S-61 Configuration Summary). There are a number of significant differences between this aircraft and the two described above. Adjustable trim tabs were added to the Carson blades outboard of the fixed tab (0.9R). Note that Carson Helicopters does not use adjustable tabs as seven years experience with

the blades has demonstrated that they are not required for tracking. The tabs are located far outboard on the trailing edge of the blade (from 0.90R to 0.95R) where they are likely to contribute a loss in main rotor efficiency. The tail rotor is of smaller diameter (10 ft 4 in). At high altitudes, the tip of the tail rotor blade is likely to be either stalled or very close to stall. The tail moment arm is 3 in less (FS 704.5) than on the N model. In addition, one main rotor blade was instrumented with strain gages whose lead wires were taped to the upper and lower blade surfaces increasing blade drag and reducing the rotor efficiency. In addition, an unconventional method of hover testing, described above, was used where measurements were made at four relative wind azimuths. The recent tests conducted in August of 2010 at the Carson facility also used this method. The penalty incurred by this approach is indicated in Figure 7 compared to the standard approach of using nose into the wind data. All of the above factors (added trim tabs, small tail rotor, instrumentation wires on one blade, and the method of testing) would be expected to contribute to a loss in performance. The poor efficiency of the small tail rotor is discussed in detail in "A Review of Tail Rotor Design and Performance", C.V. Cook, *Vertica*, Vol. 2 .

As a result of some controversy generated by the results of this flight test with Carson main rotor blades described in the paragraph immediately above related to the validity of the Carson long body charts, Carson Helicopters contracted an independent organization, Whipple Aviation Services, LLC to make a series of hover performance measurements with an S-61N. These results of the Whipple tests are shown on the Figure 9 along with the results of Figure 1. The few points agree very well with Carson data.

5. Comparison with Metal Blade Performance

The Carson blades give a significant improvement in hover performance compared to the standard metal blades. The performance increase is particularly evident at higher altitudes. Figure 10 compares the lifted weight vs. power at 6000 ft, 15° C for both sets of main rotor blades. The metal blade curve in the figure is derived from Figure 4-8 of Sikorsky Aircraft S-61N Flight Manual, SA 4045-82. The Carson blade curve is from the Carson Rotorcraft Flight Manual Supplement No.8, Figure 6. The lift increase produced by use of the Carson blades is shown to be 1700 lbs at 2200 HP at this atmospheric condition. This improvement increases with altitude and power.

The very good agreement of the data among these various sources supports the validity of the Carson flight test data and consequently the Carson long body charts derived from these tests.

6. Aircraft Details

The Carson test aircraft was an S-61N, with registration number N15456, C/N 61826 .

a.) Power Usage:

Electrical loading: 28v DC system. Current less than 40 amps (less than 2 HP)
Bleed air: no bleed air
Air conditioning: not installed
Heating setting: off
Engine de-ice setting: off

b.) Instrumentation

OAT: aircraft instrument
Pressure altitude: aircraft instrument
Engine temperature: aircraft instrument
Main rotor tachometer: aircraft instrument and a digital readout meter
AGL height measurement:
OGE: Aircraft AGL determined by the length of tether cable, 100 feet
IGE: Calibrated radar altimeter. The altimeter was calibrated for a 10 ft wheel height above ground by a line dropped to the ground.
Wind conditions: Tethered balloon at the height of the hovering aircraft, AWOS data and hand held anemometers

7. Calibrations

a.) Tether Load Cell Calibration

Two load cells were used in the long body flight test program. Carson personnel conducted the calibrations. The first calibration took place on 9/20/06 prior to initial tether hover testing at Leadville, CO on 9/27/06. The results are shown in Figure 11. There was concern about the performance of this load cell due to a difference between the cockpit reading and computer output. As a consequence, the unit used in Leadville was replaced with a different model after the Leadville tests as noted above. The replacement was calibrated on 10/30/06, prior to the first Alamosa tether hover test on 11/1/06. This load cell was used for this and all succeeding tests. This calibration is shown in Figure 12. As a result of a possible problem associated with the operation of the load cell used in Leadville Flight #1, this OGE hover test was repeated on 11/2/06 with this new load cell. The test results from this flight (denoted above as Alamosa #7) agreed very well with Leadville #1 as shown in Figure 2.

Generally, the computer results using these calibrations showed that the cockpit readouts showed a larger load than indicated from the computer.

b.) Torque Calibration

The engine torques are determined by pressure measurements in the torque indicating system. In the flight test programs described above, pressure transducers were installed at suitable locations for each engine in the Engine Torque Indicating System. See Sikorsky Aircraft S-61N Maintenance Manual, SA 4045-80, pps. 201-206 for a description of the system. The relationship between the system oil pressure and indicated torque of the engine is given in Figure 202 on page 206. This is the standard method of engine torque measurement used by SAC. The calibration curves for engines #1 and #2 are shown in Figures 13 and 14.

8. Figures

Figure 1: Carson Flight Test Aircraft, Long Body S-61N, 2006/2007

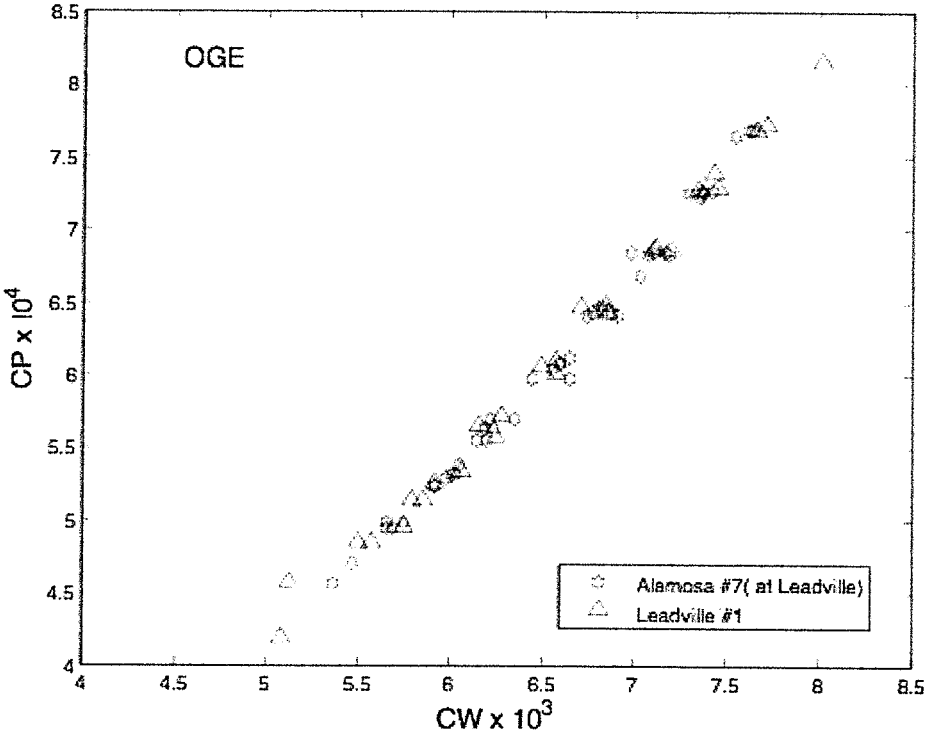

Figure 2: Comparison of Flight Test Results at Leadville Using Two Different Load Cells

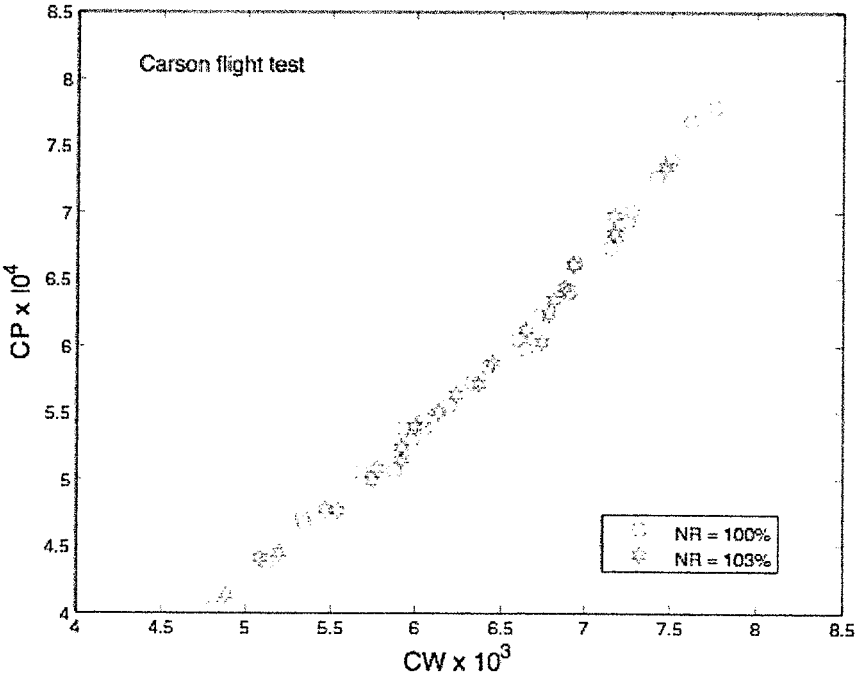

Figure 3: Effect of Rotor Rotational Speed on S-61N Hover Performance with Carson Blades

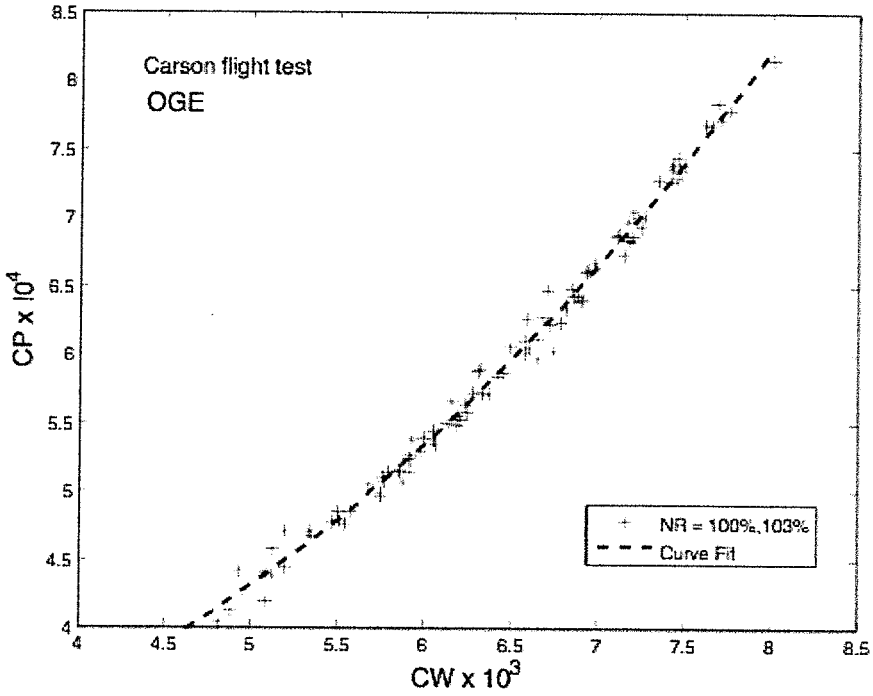

Figure 4: Hover Performance Data OGE and CP-CW Curve Fit used for Chart Development with Carson Blades

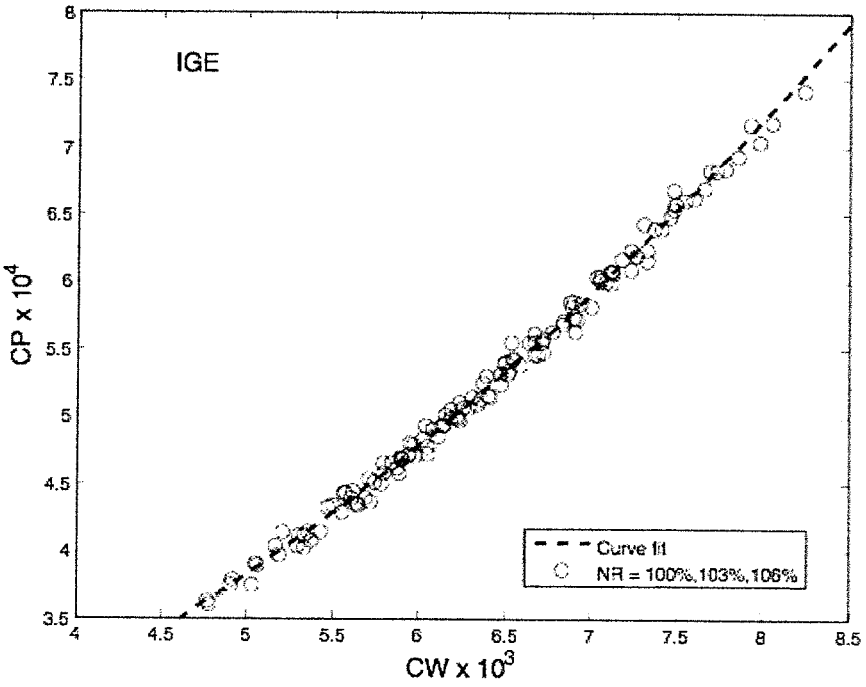

Figure 5: Hover Performance Data, IGE and CP-CW Curve Fit used for Chart Development with Carson Blades

Figure 6: Carson/SAC Flight Test Aircraft, August 2010

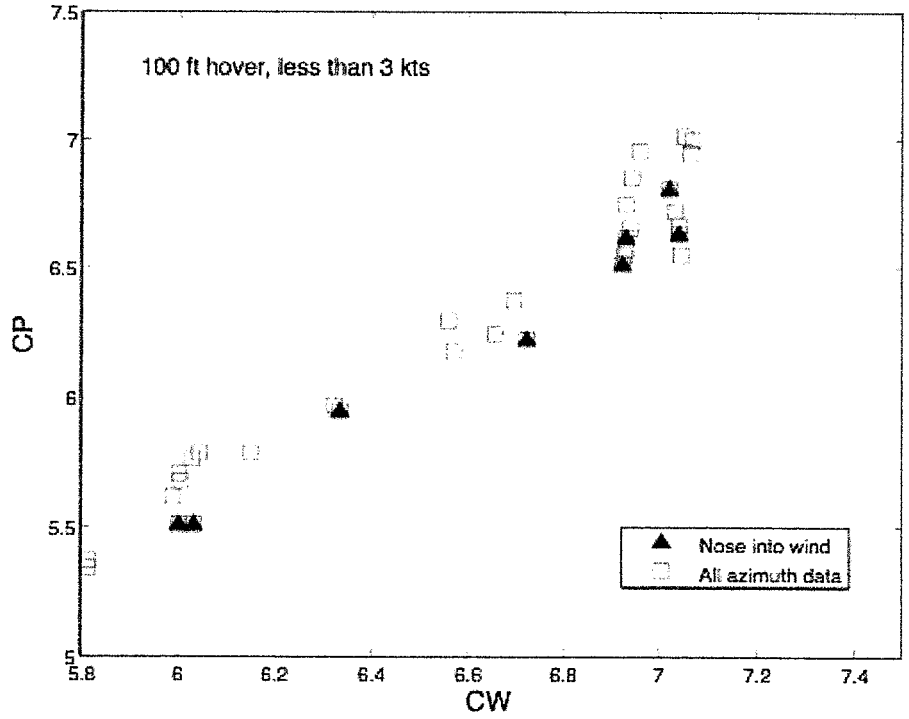

Figure 7: Effect of Wind Azimuth on Hover Performance. Wind Less Than 3 kts

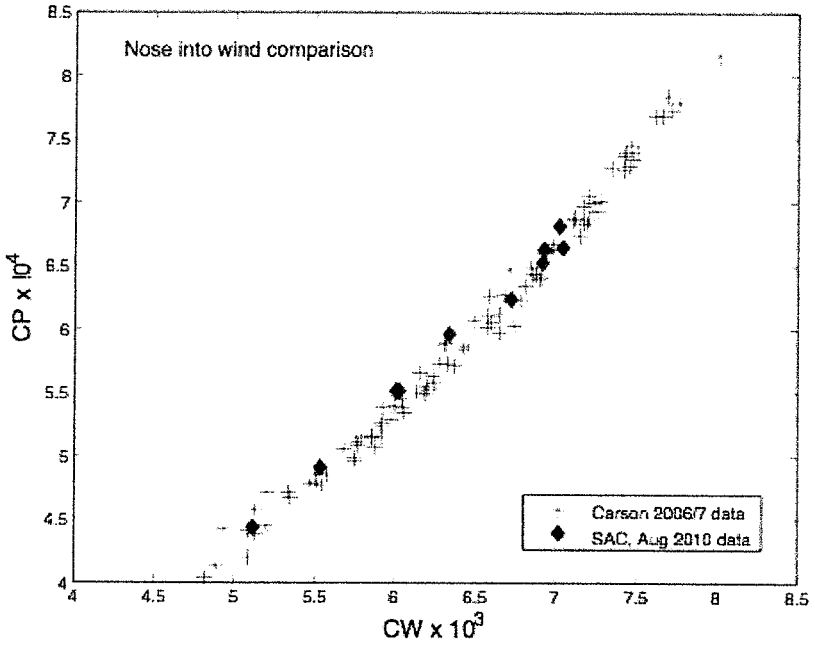

Figure 8: Comparison of Nose into Wind Data, Carson 2006/7 and SAC 2010 Flight Test

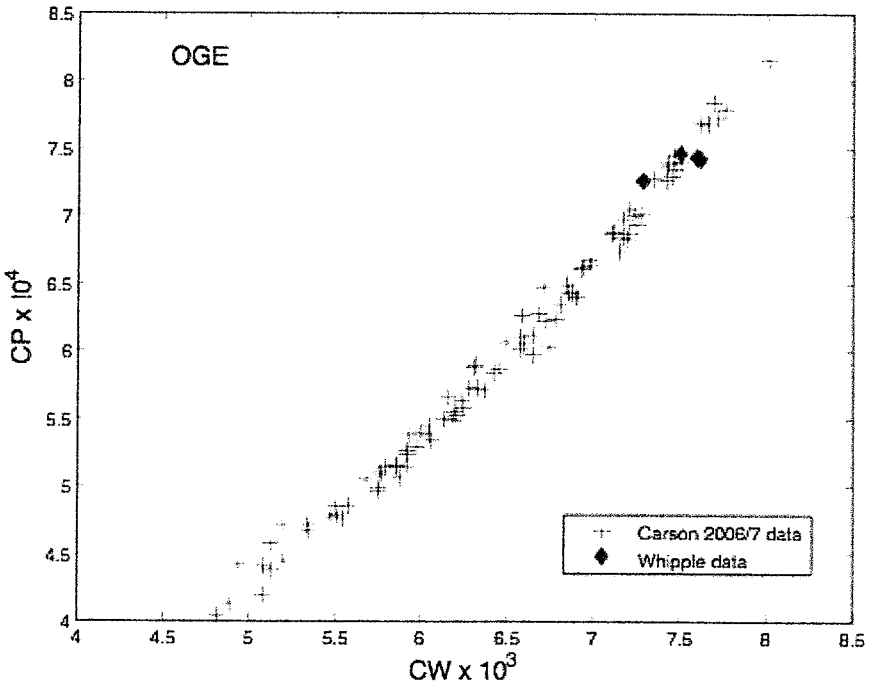

Figure 9: Comparison of Carson Flight Test 2006/7 with Whipple Test 2010

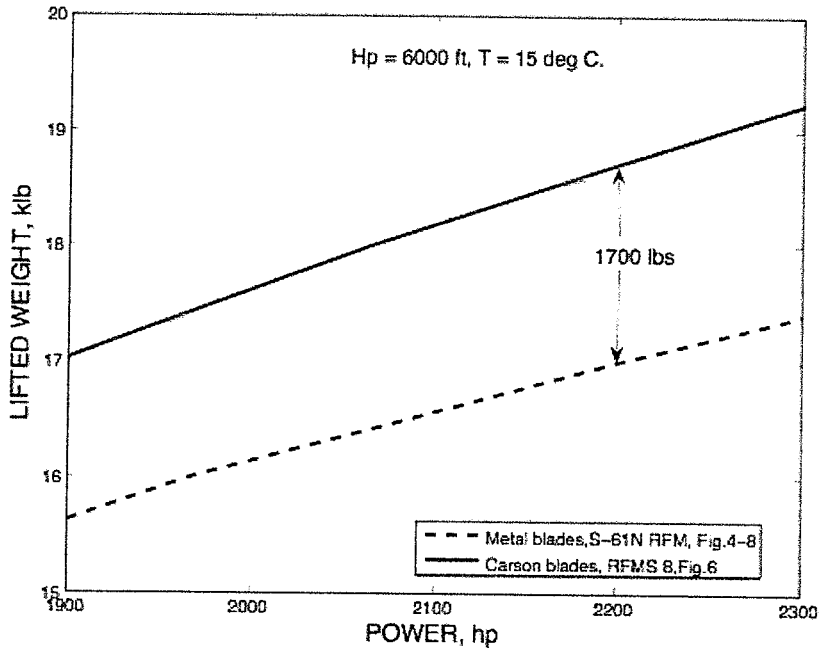

Figure 10: Comparison of S-61N Performance with Carson Blades and Metal Blades Derived from Performance Charts

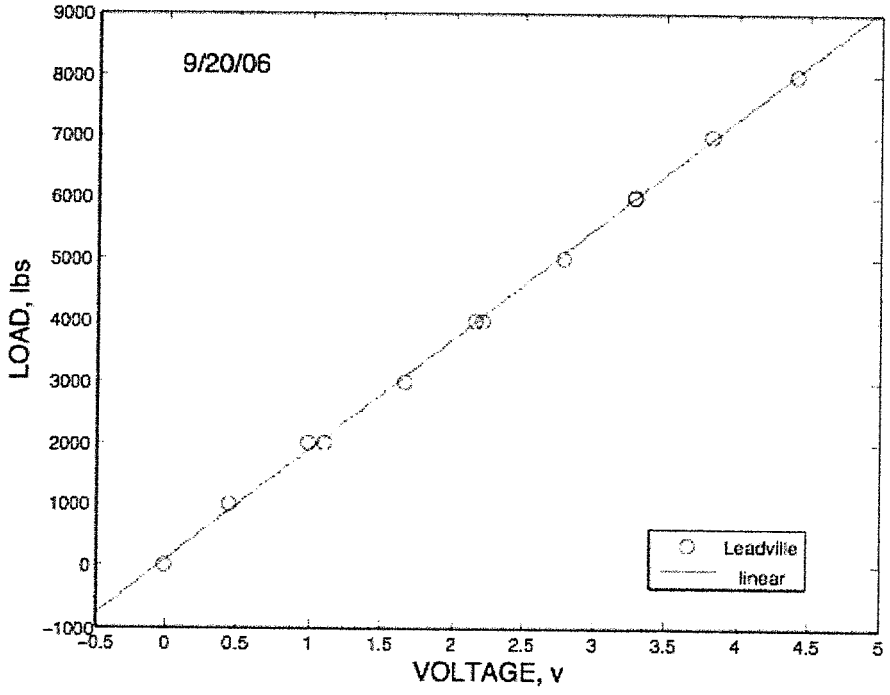

Figure 11: First Load Cell Calibration, Leadville, CO

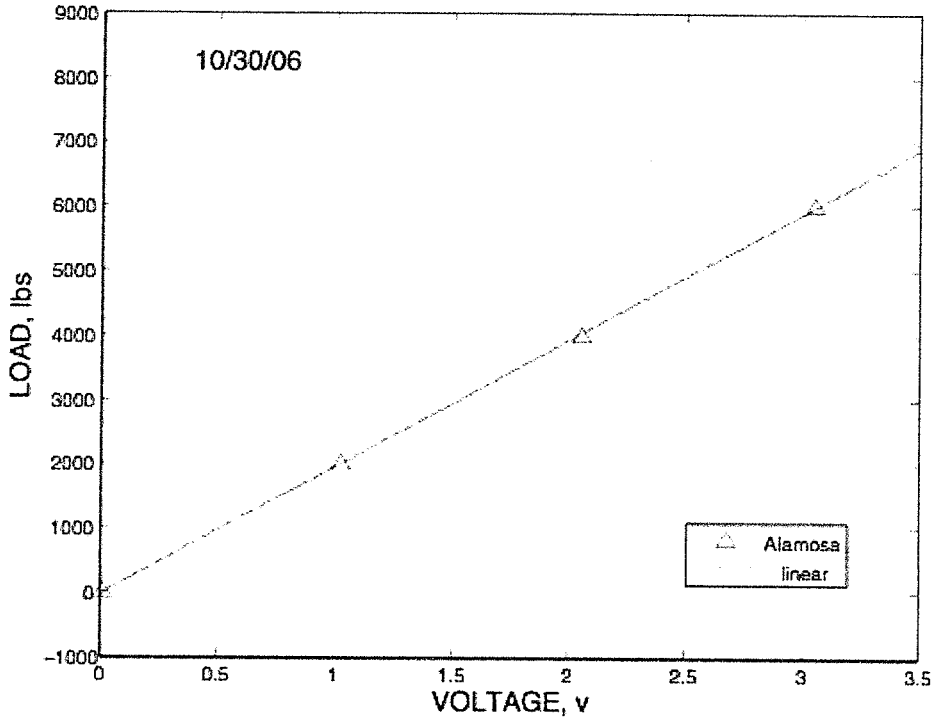

Figure 12: Second Load Cell Calibration, Alamosa, CO

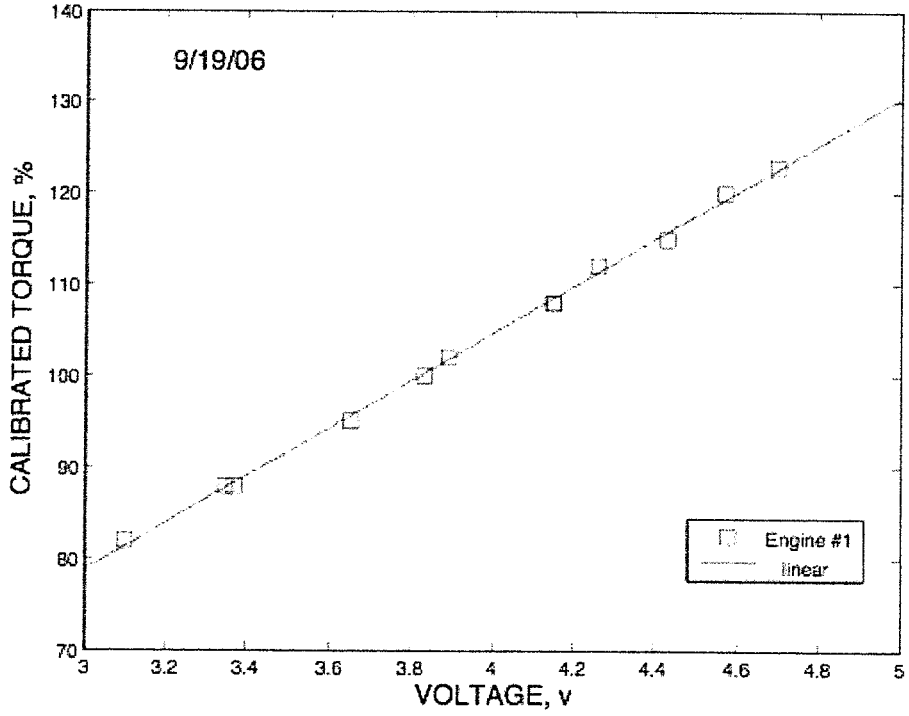

Figure 13: Engine #1 Torque Calibration

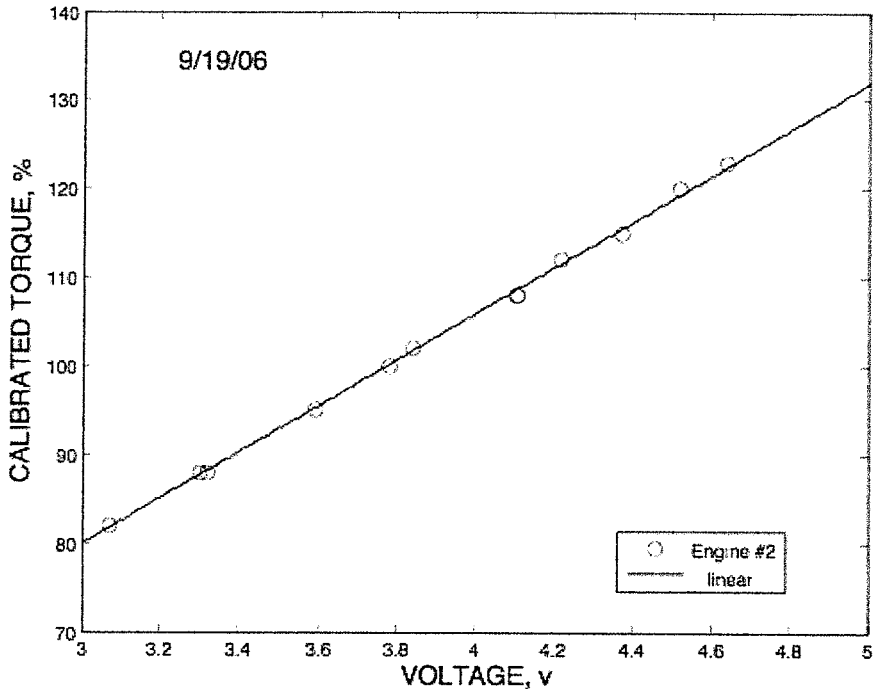

Figure 14: Engine #2 Torque Calibration.

Appendix A

Aircraft Components

This appendix identifies certain components installed in the two aircraft employed in flight tests described above.

N15456(C/N 61826)

Engines: CT58-140-1, no modifications
Engine accessories:
Anti Ice Valve: 4025T87P03
Accessory Gearbox: 5001T90G06
Start Bleed Valve: 4003T62P04
Exciter: 370400347P101,Flow Divider: 4003T68G04
Fuel Control: 725725-5
Fuel Pump: 5003T42P02
Centrifugal Filter: 4005T01P03
Oil Pump: 4000T98P02

Pilot Valve: 4920T00G05
Tachometer Generator Nf: 32005-007
Tachometer Generator Ng: TG255-002
Main Transmission: S6135-20600-039

Main Transmission accessories:
AC generator (2ea.): 28B135-145AM
DC Generator: 30E20-97A
Tachometer Generator: GEU7A
Primary Hydraulic Pump: 66WAP200-1
Auxiliary Hydraulic Pump: 66WAP200-2

Drive Line components:
Intermediate Gear Box: S6135-66300-002
Tail Gear Box: S6135-66600-043

No Major alterations on this aircraft
External configuration:
Engine Air Inlet Screens were installed (Bird Screens) S61N optional
S6130-80179-002 Engine air Inlet duct installed
Flown with both fixed landing gear and Sponsons
Long Fuselage Aircraft

Tail Rotor Blades: S6117-30101-045
Bifilar: S6112-23039-017
Pitch Beam: S6135-66705-1
Pylon Assembly: S6120-76265-1
Stabilizer Assembly: S6120-76150-71

N3173U (C/N 61186)

All components of this aircraft are the same as N15456 as listed above except as follows:

Intermediate Gear Box: S6135-66100-041
Pitch Beam: S6135-66705-041
Pylon Assembly: 61200-66001-42
Stabilizer Assembly: S6120-76150-76

Engine Air Inlet Screens were installed (Bird Screens)
Flown with fixed landing gear
Short Fuselage Aircraft

Appendix B

Pilot Cards, Weight and Balance Statements

The pilot cards and weight and balance statements are contained in this Appendix. Note that the listed values in the cards of average engine torque and load cell tether tension should serve only as guidelines. The true values of these quantities as determined by the calibrations in Appendix A and calculated as averages over the recording time by a computer were used to develop the CP-CW relationship for the aircraft charts.

FLT #1

ATTN: JERRY WASHCALUS.
ALL FILES ARE 8 SECONDS

Flight No 1 of 1

A/C N15455 CG _____ GW 13706 DATE 9.26.06

Fwd Fuel ~~675~~ 700 HCC Aft Fuel ~~650~~ 700 HCC

Location Leadville OAT -2 PA 9480 9500 FlightTime 48 mins

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rory/Rob

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
	60	0	106	650	600	✓	4		1
	65	1250	106	625	575	✓	4	T 90 P 60	2
	70	2000	106	600	600	✓	3	T 100 P 60	3
	75	3250	106	600	550	✓	3	T 100 P 60	4
	80	4000	106	575	550	✓	3	T 100 P 60	5
	85	4400	105.5	550	500	✓	3	T 100 P 60	6
	90	5600	105	550	500	✓	3	T 100 P 60	7
	95	6800	105	550	500	✓	3	T 100 P 60	8
	60	0	106	550	500	✓	3	T 100 P 60	9
	60	0	103	550	500	✓	3	T 100 P 60	10
	65	1000	103	500	475	✓	3	T 100 P 60	11
	70	1700	103	500	475	✓	+4	T 105 P 60	12
	75	2750	103	500	475	✓	+4	T 105 P 60	13
	80	3700	103	500	475	✓	4	T 105 60	14
	85	4750	103	475	450	✓	4	105 60	15
	90	~~5500~~ 5500	103	475	450	✓	4	105 60	16
	95	6600	103	475	450	✓	4	105 60	17
	60	0	103	450	400	✓	4	T 105 P 60	18
	60	0	100	450	400	✓	4	T 105 P 60	19
	65	1200	100	425	400	✓	4	105 60	20
	70	2000	100	425	375	✓	4	105 60	21

[redacted]

100 ft tethered hover

Flight No 1 pg 2

A/C N15456 CG _____ GW 13706 DATE 9/26/06

Fwd Fuel (End) 360 Aft Fuel 200

Location Lenduith OAT +4 PA 9500 FlightTime 48 mins

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rory / Rod

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

				Fuel					
Torque	Load Cell	NR	FWD	AFT	W@ <3KTS	OAT/PA	TRNS T@P		EVENT
75	3000	100	425	350	✓	+3 9600	105	60	22
80	3900	100	415	350	✓	+3 9400			23
85	4700	100	415	350	✓	+3 9600			24
90	5200	100	400	350	✓	+3 9600	105	60	25
95	6400	100	400	350	✓	+3 9600			26
60	0	100	375	325	✓	+3 9600	105	60	27
60	0	106	375	300	✓	+3 9600	105	60	28
65	2000	106	350	300	✓	+3 9600	105	60	29
70	3100	106	350	300	✓	+3 9600	105	60	30
75	3700	106	325	300	✓	+3 9600	110	60	31
80	4900	106	325	300	✓	+3 9600	110	60	32
85	5600	106	325	275	✓	+3 9600	112	60	33
90	6600	106	300	275	✓	+3 9600	112	60	34
95	7000	105	300	250	✓	+3 9600	112	60	35
55	+100	106	300	250	✓	+3 9600	112	60	36
→			300	200					

LEADVILLE FLIGHT 1	WEIGHT	ARM	MOMENT
N15456	11420	264.29	3018191.8
PILOT	230	88.6	20378
TEST PILOT	204	88.6	18074.4
FLIGHT LOG PERSON	285	128.5	36622.5
COMPUTER OPERATOR	167	201	33567
FWD FUEL	700	203.9	142730
AFT FUEL	700	305.9	214130
A/C TOTAL WEIGHT	13706	254.1728951	3483693.7

FLT #2

ATTN: Jerry

17535

Flight No 2 pg 1

A/C N16456 CG _____ GW 18515 DATE 9/28/06

Fwd Fuel ~~675~~ 1015 Hee Aft Fuel ~~675~~ 1250 Hee

start 7~~36~~
end 918

Location Leadville, Co OAT -3 PA 9450 FlightTime 1.8

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Ron / Rod

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 10 Foot Free Flight Hover

Fuel

Torque	WT Reduction	NR	FWD	AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
82		~~107~~	990	1250	2.2	-3	95/60	1
80		106	990	1250	2.2	-3	98/60	2
~~82~~ 83		100	950	1225	3.2	-3 9450	100/60	3
79		106	950	1200	✓	-3 9450	102/60	4
83		103	925	1175	✓	-3 9450	100/60	5
84		100	900	1175	✓	-2 9450	110/60	6
77	400#	106	900	1150	1.9 ✓	-2 9450	100/60	7
~~80~~		103	900	1150	✓	-2 9440	100/60	8
80		100	875	1125	✓	-2 9440	101/60	9
77		105	875	1125	✓	-2 9440	110/60	10
77		103	850	1100	✓	-2 9440	112/60	11
80		100	825	1100	✓	+2 9440	112/60	12
74	400#	106	800	1075	✓	+3 9440	112/60	13
75		103	800	1050	✓	+3 9440	115/60	14
77		100	800	1050	✓	+3 9440	115/60	15
73		106	775	1050	✓	+3 9440	115/~~58~~ 59	16
75		103	775	1025	✓	+3 9440	115/58	17
76		100	750	1025	✓	+3 9440	115/58	18
70	400#	106	750	1000	✓	+3 9440	105/60	19
71		103	725	975	✓	+3 9440	105/60	20
73		100	700	950	✓	+3 9440	105/60	21

18515

[redacted]

ATTN. Jerry

Flight No 2 pg 2

A/C N16468 CG _____ GW 18515 DATE 9/28/06

Fwd Fuel _____ Aft Fuel _____

Location Leadville, Co OAT _____ PA _____ FlightTime 1.8

Crew: Pilot Bob Bord Test pilot Charlie Evans Computer Operator Rory/Rod

Aircraft Configuration S81N Composite Blades Long Body Fixed Gear

Test Description 10 Foot Free Flight Hover

Torque	WT Reduction	NR	FWD	AFT	WG <3KTS	OAT/PA	TRNS TQP	EVENT
			Fuel					
72		106%	700	950	✓	+3 9440	105/60	22
70		103	700	950	✓	+3 9440	105/60	23
72		100	675	950	✓	+3 9440	110/60	24
68	400#	106	675	950	✓	+3 9440	105/60	25
67		103	650	925	✓	+3 9440	110/60	26
70		100%	650	925	✓	+3 9440	112/60	27
66		106	650	900	✓	+3 9440	110/60	28
68		103	650	900	✓1.0-1.5	+3 9440	110/60	29
69		100	650	900	✓	+3 9440	105/60	30
65	400#	106	600	875	✓	+5 9440	105/60	31
65		103	600	875	✓	+5 9440	105/60	32
65		100	600	875	✓	+5 9440	105/60	33
64		106	575	875	✓1.0-1.5	+5 9440	105/60	34
66		103	575	850	✓	+5 9440	105/60	35
67		100	575	850	✓	+5 9440	105/60	36
62	400#	106	550	850	✓	+5.5 9440	105/60	37
63		103	550	825	✓	+5.5 9440	105/60	38
63		100	550	825	1.5-2.0	+5.5 9440	105/60	39
61		106	525	800	✓	+5.5 9440	105/60	40
62		103	525	800	✓	+5.5 9440	105/60	41
64		100	525	800	✓	+5.5 9440	105/60	42

Flight No 2 pg 3

A/C N15456 CG _____ GW 18515 DATE 9/28/06

Fwd Fuel _____ Aft Fuel _____

Location Leadville, Co OAT _____ PA _____ FlightTime 1.8

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod / Rod

Aircraft Configuration S81H Composite Blades Long Body Fixed Gear

Test Description 10 Foot Free Flight Hover

Torque	WT Reduction	NR	Fuel FWD	Fuel AFT	WOB <3KTS	OAT/PA	TRNS T@P	EVENT
59	400#	105%	500	750	✓	5.5 9440	110/60	43
60		103	500	750	✓	5.5 9440	111/61	44
62		100	500	750	✓	5.5 9440	111/60	45
58		106	500	725	1.5	5.5 9440	110/60	46
59		103	475	725	✓	5.5 9440	110/60	47
60		100%	475	725	✓	5.5 9440	110/60	48
50	400#	106	450	700	✓ 2.5-3.0	6 9440	110/60	49
57		103	450	675	CALM	6 9440	110/60	50
58		100	425	675	✓	6 9440	110/60	51
57		106	425	675	✓	6 9440	110/60	52
57		103	425	675	✓ 5?	6 9440	110/60	53
57		100	400	650	✓	6 9440	110/60	54
53	550#	106%	400	650	✓	6 9440	110/60	55
53		103	375	650	3.5	6 9440	110/60	56
54		100	375	650	✓	6.5 9440	111/60	57
53		106	350	625	2.5-3.0	6.5 9440	112/60	58
54		103	350	625	✓	6.5 9440	112/60	59
55		100%	350	600	2.0-4.0	6.5 9440	112/60	60

End Fuel Fwd 350 AFT 600 924 AM

Flight No 2 Page 1 of 2

A/C N1545B CG _____ GW 20507 DATE 10-25-06

Gross Weight Includes this fuel Fwd Fuel 640 Aft Fuel 1260

Location Alamosa, CO. OAT 2° PA 7480 FlightTime _____

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 10 Foot Free Flight Hover

Fuel Remaining

Torque	WT Reduction	NR	FWD	AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
90		106	620	1240			90°/60	1
91		103	600	1200				2
93		100	590	1190				3
87	400	106	580	1170	<1	2/7480	92°/60	4
88		103	560	1140				5
90		100	550	1150				6
82	400	106	530	1120	<3		94°/60	7
85		103	520	1120				8
87		100	510	1110				9
80	400	106	500	1100	<2		96°/65	10
81		103	480	1090				11
84		100	460	1070				12
77	400	106	460	1060	3	2/7480		13
80		103	450	1050				14
82		100	450	1040				15
75	400	106	430	1030	4	3/7480		16
76		103	420	1020	<3			17
77		100	420	1020				18
72	400	106	400	1000				19
74		103	380	980	2			20
76		100	370	970				21

Flight No 2 Page 2 of 2

A/C N1548S CG _____ GW _____ DATE 10·25·06

Gross Weight Includes this fuel ENDING Fwd Fuel 240 ENDING Aft Fuel 720

Location Alamosa, Co. ENDING OAT 4° PA 7480 FlightTime _____

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod Boad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 10 Foot Free Flight Hover

Fuel Remaining

	Torque	WT Reduction	NR	FWD	AFT	WD <3KTS	OAT/PA	TRNS T@P	EVENT
	70	400	106	360	1060	< 2		99/50	22
*	72		103	360	950				23
	73		100	350	950				24
	66	400	106	340	940		4/7480	98/55	25
*	68		103	330	930				26
	70		100	320	920				27
	64	400	106	310	910				28
	66		103	300	890			98/55	29
	67		100	290	890				30
	61	400	106	290	890				31
	63		103	280	880				32
	64		100	270	870				33
	60	400	106	260	860	< 3			34
	61		103	260	840			98/55	35
	62		100	250	820				36
	57	400	106	240	780	< 3			37
	58		103	240	760	calm		98/60	38
	60		100	240	740		4/7480		39

FLT 2 10 FT hover

N15458	WEIGHT	ARM	MOMENT
N15458 ALS CO	11420	264.29	3016191.8
PILOT	230	88.6	20378
TEST PILOT	204	88.6	18074.4
FLIGHT LOG PERSON	175	128.5	22487.5
COMPUTER OPERATOR	285	201	57285
FWD FUEL	640	203.9	130496
AFT FUEL	1260	305.9	385434
STA 128.5		128.5	0
Net-Tie down straps floor mat	131	203.9	26710.9
BALLAST (30in) 2.5ft x 6ft fl3000	700	203.9	142730
Net-Tie down straps floor mat	131	266	34846
BALLAST (42in) 3.5ft x 6 ft fl4200	4150	266	1103900
Net-Tie down straps floor mat	131	305.9	40072.9
BALLAST (30in) 2.5ft x 6ft fl3000	1050	305.9	321195
Net-Tie down straps floor mat		440	0
BALLAST C16 aft cg		440	0
A/C TOTAL WEIGHT	20507	259.5114595	5321801.5
		700/25=28	
CG=258		1050/25=42	
		4150/25=166	

ATTN GERRY 1047

1

Flight No 6

A/C N15456 CG _____ GW 13714 DATE 11/1/06

Gross Weight Includes this fuel Fwd Fuel 700 Aft Fuel 700

Start - 7:35
End - 8:00
Total Flight Time 1.1

Location Alamosa, CO. OAT -3 PA 7300

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod / Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
SLP	60	150	106	650	650	0	-2/7400	85/65	1
	65	1030	106	640	640	0	-2/7400		2
	70	1720	106	630	630	0	-2/7400		3
	75	2680	106	630	620	0	-2/7400		4
	80	3630	106	620	610	0	-2/7400		5
	85	4100	106	620	610	0	-2/7400	90/60	6
	90	5250	106	610	600	0	-2/7400		7
	95	5650	106	600	590	0	-2/7400		8
	100	—	106	No	Good	0	-2/7400	95/55	9
	100	6620	106	580	560	0	-2/7400		10
SLP	57	150	103	570	550	0	-2/7400		11
	65	1220	103	560	540	2-3	-2/7400		12
	70	2450	103	560	530	2-3	-1/7400	95/55	13
	75	3050	103	550	530	0	-1/7400		14
	80	3970	103	540	520	0	-1/7400		15
	85	4800	103	540	510	0	-1/7400		16
	90	5240	103	530	510	0	-1/7400		17
	95	5900	103	520	500	0	-1/7400	98/50	18
	100	6740	103	510	490	0	-1/7400		19
SLP	60	150	100	500	480	0	-1/7400		20

Flight No 6

A/C N15486 CG _____ GW 13714 DATE 11/1/06

Gross Weight includes this fuel Fwd Fuel _____ Aft Fuel _____ Total Flight Time 1.1

Location Alamosa, CO. OAT _____ PA _____

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod / Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
65	1400	100	500	470	3	-1 / 7400	98/50	21
70	1920	100	490	460	0	-1 / 7400		22
75	2910	100	490	450	0	-1 / 7400		23
80	3700	100	480	450	0	-1 / 7400		24
85	4320	100	470	430	0	-1 / 7400		25
90	5380	100	460	420	0	-1 / 7400	98/50	26
95	5940	100	450	410	3-5	-1 / 7400		27
100	6590	100	440	410	4	0 / 7400		28

Flight No 6

A/C N15466 CG _____ GW 13714 DATE 11/1/06

Gross Weight includes this fuel Fwd Fuel 700 Aft Fuel 700 Start - 8:00 End - 8:30

Location Alamosa, CO. OAT _____ PA _____ Total FlightTime 1.1

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod / Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
SCP	60	150	106	400	390	0	-1 / 7400	98/50	29
	65	1730	106	400	390	0	-1 / 7400		30
	70	2500	106	390	380	0	-1 / 7400		31
	75		106	390	380	2-3	-1 / 7400		32
	75	3500	106	390	370	4-5	-1 / 7400		33
	80	4320	106	380	360	0	-1 / 7400		34
	85	5280	106	380	360	0	-1 / 7400	100/50	35
	90	6020	106	370	340	0	-1 / 7400		36
	95	7040	106	360	330	0	-1 / 7400		37
	100	7620	106	360	320	0	-1 / 7400		38
SCP	58	150	103	350	310	0	-1 / 7400		39
	65	1720	103	340	300	0	-1 / 7400		40
	70	2500	103	340	300	0	0 / 7400		41
	75	3480	103	330	290	0	0 / 7400	100/50	42
	80	3840	103	320	280	0	0 / 7400		43
	85	4900	103	320	270	0	0 / 7400		44
	90	5880	103	310	260	<2	0 / 7400		45
	95	6480	103	300	250	0	0 / 7400		46
	100	6980	103	290	250	0	0 / 7400	100/50	47

Flight No 6

A/C N15456 CG _____ GW 13714 DATE 11/1/06

Gross Weight includes this fuel ENDING Fwd Fuel 210 ENDING Aft Fuel 180

Location Alamosa, CO. ENDING OAT 2 PA 7300 Total FlightTime 1.1

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod / Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@<3KTS	OAT/PA	TRNS T@P	EVENT
SLP	57	150	100	280	230	0	0/7400	100/50	48
	65	1660	100	280	230	0	0/7400	100/50	49
	70	2620	100	270	220	0	0/7400	100/50	50
	75	3040	100	260	220	0	0/7400	100/50	51
	80	3960	100	250	210	0	0/7400	100/50	52
	85	4650	100	240	210	0	1/7400	100/50	53
	90	5320	100	240	200	2-3	1/7400	100/50	54
	95	6100	100	230	200	0	1/7400	100/50	55
	100	6680	100	220	190	0	1/7400	100/50	56
0	20	0	103	210	180	0	2/7300	100/50	57

FLT6 Alamosa CO 11/1/06	WEIGHT	ARM	MOMENT
N15456	11420	264.29	3018191.8
PILOT	230	88.6	20378
TEST PILOT	204	88.6	18074.4
FLIGHT LOG PERSON	175	128.5	22487.5
COMPUTER OPERATOR	285	201	57285
FWD FUEL	700	203.9	142730
AFT FUEL	700	305.9	214130
A/C TOTAL WEIGHT	13714	254.7233994	3493276.7

Flight No 7 (ALAMOSA #7 at LEADVILLE) HCC

A/C N15456 CG _____ GW 14014 DATE 11/2/06

Start: 4:46
End: 5:19

Gross Weight includes this fuel Fwd Fuel 850 Aft Fuel 850

Location ~~Alamosa~~ Leadville, CO. OAT 0 PA 9610 FlightTime .6

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
SLP	62	14	106	840	830	0	0/9710		1
G	65	65	106	840	830	0	0/9710		2
	70	168	106	830	820	0	0/9710	80/58	3
	75	255	106	820	810	0	0/9710		4
G	80	315	106	820	810	0	0/9710		5
	85	360	106	810	800	0	0/9710		6
G	90	415	106	800	790	0	0/9710	88/58	7
	95	520	106	790	790	0	0/9710		8
	~~100~~		~~106~~	~~790~~	~~780~~	~~0~~	~~0/9710~~		
SLP	62	15	103	780	770	0	0/9710		9
	65	52	103	780	770	0	0/9710		10
G	70	138	103	770	760	0	0/9710	90/56	11
G	75	250	103	770	760	0	0/9710		12
	80	297	103	760	750	0	0/9710		13
G	85	368	103	750	740	0	0/9710		14
	90	405	103	750	730	0	0/9710		15
	95	467	103	740	720	0	0/9710	95/50	16

Flight No 7

A/C N15456 CG [illegible] GW 14014 DATE 11/2/06

Gross Weight includes this fuel Fwd Fuel _____ Aft Fuel _____

Location Leadville, CO. OAT _____ PA _____ FlightTime _____

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

Fuel

	Torque	Load Cell	NR	FWD	AFT	W@ <3KTS	OAT/PA	TRNB T@P	EVENT
SLP	63	15	100	730	710	0	0/9710	95/50	17
	65	42	100	730	710	0	0/9710		18
	70	154	100	720	700	0	0/9710		19
G	75	222	100	720	700	0	0/9710		20
	80	289	100	710	690	0	0/9710		21
G	85	338	100	710	690	0	0/9710	98/50	22
	90	384	100	710	690	0	0/9710		23

Flight No 7

A/C N15458 CG _____ GW 14014 _____ DATE 11/2/06

Gross Weight includes this fuel Fwd Fuel _____ Aft Fuel _____

Location ~~Alamosa~~ Leadville, CO. OAT _____ PA _____ FlightTime _____

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

Fuel

	Torque	Load Cell	NR	FWD	AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
SLP	60	15	106	700	680	0	0/9710		24
	65	110	106	700	670	0	0/9710	98/50	25
G	70	188	106	690	660	0	0/9710		26
	75	237	106	690	660	0	0/9710		27
	80	340	106	680	660	0	0/9710		28
	85	404	106	680	650	0	0/9710		29
G	90	478	106	670	640	0	0/9710		30
SLP	62	14	103	670	640	0	0/9710		31
	65	77	103	660	640	0	0/9710		32
	70	150	103	660	630	0	0/9710		33
G	75	242	103	650	630	0	0/9710	99/60	34
	80	288	103	650	620	0	0/9710		35
83	~~85~~	366	103	640	620	0	0/9710		36
	90	448	103	640	620	0	0/9710		37

Flight No 7

A/C N16456 CG _____ GW 14014 _____ DATE 11/2/06

Gross Weight includes this fuel — ENDING Fwd Fuel 580 — ENDING Aft Fuel 550

Location Leadville, CO. OAT _____ PA _____ FlightTime _____

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
SLP	62	15	100	630	610	0	0/9710	99/50	38
	65	56	100	630	610	0	0/9710		39
	70	128	100	620	600	0	0/9710		40
G	75	200	100	620	600	0	0/9710		41
	80	275	100	610	590	0	0/9710		42
G	85	346	100	610	580	0	0/9710		43
	90	397	100	600	570	0	0/9710		44
O	30	0	100	580	550	0	0/9710	98/50	45

ALAMOSA 7

FLT7 Leadville CO 11/2/06	WEIGHT	ARM	MOMENT
N15456	11420	264.29	3018191.8
PILOT	230	88.6	20378
TEST PILOT	204	88.6	18074.4
FLIGHT LOG PERSON	175	128.5	22487.5
COMPUTER OPERATOR	285	201	57285
FWD FUEL	850	203.9	173315
AFT FUEL	850	305.9	260015
A/C TOTAL WEIGHT	14014	254.72718	3569746.7

Flight No 6

A/C N15456 CG _____ GW 14314 DATE 11/11/06

Gross Weight includes this fuel Fwd Fuel 1000 Aft Fuel 1000 9:56 10:50

Location Casa Grande, AZ. OAT 18 PA 1400 FlightTime (.9)

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
O									
SLP	60	12	106	980	950	1-2	19/1500	98/50	1
	65	142	106	930	900	1-2	19/1500	100/50	2
	70	222	106	920	900		19/1500	100/50	3
	75	330	106	920	890		19/1500	100/50	4
GP	80	407	106	910	880		19/1500	100/50	5
GP	85	525	106	900	870		19/1500	100/50	6
GP	90	570	106	890	860		19/1500	100/48	7
GP	95	670	106	880	860		19/1500	100/48	8
GP	100	730	106	870	850		19/1500	100/48	9
GP	103	798	106	860	840		19/1500	102/45	10
SLP	61	15	103	860	840		19/1500	102/45	11
	65	60	103	850	830		19/1500	102/45	12
	70	184	103	845	825		19/1500	102/45	13
	75	284	103	840	820		19/1500	102/44	14
	80	360	103	835	815		19/1500	102/44	15
GP	85	446	103	830	810		19/1500	102/43	16
GP	90	538	103	825	805		19/1500	102/42	17
	95	620	103	820	800	↓	19/1500	102/42	18
GP	100	662	103	815	795	1-2	19/1500	102/42	19
GP	103	740	103	810	790	1-2	19/1500	102/42	20

Flight No 6

A/C N15456 CG _____ GW 14314 DATE 11/11/06

Gross Weight includes this fuel Fwd Fuel 1000 Aft Fuel 1000

Location Casa Grande, AZ. OAT 18 PA 1400 FlightTime _____

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
SLP	62	13	100	790	760	1	19/1500	102/42	21
	65	112	100	785	755	1	19/1500	102/42	22
GP	70	157	100	780	750		20/1540	102/42	23
	75	235	100	775	745	↓	20/1540	102/42	24
	80	349	100	770	740	1-2	20/1540	102/42	25
	85	466	100	765	735		20/1540	102/42	26
	90	555	100	760	730		20/1540	106/42	27
	95	627	100	755	725	↓	20/1540	106/42	28
	100	720	100	750	720	1	20/1540	106/42	29
LP	103	746	100	740	710	1	20/1540	106/42	30

Flight No 6

A/C N15456 CG _____ GW 14314 DATE 11/11/06

Gross Weight includes this fuel Fwd Fuel 1000 Aft Fuel 1000

Location Casa Grande, AZ OAT 18 PA 1400 FlightTime _____

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
SLP	60	14	106	720	690	2	20/1540	108/42	31
GP	65	134	106	715	685		20/1540	108/42	32
	70	310	106	710	680		20/1540	108/42	33
	75	395	106	710	670		20/1540	108/42	34
	80	450	106	705	660		20/1540	108/42	35
GP	85	565	106	700	650		20/1540	108/42	36
	90	584	106	695	645		20/1540	108/42	37
	95	680	106	690	640		20/1540	108/42	38
	100	808	106	685	635	↓	20/1540	108/42	39
	103	800	106	680	630	1-2	20/1540	108/42	40
LP	58	14	103	670	620	1-2	20/1540	108/42	41
	65	154	103	660	610		20/1540	108/42	42
	70	248	103	650	600		20/1540	108/42	43
	75	360	103	645	595		20/1540	109/40	44
SP	80	438	103	640	590		20/1540	109/40	45
	85	520	103	635	580		20/1540	109/40	46
	90	628	103	630	570		20/1540	109/40	47
SP	95	748	103	620	560		20/1540	109/40	48
	100	770	103	610	550		21/1550	109/40	49
	103	751	103	600	540	↓	21/1550	109/40	50
							~~21/1550~~	~~109/40~~	

Flight No 6

A/C N15456 CG _____ GW 14314 DATE 11/11/06

Gross Weight includes this fuel Fwd Fuel 1000 Aft Fuel 1000

Location Casa Grande, AZ. OAT 18 PA 1400 FlightTime _____

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod / Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 100 Foot Tethered Hover

	Torque	Load Cell	NR	Fuel FWD	Fuel AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
SLP	59	13	100	590	530	1-2	21/1550	109/40	51
	65	132	100	580	525	1	21/1550	109/40	52
	70	231	100	570	520	↓	21/1550	109/40	53
	75	330	100	565	515	↓	21/1550	109/40	54
	80	460	100	560	510	↓	21/1550	109/40	55
	85	514	100	550	500	2	21/1550	109/40	56
	90	533	100	540	490	2	21/1550	109/40	57
	95	626	100	535	475	1-2	21/1550	109/40	58
	100	764	100	530	460	↓	22/1550	110/40	59
	103	770	100	520	450	↓	22/1550	110/40	60
LP	59	12	100	520	450	↓	22/1550	110/40	61

20984

7700
13284

1030

13284

21502

21422

CASA GRANDE 6

FLT6 Casa Grande AZ 11/11/06	WEIGHT	ARM	MOMENT
N15456	11420	264.29	3018191.8
PILOT	230	88.6	20378
TEST PILOT	204	88.6	18074.4
FLIGHT LOG PERSON	175	128.5	22487.5
COMPUTER OPERATOR	285	201	57285
FWD FUEL	1000	203.9	203900
AFT FUEL	1000	305.9	305900
A/C TOTAL WEIGHT	14314	254.730802	3646216.7

Flight No 07 Page 1 of 2

A/C N15468 CG _____ GW 20407 DATE 18 JAN 07

Gross Weight Includes this fuel Fwd Fuel 900 Aft Fuel 900 8:02 8:44

Location Casa Grande OAT 1 PA 1500 FlightTime .7

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rad/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 10 Foot Free Flight Hover

Fuel Remaining

Torque	WT Reduction	NR	FWD	AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
82		106	850	840	calm	1	90/55	1
84		103	840	830		1	90/55	2
85		100	830	820		1	90/55	3
80	400	106	810	800		1	90/50	4
82		103	800	790		1	95/50	5
83		100	790	780	calm	1	95/50	6
84		100	780	770		1	95/50	7
78	400	106	770	760		1	95/50	8
78		103	760	750		1	95/50	9
80		100	750	740		1	95/50	10
77		106	740	730		1	95/50	11
75	400	106	720	710	calm	2	95/50	12
75		103	715	705		2	95/50	13
77		100	710	700		2	95/50	14
71	400	106	700	690		2	95/50	15
73		103	695	685		2	95/50	16
74		100	690	680		2	95/55	17
71	400	106	680	660		2	95/55	18
72		103	670	655		2	95/55	19
73		100	660	650	calm	2	95/55	20
							/	[redacted]

2045

Flight No [redacted]07 Page 2 of 2

A/C N1845S CG _____ GW 20407 DATE 18 JAN 07

Gross Weight Includes this fuel Fwd Fuel 900 Aft Fuel 900

Location Casa Grande OAT 1 PA 1500 FlightTime .7

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration 881N Composite Blades Long Body Fixed Gear

Test Description 10 Foot Free Flight Hover

Fuel Remaining

Torque	WT Reduction	NR	FWD	AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
66	400	106	650	640	calm	2	95/55	21
67		103	645	630		2	95/55	22
68		100	640	620		2	95/55	23
66	400	106	630	610		2	95/50	24
66		103	620	600		2	95/50	25
68		100	610	590		2	95/50	26
64	400	106	600	580		2	95/50	27
65		103	595	575	calm	2	95/50	28
65		100	590	570		2	95/50	29
61	400	106	580	550		2	95/50	30
63		103	575	545		2	96/50	31
63		100	570	540		2	96/50	32
59	400	106	560	530		2	96/50	33
60		103	550	520		2	97/50	34
61		100	545	510	calm	2	97/50	35

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[redacted]

N15456 FWD CG 258	WEIGHT	ARM	MOMENT
N15456 CGZ AZ	11420	264.29	3018191.8
PILOT	230	88.6	20378
TEST PILOT	204	88.6	18074.4
FLIGHT LOG PERSON	175	128.5	22487.5
COMPUTER OPERATOR	285	201	57285
FWD FUEL	900	203.9	183510
AFT FUEL	900	305.9	275310
STA 128.5		128.5	0
Net-Tie down straps floor mat	131	203.9	26710.9
BALLAST (30in) 2.5ft x 6ft fl3000	700	203.9	142730
Net-Tie down straps floor mat	131	266	34846
BALLAST (42in) 3.5ft x 6 ft fl4200	4150	266	1103900
Net-Tie down straps floor mat	131	305.9	40072.9
BALLAST (30in) 2.5ft x 6ft fl3000	1050	305.9	321195
Net-Tie down straps floor mat		440	0
BALLAST C16 aft cg		440	0
A/C TOTAL WEIGHT	20407	257.9845886	5264691.5
		700/25=28	
CG=258		1050/25=42	
		4150/25=166	

Casa Grande, AZ

1/18/07

IGE Hover FL 07

To: Jerry Washcalus. 1045.

Flight No 08 PAGE 1 OF 2

A/C N15456 CG _____ GW 22321 DATE 18 JAN 07

Gross Weight includes this fuel Fwd Fuel 1200 Aft Fuel 1200 10:22 11:20

Location Casa Grande OAT 7 PA 1500 FlightTime 1.0

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 10 Foot Hover - External Load Combination

Fuel Remaining

Torque	WT Reduction	NR	FWD	AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
101	LEFT 10 KTS	106	1150	1150	1-2	7	100/50	1
99	RIGHT 10 KTS	106	1140	1140	1-2	7	100/50	2
101	REAR 5 KTS	106	1130	1130		7	100/45	3
93		106	1120	1110		8	100/45	4
93		103	1115	1105		8	100/45	5
96		100	1110	1100		8	100/45	6
89	400	106	1060	1050		8	100/45	7
91		103	1050	1040		8	110/45	8
91		100	1040	1030		8	110/45	9
87	400	106	1000	980		9	110/45	10
89		103	990	970		9	110/45	11
90		100	980	960		9	110/45	12
83	400	106	950	930	↓	10	110/45	13
85		103	940	920	2-3	10	110/45	14
87		100	930	910		10	110/45	15
82	400	106	910	890		10	110/45	16
84		103	900	880		10	110/45	17
85		100	890	870		10	110/45	18
81	400	106	870	850		11	110/45	19
82		103	860	840		11	110/45	20
83		100	850	830	↓	11	110/45	21

* Events 1, 2, 3 are controllability.

30 ft

Flight No 08 PAGE 2 OF 2

A/C N15456 CG _____ GW 22321 DATE 18 JAN 07

Gross Weight includes this fuel Fwd Fuel 1200 Aft Fuel 1200

Location Casa Grande OAT 7 PA 1500 FlightTime 1.0

Crew: Pilot Bob Boyd Test pilot Charlie Evans Computer Operator Rod/Brad

Aircraft Configuration S61N Composite Blades Long Body Fixed Gear

Test Description 10 Foot Hover - External Load Combination

Fuel Remaining

Torque	WT Reduction	NR	FWD	AFT	W@ <3KTS	OAT/PA	TRNS T@P	EVENT
79	400	106	830	810	2-3	11	110/45	22
80		103	820	800		11	110/45	23
81		100	810	790		11	110/45	24
76	400	106	790	770		12	105/45	25
77		103	780	760		12	105/45	26
77		100	770	750		12	105/45	27
74	400	106	750	730		12	105/45	28
76		103	740	720	↓	12	105/45	29
75		100	730	710	2-3	12	105/45	30

40/5

FL 08 Casa Grande 18 JAN 07

N15456 MID CG	WEIGHT	ARM	MOMENT
N15456	11420	264.29	3018191.8
PILOT	230	88.6	20378
TEST PILOT	204	88.6	18074.4
FLIGHT LOG PERSON	175	128.5	22487.5
COMPUTER OPERATOR	285	201	57285
FWD FUEL	1200	203.9	244680
AFT FUEL	1200	305.9	367080
EXTERNAL LOAD	2020	267	539340
Net-Tie down straps floor mat		203.9	0
BALLAST (30in) 2.5ft x 6ft		203.9	0
Net-Tie down straps floor mat	131	266	34846
BALLAST (42in) 3.5ft x 6 ft	3300	266	877800
Net-Tie down straps floor mat	131	305.9	40072.9
BALLAST (30in) 2.5ft x 6ft	2025	305.9	619447.5
A/C TOTAL WEIGHT	22321	262.5188432	5859683.1
		3300/25=132	
		2025/25=81	

FL 08 CASA Grande, AZ 18 JAN 07

Controllability + IGE [redacted] 22321

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