Architectures for crafting your personal “Plan-B”

If you launch into the crud with a TC aircraft today, you're probably going to do it with an architecture like this . . .

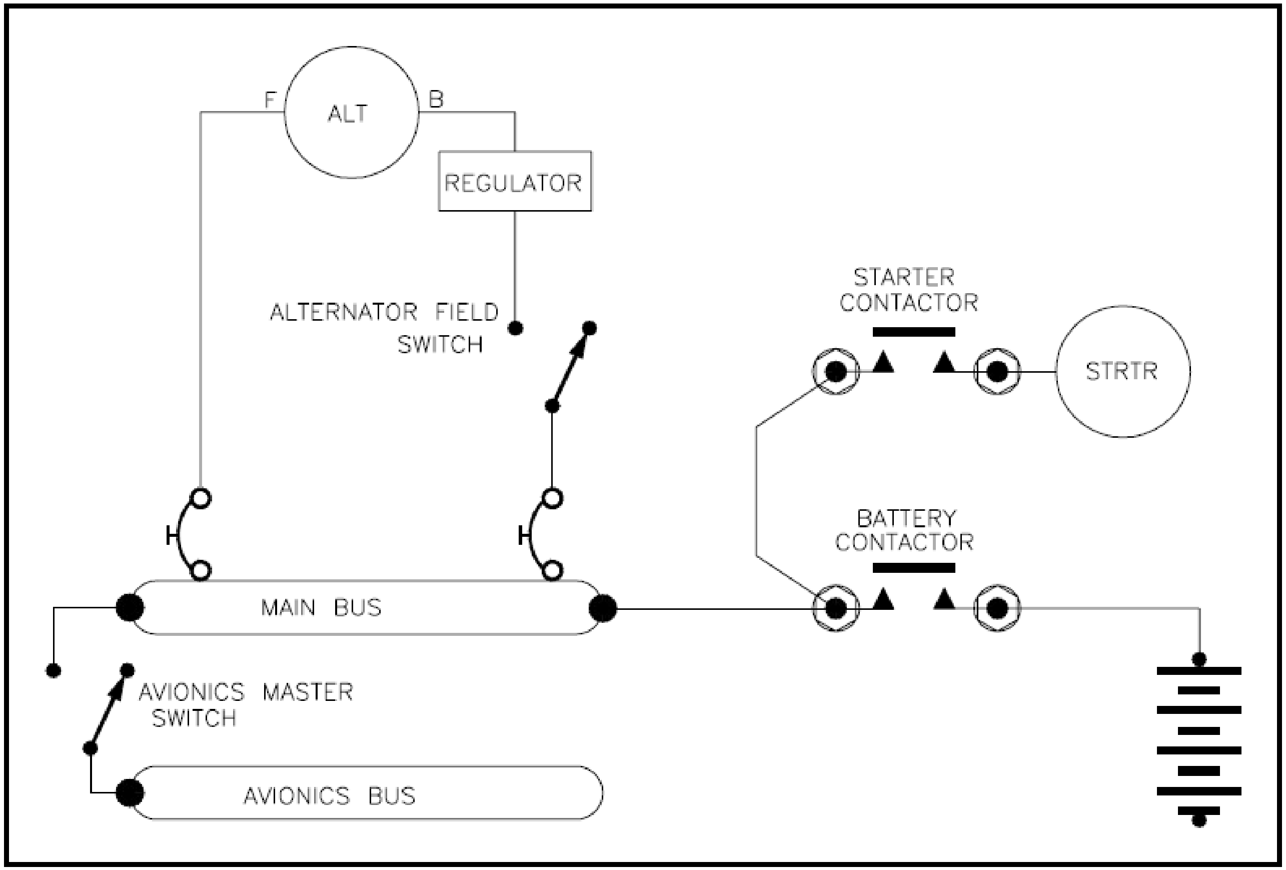


Figure 17-1. Rudimentary Single Battery, Single Alternator Power Distribution System.

Hundreds of thousands of certificated aircraft are flying in IMC with a system that hasn't materially changed in about 70 years . . .

What, if anything makes sense to improve the probability that any single failure is a ho-hum event???

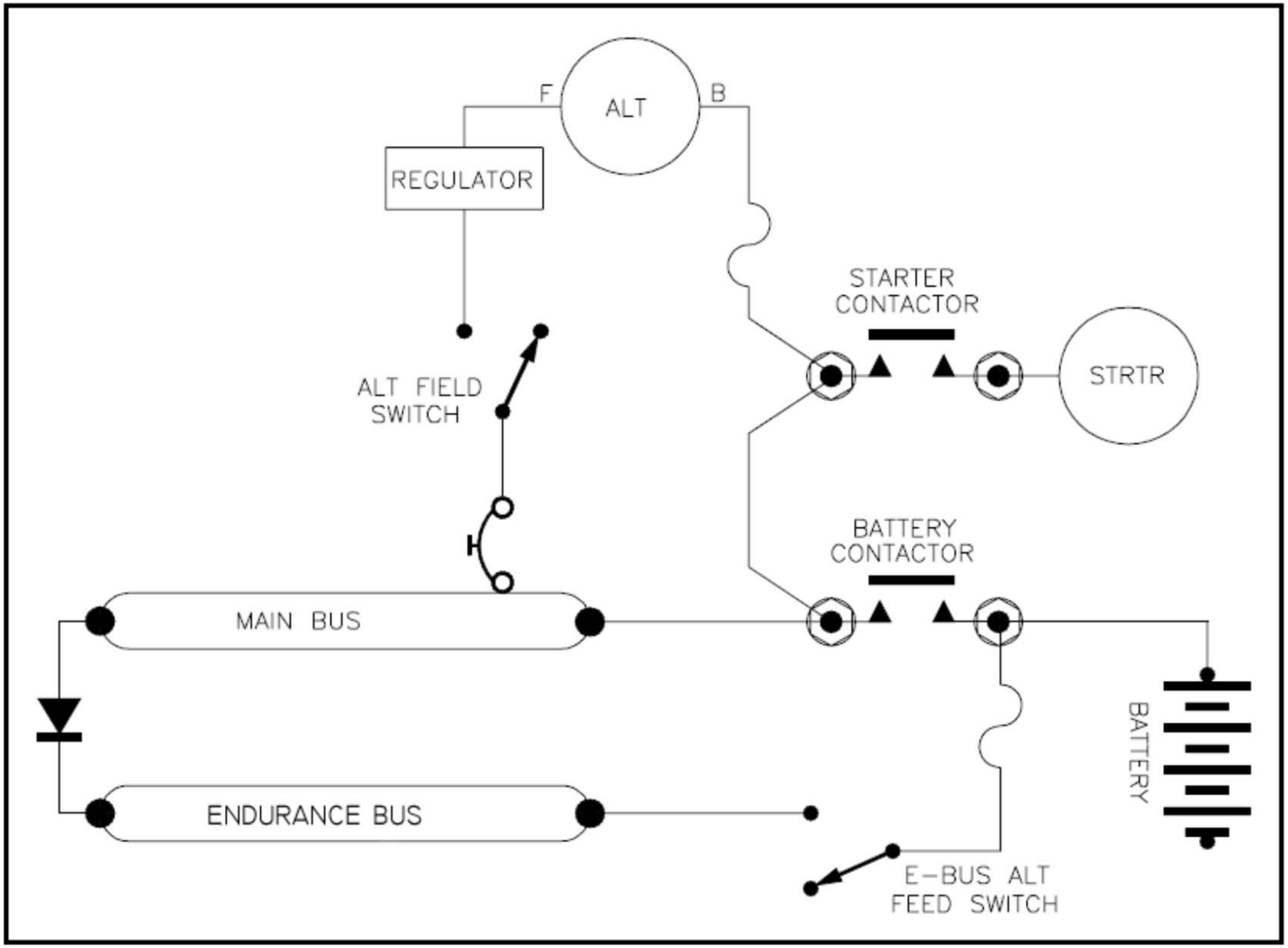


Figure 17-2. Single Battery, Single Alternator System with Dual Feed Essential Bus.

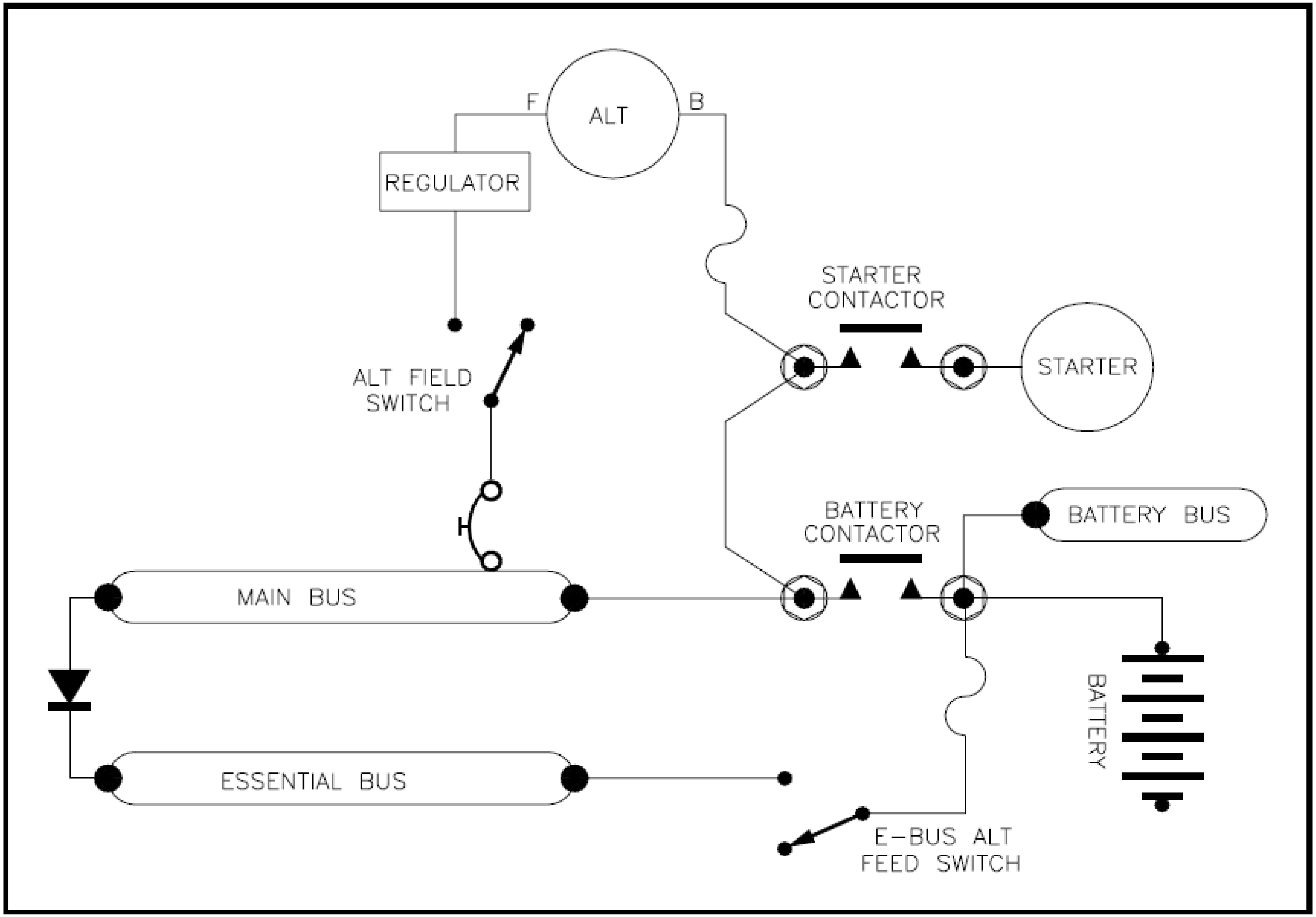


Figure 17-3. . . . Addition of an Always Hot Battery Bus.

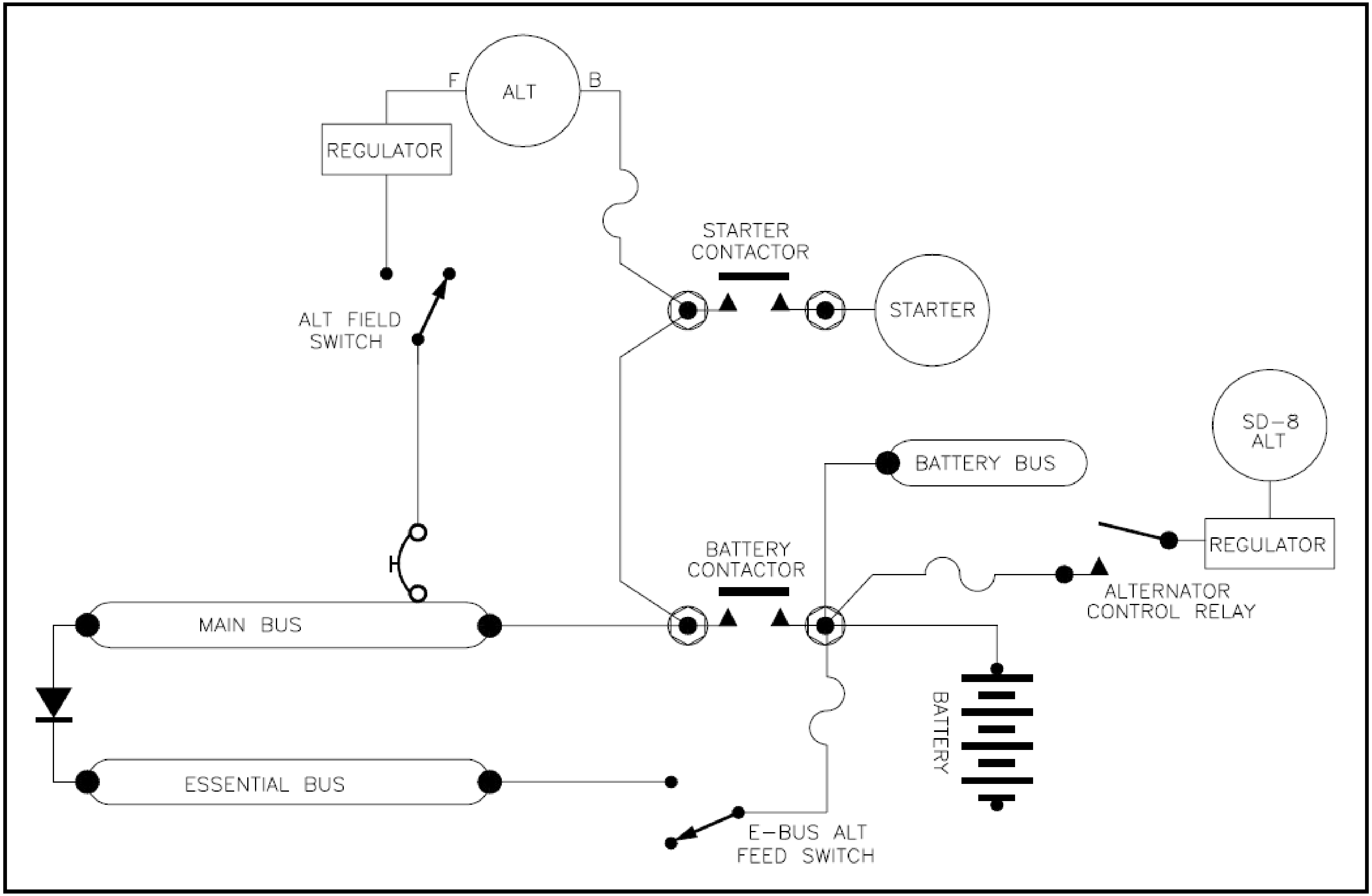


Figure 17-4. Adding the SD-8 Auxiliary Alternator

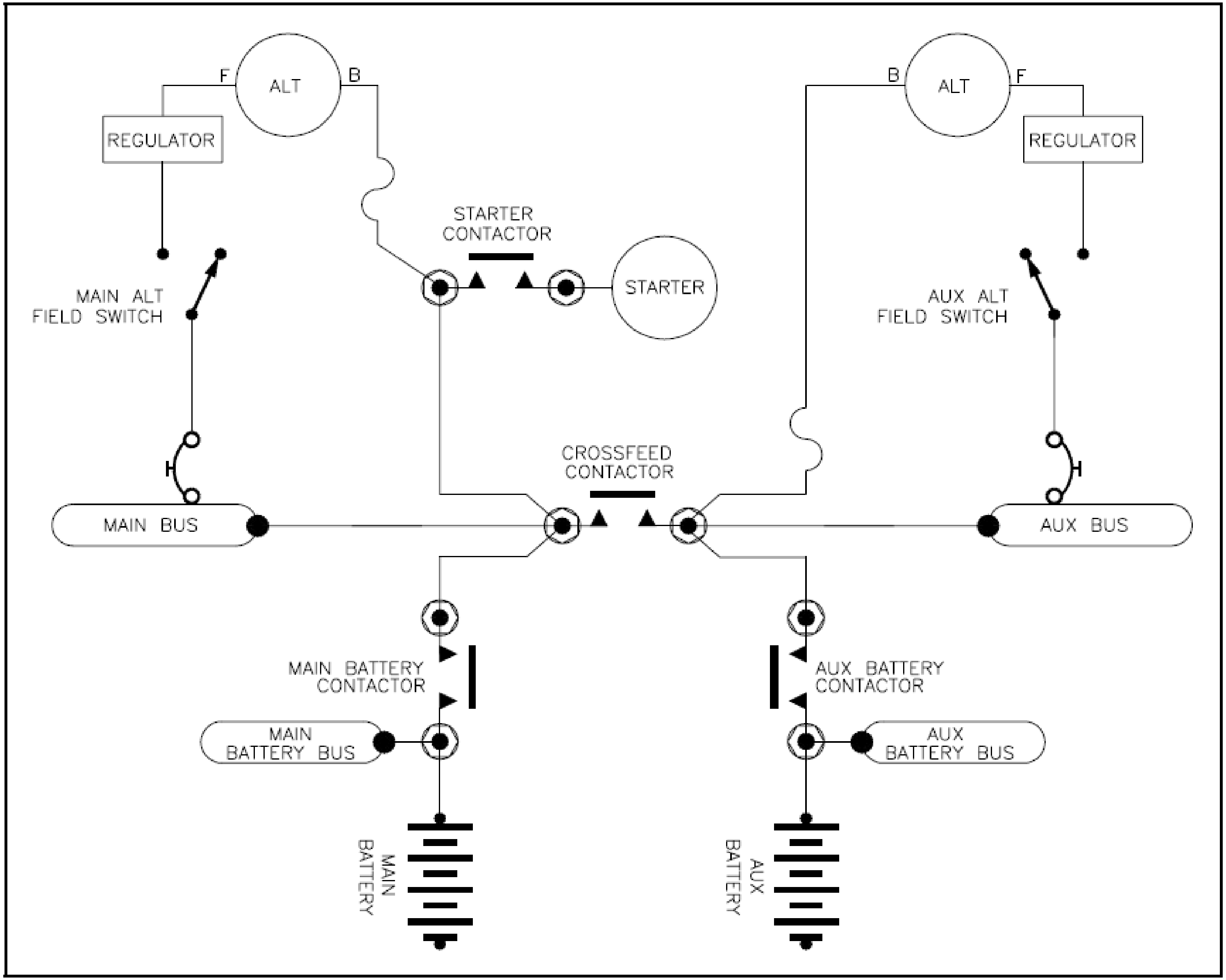


Figure 17-5. Dual Alternator, Dual Battery Electrical systems.

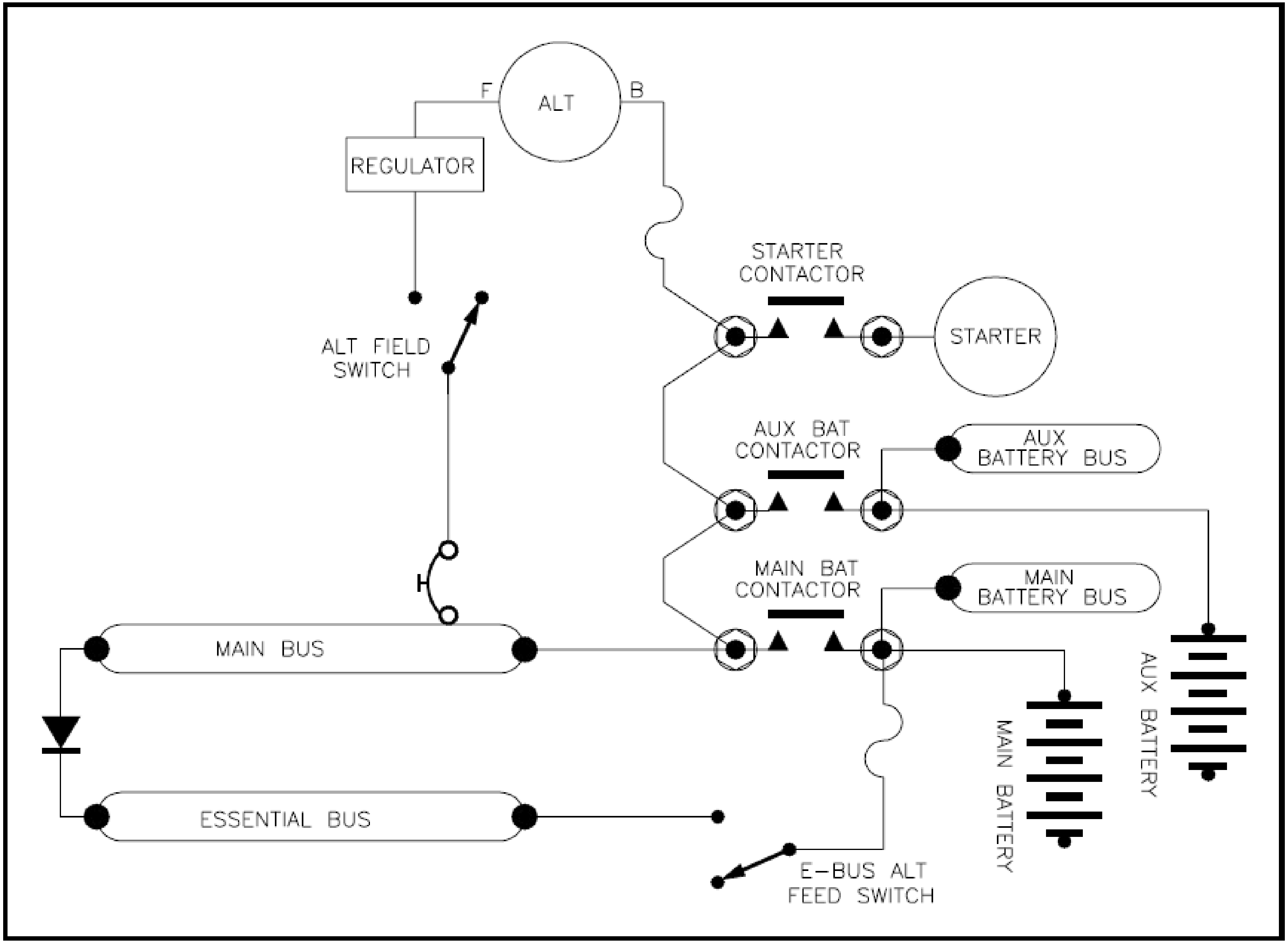


Figure 17-6. Dual Battery Installation

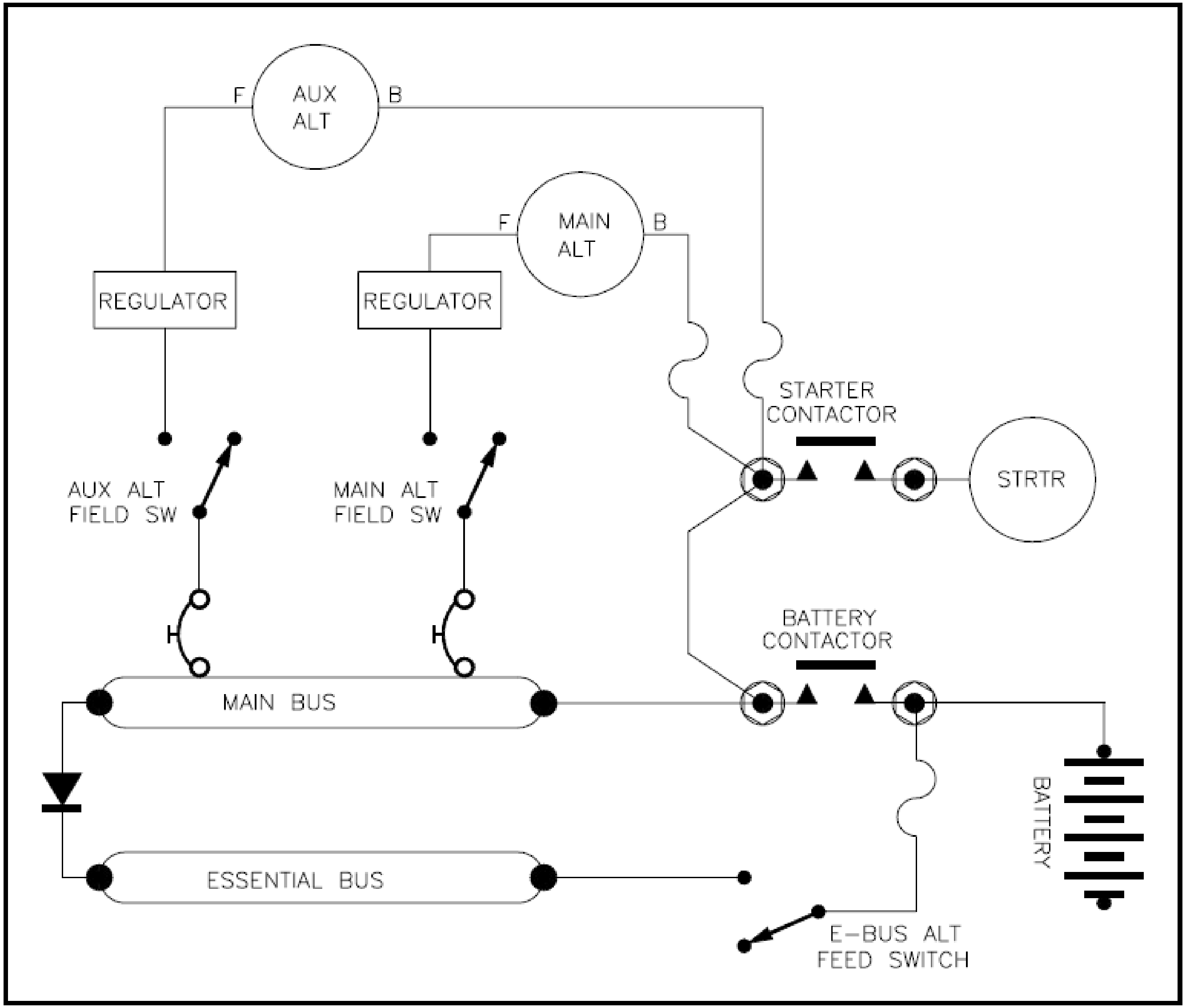
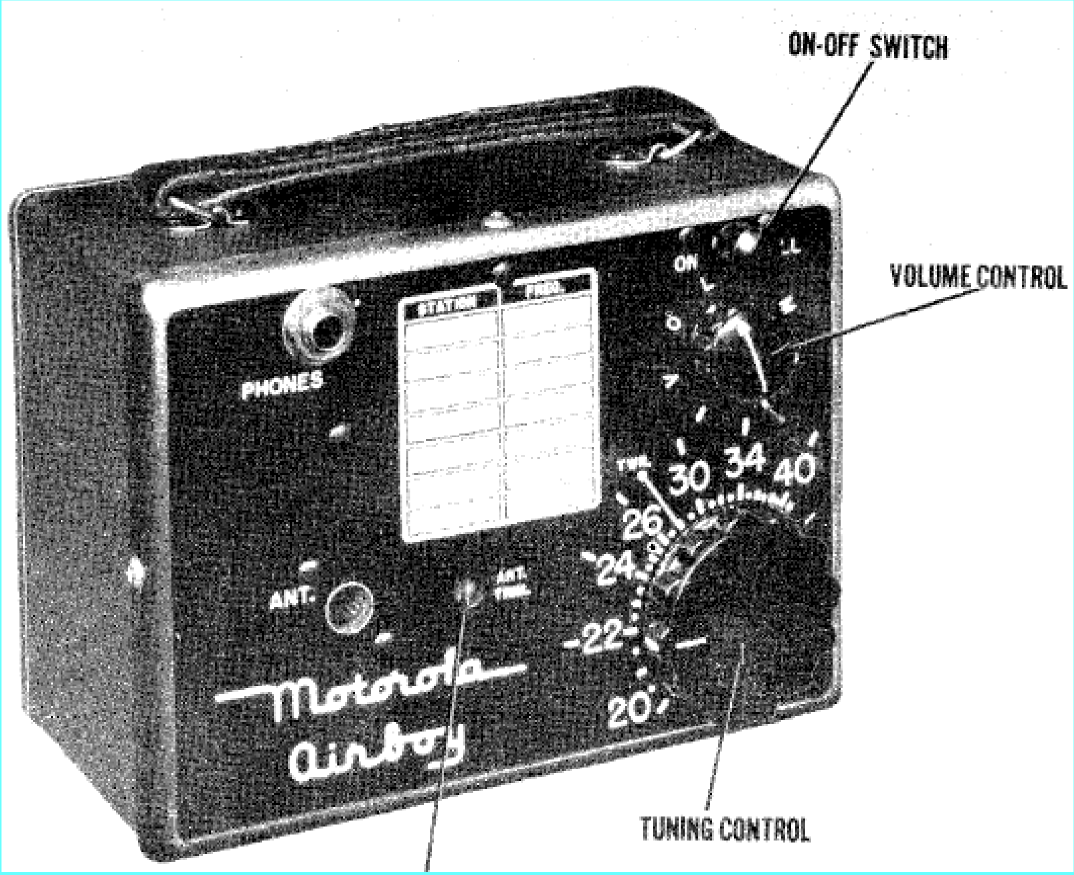


Figure 17-8 Auxiliary Alternator with Autoswitching.

In the 1940s one might find this kind of radio in the cockpit of a light aircraft.



The "Airboy" series of radios were manufactured by Gavin, Motorola and Mitchell.

Dry battery powered. Early offerings receivers for radio range stations. Later versions added VHF transmitter and ability to receive broadcast band as well.

- If you rent an airplane . . . How much time do you spend checking out that airplane's maintenance records???

Vaccinations against "Dark Panel Syndrome" in a T/C aircraft environment . . .

Nuckolls' first law of airplane systems design sez: "Things break"

The second: "Systems shall be designed so that when things break, no immediate hazard is created."

The third: "Things needed for comfortable termination of flight requires backup or special consideration to insure operation and availability"

The forth: "Upgrading the quality, reliability, longevity, or capability of a part shall be because you're tired of replacing it or want some new feature, not because it damned near got you killed."

What's all this DO-160 stuff anyhow?

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DO-160 is not a REQUIREMENT . . . it's simply a listing of various tests (recipes for success) recommended to show any particular piece of equipment is (1) not subject to damage or degradation of performance from the aircraft environment (2) not vulnerable to common noises and (3) does not itself generate noises unacceptable to other system in the airplane.

Power Input:

Try to make your gizmo work as specified over the range of 13.0 to 15.0 volts and function with perhaps degraded but still useful performance down to 10.5 volts (end of battery life).

Bus Noise:

Expect noise on the bus ranging from 10 to 100 Hz ramping upward zero volts pk-pk to 1.5 volts pk-pk. Then from 100 Hz to 1000 Hz, at 1.5 volts pk-pk constant. Finaly 1000Hz to 10,000 Hz with the amplitude ramping downward from 1.5 volts pk-pk to zero at 10KHz. A sine wave "noise" is satisfactory for testing.

Power Interruptions:

Test for all manner of interruption and brownout. Your gizmo should not be damaged by any downward excursions of power supply for any duration and levels down to and including zero volts. The gizmo can fail to function below 10.5 volts but should come back to normal operation without pilot intervention when the bus returns to normal.

Surges:

Can you take 20 volts for 1 second with no damage to your product? Can you take 40 volts for 100 milliseconds? For small electro-whizzies a simple shunt regulated zener or active device (FET or Transistor) supply can be configured to take these hits. For larger current draws, you might have to add an active pass transistor, or other power supply designed to handle at least 40 volts.

300V Spike:

There's a test you can conduct that feeds a short duration spike of up to 300 volts into the 14V input of your gizmo . . . it's easy to pass this test with a 10uF capacitor (rated for 40v surge of course) right across the input.

Temperature Altitude:

There are LOTS of categories but cabin mounted gizmos for our airplanes would be rated for up to 15,000 feet and operating temperatures of -40 to +55 degrees C. Except where there are issues surrounding forced air cooling, I've never had a concern about altitude effects.

Vibration:

There are lots of categories here too . . . but unless you're going to mount the gizmo directly on the engine or landing gear, very ordinary fabrication techniques will suffice. In this day of surface mount components, it's REALLY easy to build for robustness.

Gunks, goos, grit, bad gas and death by athlete's foot:

Consider all forms of wet. Water, hydraulic fluid, fuel, oil. Are you gonna keep it out or always mount it where it doesn't matter? (continued . . .)

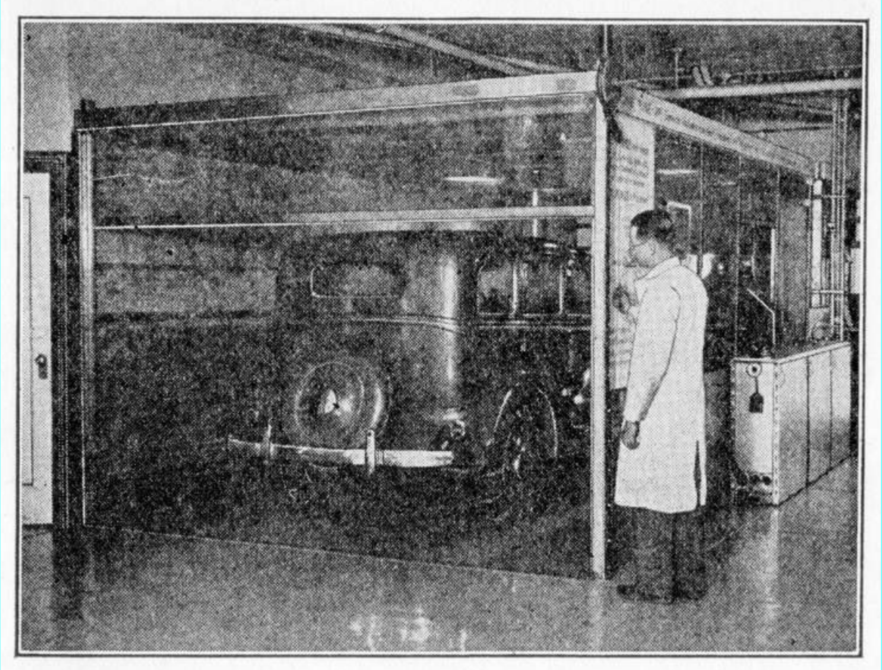
Sand/dust:

If you're under the cowl and/or have any moving parts, this should be considered. There's also a test for fungus. This is routinely bought off with a statement in the qualification document that there are, "no materials that are nutrients to fungus used in the fabrication of this device. "How about ozone . . . lots of it under the cowl that will eat up may forms of plastic finishes and insulations.

Radio Noise:

All system components should be evaluated both for their noise output characteristics and their ability to operate properly in a pre-determined level of noise.

This screen room provides a "radio quiet" test environment for a 1935 automobile.



Electo-Static Discharge:

Can you hold your gizmo in hand and shuffle across the carpet and safely draw a body-static spark to any pin in your input/output

Lightning:

This is a BIG thing with the FAA nowadays (which I choose to ignore for amateur built aircraft projects). It's not difficult to design for lighting protection but it drives up costs and parts count. Further, I figure if a pilot has flown into a high lightning (or ice) risk, whether or not MY gizmo still works after the lighting strike is probably the least of his problems.