ELECTRICAL LOAD ANALYSIS

G500H

BELL 206A/B

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Garmin Ltd. or its subsidiaries
c/o Garmin International, Inc.
1200 E. 151st Street
Olathe, KS 66062

Company Proprietary Information

Garmin Ltd. or its subsidiaries
c/o Garmin International, Inc.
1200 E. 151st Street
Olathe, Kansas 66062 U.S.A.

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1 INTRODUCTION

1.1 Purpose of Document

The purpose of this electrical load analysis (ELA) is to document electrical loads for the G500H system as installed for this STC. This ELA will show the following:

1) The total change in power consumption after the alteration is negligible and does not exceed the capacity of the electrical power generation and distribution system of the aircraft under foreseeable operating conditions.
2) The aircraft systems can be supported by the generator during normal operation.

2 APPLICABLE DOCUMENTS

Bell Helicopter, BHT-206A/B-Series-MM, Bell model 206A/B series Maintenance Manual

Garmin International, Document No. 190-01150-06, G500H Installation Manual

Garmin International, Document No. 005-C0577-00, G500H Flight Display System STC Installation Master Drawing List (MDL)

2.1 Applicable Regulations

This analysis will show compliance to the following regulations:

1) 14 CFR 27.1351(a) Amdt. 27-13

3 SYSTEM DESCRIPTION

The Bell 206A/B is equipped with a 28 VDC electrical system. The generator furnishes regulated power for all DC electrical circuits of the helicopter. Generator output is transferred to the main bus when a minimum of 24 VDC is achieved.

The Starter-generator is located on the underside of the engine to the right of helicopter centerline. This unit is used to start the engine, charge the battery, and supply power for operation of DC equipment. Power is stored in the 24 Volt battery.

The DC generator power capacity at 30 VDC is as follows:

105 Amps—continuous operation
170 Amps—2 minutes
200 Amps—5 seconds

The generator is rated at 150 Amps, but is derated to 105 Amps for this installation. Refer to Figure 3-1 for a simplified diagram of the Bell 206A/B Electrical power system.

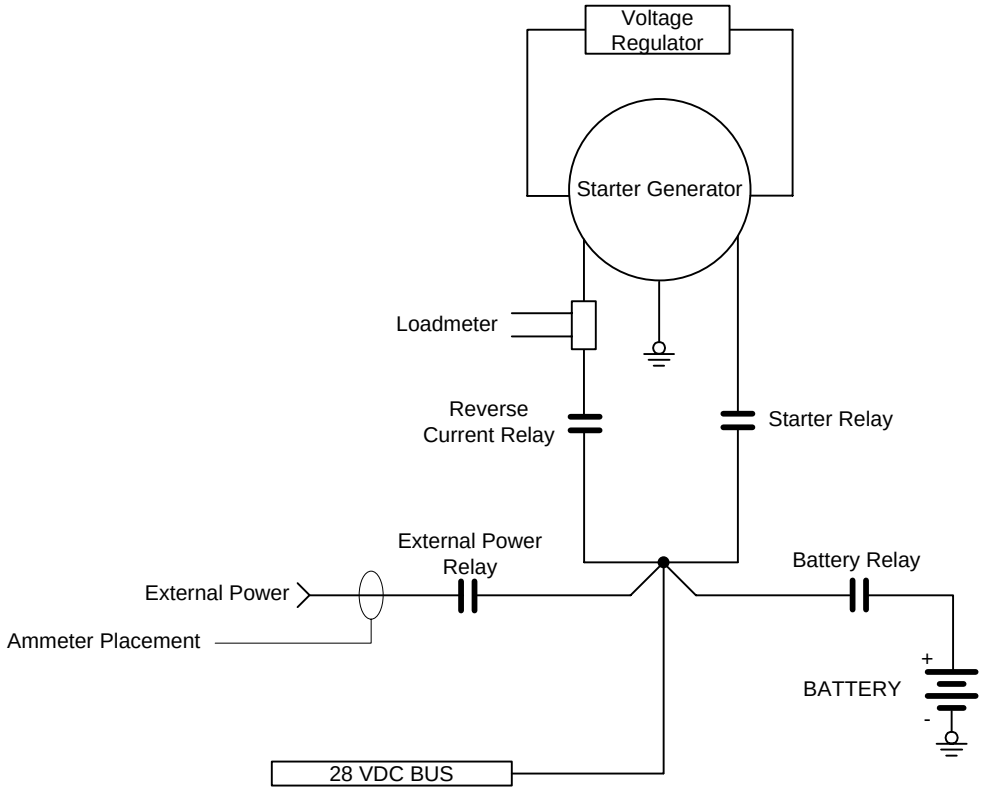

Figure 3-1. Bell 206A/B Electrical Power System

3.1 Electrical Load Analysis

An electrical load analysis (ELA) must be completed on the Bell 206 A/B rotorcraft prior to installation to verify that the rotorcraft electrical system is capable of supporting the additional electrical load of the G500H system. The purpose of the ELA is to show compliance with FAR 27.1351(a). As part of the G500H installation it must be shown that the maximum electrical system demand does not exceed the DC power generating system capacity. The results of the ELA must be recorded on FAA Form 337. There are several approaches that can be taken, as described in the following sections. For each approach, use the following values for computation:

LRU	28 Volt Current Draw	
	Typical	Maximum
GDU 620	1.9 A	2.7 A
GRS 77H/GMU 44	300 mA	1.0 A [1]
GDC 74H/GTP 59	200 mA	235 mA

[1] Maximum current draw occurs momentarily at startup or when the supply voltage drops to 9 VDC.

Table 3-1. G500H LRU Current Requirements

3.2 Bell 206A/B with Existing Electrical Load Analysis

If there is an existing ELA for the rotorcraft, this must be updated to reflect the modification. It must show that the generator has adequate capacity to supply power to the modified systems in all anticipated conditions. Add the loads outlined above to the existing analysis and ensure that the generator capacity is not exceeded under all anticipated operating conditions.

The Bell 206A/B Maintenance manual contains load values which cover the basic rotorcraft electrical loads and the more common electrical kits and avionics equipment. The ELA is used to ensure that the DC power generating system will not exceed its designed capacity during all in-flight conditions. If additional electrical or avionics equipment is installed in the helicopter beyond what is covered in the existing ELA, be sure to obtain appropriate electrical load data for the installed equipment and add it to the ELA. Ensure the electrical load limits will not be exceeded with the installation of the G500H system.

3.3 Aircraft without Existing Electrical Load Analysis

If no ELA is present in the aircraft records, prior to undertaking a complete electrical load analysis, the net change to the electrical load resulting from the G500H system installation should be determined. The results of this analysis will determine how to proceed further.

3.3.1 Electrical Load is Reduced Following Modification

In many instances when older systems are replaced with newer equipment, the electrical load presented to the power system is reduced. If the overall load on the electrical system is reduced as a result of the G500H modification (as shown in the following example), no further analysis is required – this assumes that the electrical system was within all limits prior to the G500H installation. The amended electrical load calculation must be included with the FAA Form 337 to document the electrical load reduction.

Items **removed from** aircraft:	**Electrical Load (Amps)**
KI 256 Horizon Indicator (ADI)	0.76
KI 525A Pictorial NAV Indicator (HSI)	0.36
KG 102A Directional Gyro	3.00
KA 51B Slaving Accessory [3]	0.00
Shadin ADC 200	1.30
SUB TOTAL:	5.42

Items **added to** aircraft:	
Garmin GDU 620 (PFD/MFD Display)	1.90
Garmin GRS 77H (AHRS) / GMU 44 (Magnetometer) [4]	0.30
Garmin GDC 74H (Air Data Computer) / GTP 59 (OAT Probe)	0.20
SUB TOTAL:	2.40

NET CHANGE IN BUS LOAD (NEW BUS LOAD - OLD BUS LOAD): **-3.02**

Notes/Assumptions:

1. All LRU load values listed are typical continuous current draw in Amps at 28VDC
2. It is assumed that the removed and added loads listed in this example continuously consume power in all phases of flight.
3. Received power from KG 102A, which was also removed. The load for the KA 51B included as part of the KG102A load.
4. Maximum current draw of 1.0 amps at 28 VDC occurs momentary at startup or when the supply voltage drops to 9 VDC. For the purposes of this analysis, the published typical current draw load value of 0.300 amps at 28VDC is used.

Table 3-2. Sample Net Electrical Load Change Calculation

3.3.2 Electrical Load is increased Following Modification

If it is determined that the electrical load has increased, a complete electrical load analysis must be performed to show that the capacity of the generator is sufficient for the additional electrical load. For guidance on preparing an ELA, refer to ASTM F 2490-05 Standard Guide for Aircraft Electrical Load and Power Source Capacity Analysis. Alternatively, the loads under various operating conditions may be measured, as described in Section 3.4.

3.4 Performing an Electrical Load Analysis by Measurement

Many aircraft do not have an existing load analysis. If the installation of the G500H increases the overall load, an electrical load measurement must be performed.

Either an in-circuit or clamp-on ammeter can be used for current measurement. The instrument used must be capable of reading current to the nearest 0.5 A, or better. Use the following procedure for the electrical load check:

1. Using the electrical load tabulation form provided in Table 3-3, compile a list of electrical loads on the aircraft (generally, this is a list of circuit breakers and circuit breaker switches). Refer to the example in Table 3-4. Table 3-3 is partially filled in with the standard equipment installed in the Bell 206A/B. Note that any loads/circuit breakers that are installed in the aircraft and not listed in Table 3-3 must be added to the load check for each specific helicopter installation.
2. Identify whether each load is *continuous* or *intermittent*.
3. Using the worst-case flight condition, identify whether each load is used in a particular phase of flight for normal operation. If some loads are mutually exclusive and will not be turned on simultaneously (e.g. pitot heat and air conditioning), use only those loads for the worst-case condition.
4. Insert/attach the ammeter at the external power source to the master relay circuit as shown in Figure 3-1(this will eliminate errors due to the charging current drawn by the battery).
5. Ensure that all circuit breakers are closed.
6. Apply external power to the aircraft. **The voltage of the power source should be set to the nominal aircraft voltage (usually 27.5 VDC for the Bell 206A/B).**
7. Ensure Battery Master switch is off to prevent battery charge current from being read.
8. Set the lighting as described below. These settings will be used for every current measurement that follows.
    - All instrument panel and flood lights should be set to maximum brightness.
    - The GDU 620 backlight should be set to 50% brightness.
    - Any other displays with a backlight should be set to 50% brightness.
    - The GPS navigator backlight should be set to 50% brightness.
9. Using the tabulation completed below, switch on all *continuous* electrical loads that are used for the **Start/Warmup** phase and record the current that is measured by the ammeter under the 'MEASURED VALUE' line in table 3-3.
10. Switch on all *continuous* electrical loads that are used for the **Takeoff** phase of flight and record the current that is measured by the ammeter under the 'MEASURED VALUE' line in table 3-3.
11. Switch on all *continuous* electrical loads that are used for the **Cruise** phase of flight and record the current that is measured by the ammeter under the 'MEASURED VALUE' line in table 3-3.
12. Switch on all *continuous* electrical loads that are used for the **Landing** phase of flight and record the current that is measured by the ammeter under the 'MEASURED VALUE' line in table 3-3.
13. Using the values measured and recorded, complete the ELA using the blank form in Table 3-3. Verify that the maximum demand does not exceed the generator data plate rating.

Date: _____ **Electrical Load Measurement** Tail No.:_____

		Normal Operation			
		Start and Warmup	Takeoff	Cruise	Landing
Circuit/ System	Operating Time	Used in this phase of flight?	Used in this phase of flight?	Used in this phase of flight?	Used in this phase of flight?
ELT	*Intermittent*	❑	❑	❑	❑
LDG LT	*Continuous*	❑	❑	❑	☒
INST LT	*Continuous*	☒	☒	☒	☒
COCKPIT LT	*Continuous*	☒	☒	☒	☒
CAUTION LT	*Continuous*	☒	☒	☒	☒
TOT IND	*Continuous*	☒	☒	☒	☒
FUEL BOOST AFT	*Continuous*	☒	☒	☒	☒
FUEL BOOST FWD	*Continuous*	☒	☒	☒	☒
FUEL QTY PRESS	*Continuous*	☒	☒	☒	☒
FUEL VALVE	*Intermittent*	❑	❑	❑	❑
ENG XMSN TEMP IND	*Continuous*	☒	☒	☒	☒
HYD BOOST	*Continuous*	☒	☒	☒	☒
GOV CONT	*Continuous*	☒	☒	☒	☒
IGN ENG	*Intermittent*	❑	❑	❑	❑
START ENG	*Intermittent*	❑	❑	❑	❑
ENG HEAT	*Intermittent*	❑	❑	❑	❑
POS LT	*Continuous*	☒	☒	☒	☒
ANTI COLL LT	*Continuous*	☒	☒	☒	☒
GEN FIELD	*Continuous*	☒	☒	☒	☒
GEN RESET	*Intermittent*	❑	❑	❑	❑
GDU 620 PFD/MFD	*Continuous*	☒	☒	☒	☒
GRS 77H AHRS	*Continuous*	☒	☒	☒	☒
GDC 74H ADC	*Continuous*	☒	☒	☒	☒
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑

Table 3-3. Bell 206A/B Electrical Load Tabulation Form Sheet 1 of 2

Date: ______________ **Electrical Load Measurement (cont'd)** Tail No.:______________

		Normal Operation			
		Start and Warmup	Takeoff	Cruise	Landing
Circuit/ System	Operating Time	Used in this phase of flight?	Used in this phase of flight?	Used in this phase of flight?	Used in this phase of flight?
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
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		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
		❑	❑	❑	❑
MEASURED VALUE					
Generator Rating (Continuous)	**105**	**105**	**105**	**105**	**105**
Percent of generator Capacity Used:					

Table 3-3. Bell 206A/B Electrical Load Tabulation Form Sheet 2 of 2

Date: XX/XX/2010 **Electrical Load Measurement** Tail No.: NXXXX

		Normal Operation			
		Start and Warmup	Takeoff	Cruise	Landing
Circuit/ System	Operating Time	Used in this phase of flight?	Used in this phase of flight?	Used in this phase of flight?	Used in this phase of flight?
ELT	*Intermittent*				
LDG LT	*Continuous*				X
INST LT	*Cont*	X	X	X	X
COCKPIT LT	*Cont*	X	X	X	X
CAUTION LT	*Cont*	X	X	X	X
TOT IND	*Cont*	X	X	X	X
FUEL BOOST AFT	*Cont*	X	X	X	X
FUEL BOOST FWD	*Cont*	X	X	X	X
FUEL QTY PRESS	*Cont*	X	X	X	X
FUEL VALVE	*Intermittent*				
ENG XMSN TEMP IND	*Cont*	X	X	X	X
HYD BOOST	*Cont*	X	X	X	X
GOV CONT	*Intermittent*				
IGN ENG	*Intermittent*				
START ENG	*Intermittent*				
LOAD IND	*Cont*	X	X	X	X
ENG HEAT	*Intermittent*				
POS LT	*Cont*	X	X	X	X
ANTI COLL LT	*Cont*	X	X	X	X
GEN FIELD	*Cont*	X	X	X	X
GEN RESET	*Intermittent*				
CARGO HOOK	*Intermittent*				
PITOT HEAT	*Cont*	X	X	X	X
GDU 620 PFD/MFD	*Cont*	X	X	X	X
GRS 77H AHRS	*Cont*	X	X	X	X
GDC 74H ADC	*Cont*	X	X	X	X
NAV 1 (GNS 530W main)	*Cont*	X	X	X	X
COM 1 (GNS 530W com)	*Cont (Rx)*	X	X	X	X
NAV 2 (GNS 430W main)	*Cont*	X	X	X	X
COM 2 (GNS 430W com)	*Cont (Rx)*	X	X	X	X
AUDIO (GMA 347)	*Cont*	X	X	X	X
XPDR (GTX 330)	*Cont*	X	X	X	X
DATA LINK (GDL 69A)	*Cont*	X	X	X	X
TOTAL		**26 Amps**	**26 Amps**	**26 Amps**	**32 Amps**
Generator Rating (Continuous)		**105**	**105**	**105**	**105**
Percent of Generator Capacity Used:		**24.8%**	**24.8%**	**24.8%**	**30.5%**

Table 3-4. Example of Completed Electrical Load Tabulation Form for Bell 206A/B

Assumptions:

1. Motor load demands are shown for steady state operation and do not include inrush current draw.
2. Measured loads using a calibrated clamp-on DC ammeter on the Aux power cable.
3. Intermittent loads are not accounted for, as these loads will be absorbed by the battery.

3.5 Pass/Fail Criteria

For a Bell 206A/B G500H installation, the following must be shown:

1. The electrical bus load must not exceed 105 Amps under continuous operating conditions.
2. For a 2 minute duty cycle, the bus load must not exceed 170 Amps.
3. For a 5 second duty cycle, the bus load must not exceed 200 Amps.

If the limits outlined above are exceeded, alternate FAA approval is required for installation of the G500H equipment.

4 SUMMARY

The analysis above demonstrates the following statements to be true:

1. The generator capacity is sufficient with the addition of the G500H system equipment in accordance with § 27.1351 (a) Amdt. 27-13.
2. This STC contributes no significant change to the existing electrical distribution or loading of the Bell 206A/B with the G500H equipment.