

Electrical Considerations for the Stinson 108  
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By Larry Westin - May 01, 2016  
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All Stinson model 108 aircraft came from the factory with a 12 volt electrical system which consisted of a battery, a generator, a voltage regulator, circuit breakers (Stinson 108's came with automatic resetting circuit breakers), and the needed wiring. The generator on early deliveries was of 15 amp output rating capacity, most model 108 Stinsons have a 25 amp output rating capacity generator.

The electrical system is used to operate the engine starter (a majority of general aviation airplanes in the late 1940's didn't have a starter, had to be hand propped), navigation lights, instrument lights, dome light, fuel gauges, landing lights, radio, etc.

As delivered from the factory, all models of the Stinson 108 were equipped with a two way radio. From the factory the model 108 had the General Electric AS-1B radio, while the models 108-1, 108-2 and 108-3 came from the factory with a Hallicrafters model CA-2 Skyfone radio. Each of these radios had a single frequency to transmit, 3105 Kc (later changed to 3023.5 Kc), and a tunable receiver in the 200 to 1600 Kc range. By the early 1960's the 3105/3023.5 Kc frequency was almost entirely replaced by VHF frequencies. So replacement communication radios are needed (radios which could transmit on multiple VHF frequencies), followed by improved navigation such as omni range (all Stinson model 108's had a very basic fixed loop antenna which could provide limited manual navigation directional capability in the LF/MF 200 to 1600 Kc band).

This need to change radios started a continuing process of updates, almost all of which involve electrical equipment. In addition to radio (now avionics), other electrical equipment, such as strobe lights makes a significant demand on the electrical system.

### **Some important considerations when changing or adding electrical devices**

#### **Continuous versus Intermittent Electrical loads:**

A - **Continuous Loads** are those which remain on for extended periods. A radio receiver for example often will remain on for an entire flight. A rotating beacon, or strobe light system will likely remain for the entire flight. Same with navigation lights when flying at night.

B - **Intermittent Loads** are those which remain on for a limited time. Landing lights are normally used for only a short period. A radio transmitter is a device which is used only for short periods (this is important as the current drain for the receiver is small, while the current drain for the transmitter is much greater). Devices which are typically activated for two minutes or less at a time are considered intermittent loads.

### “Real Generator Output Rating:”

Stinson model 108's were delivered from the factory with a generator and voltage regulator with either a 15 amp (early airplanes) output rating, or a generator and voltage regulator with a 25 amp output rating.

Federal Aviation Administration **Advisory Circular 43.13-1B Change 1, paragraph 11-35**, specifies **ACCEPTABLE MEANS OF CONTROLLING OR MONITORING THE ELECTRICAL LOAD**. Within this paragraph AC 43.13-1B says the continuous electrical load should not exceed 80% of the output load limits of the generator or alternator.

**Real generator output** - using the FAA 80% rule means that the maximum continuous electrical load from a 15 amp output rating generator is 12 amps. The maximum continuous electrical load from a 25 amp output rating generator is 20 amps.

### Sample Actual Electrical Loads:

Because of the limited electrical output load available, I made some checks of what the **80% rule of AC 43.13-1B** electrical load really is for different devices. To measure the load I used a calibrated power supply set to 13.75 volts D.C. (same voltage as the generator outputs) while measuring the current load using a calibrated Fluke digital amp meter. All measured devices were grounded at the same point, the throttle bracket.

### Continuous Aircraft Electrical Load for Lighting, Gauges, Instruments

<u>Device</u>	<u>Current load in amps</u>
Navigation lights and Radio lights - maximum intensity	6.70
Instrument Panel Flood light - LED type - maximum intensity, 2 each at .35 amp each	.70
Electrical Turn and Bank	.35
Carburetor Air Temperature Gauge	.03
Fuel Gauge	.05
Whelen A413A HDA-DF-14 power supply and Strobe Lights - see note 1 at the bottom of page 2.	6.50
<b>Total Electrical Load in Amps Lighting, Gauges, Instruments</b>	<b>14.33</b>

NOTE 1 - The strobe light current drain changes as the capacitors charge. The current drain shown is the maximum drain obtained during the charge cycle.

## **Continuous Aircraft Electrical Load for Avionics**

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<b><u>Avionic Device</u></b>	<b><u>Current load in amps</u></b>
Narco CP136M Speaker amplifier - see NOTE 2 below	1.30
Narco CP136M Phones amplifier	.16
Narco CP136M Marker Beacon receiver	.03
King KR-80 ADF receiver	.21
Narco COM-120 transciever, 2 radios at .75 amp each - see NOTE 3 below	1.50
Narco NAV-14 receiver, UGR-3 glideslope receiver, VOA-50M VOR/ILS indicator	.85
Narco NAV-14 receiver, VOA-40 VOR/LOC indicator	.67
Terra TRT-250 transponder	.23
Narco AR-850 altitude encoder	.20
<b>Total Electrical Load in Amps Avionics</b>	<b>5.15</b>

NOTE 2 - current drain for worse case - all receivers activated at maximum volume. Typical value with 2 receivers .3 amp.

NOTE 3 - current drain shown is for the receiver operating which is a continuous load. The transmitter uses considerably more current, however the transmitter is an intermittent load so the current drain for the transmitter is not included in this table.

### **Total Electrical Load meeting the 80% rule of AC 43.13-1B Example:**

In the examples above, with all the continuous electrical devices on, the Lighting, gauges, and instruments the electrical load is 14.33 amps, while the continuous avionics electrical load is 5.15 amps, which is a combined total of 19.48 amps. With a 25 amp generator following the FAA AC 43.13-1B criteria of a 80% maximum continuous load, the maximum continuous allowable electrical load is 20 amps. The 19.48 amps with all the equipment installed in this airplane meets the 80% rule.

### **When the 80% rule of AC 43.13-1B cannot be met:**

AC 43.13-1B gives the option of adding placards in front of the pilot indicating that some loads MUST be turned off when other loads are on. For example I saw an airplane with a placard saying "Rotating must be off when radio is on." My recommendation is to keep the electrical load within the 80% for your generator.

## Modern Electrical/Electronic Changes

The biggest current drain is with lighting. Navigation lights circa 2000 require the same current as navigation lights circa 1947, about 6.7 amps. Today's crowded airspace makes anti collision lighting a necessity, especially if you fly at night. As shown the Whelan strobe lights require 6.5 amps. So the navigation lights, and strobe lights consume more than 13 amps of current, or a little over 65% of the available current.

So when thinking of changing or adding avionics you need to realize you only have about 6 amps available. The good news is the original radios which came standard with the Stinson 108's are tube type radios. Tube type radio cathodes require heating to work, which is a substantial current drain, often 5 amps for a single radio. Modern avionics, such shown in the avionics table, are solid state which do not require heating substantially reducing the current drain with all the avionics shown using only about 5 amps on a continuous basis.

### Increased Electrical Capability Change for the Stinson 108

Installing a higher capacity output rating alternator with a solid state voltage regulator is one solution. There is a multiple install Supplemental Type Certificate (STC) to install an alternator and solid state voltage regulator for the Franklin engine used in the Stinson 108's, however my understanding is the parts to install that STC are no longer available. I've heard of others who have installed an alternator using a one time approval STC from their local FAA Flight Standards District Office.

Alternators typically have a 50 amp output rating, which will open up a great number of options for the Stinson owner. Making the change from generator to alternator is not as simple as removing the generator and installing the alternator. The voltage regulator will also need to be replaced with a unit capable of controlling the additional current from the alternator. The Stinson 108's came from the factory with an automatic resetting 30 amp circuit breaker to protect the generator. A higher capacity circuit breaker is also required. From the factory the wire from the voltage regulator to the aircraft electrical bus bar is number 12 American Wire Gauge (AWG) size, which is the proper diameter wire for a 25 amp generator. A 50 amp alternator will require replacing the 12 AWG size wire with the larger diameter wire size such as 6 AWG wire. The voltage regulator output wire originates on the engine side of the firewall, passes through the firewall along the left side fuselage longerons immediately behind the firewall, down to the aircraft electrical bus. It may well require removing the engine, and the firewall to install that larger gauge wire. **RECOMMENDATION** - if for any reason the engine is removed from your Stinson it would be a good time to replace the 12 AWG size wire for the voltage regulator output, with 6 AWG size wire. The weight difference is negligible and the 6 AWG size wire will only help your generator output by reducing the wire resistance, therefore lowering the voltage drop from the voltage regulator to the aircraft electrical bus bar.

Unless a multiple install STC with available parts becomes available, such a change will also require the repair shop to present to the FAA FSDO a completed FAA form 337 with the airframe and powerplant (A&P) mechanics signature, the A&P with Inspection Authorization (IA) signature, to the local FAA inspector for his/her signature.

I mention the above so those who take their airplane to their local repair shop thinking all they have to purchase is a new alternator. So don't be shocked at repair shops estimate to make such a change. There is far more involved as the above paragraphs indicate.

If you have corrections or additional information about Stinson 108 electrical information, please contact me.

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