TECH NOTE

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Starting Sequence For Split Master/Alternator Switch Models

In the Electrical portion of the Systems and Procedures classes CPA offers, an engine starting procedure is taught for the single engine models that are equipped with belt driven alternators and a split master switch. This procedure should not be used for any gear driven alternator installations, O-200A in 150 models, O-300 series in 170,172 models and IO-360 in R172 models. There is a torque load induced when the alternator field circuit is energized and the drive belt is able to absorb this initial load without any difficulty whereas with the gear driven alternator, the load is placed directly on the drive coupling.

The red split master/alternator switch showed up in 1970 for most models. With this switch you can have just the battery position on or the battery and alternator position on. You cannot have the alternator on without the battery on. Models prior to the split switch can use this start procedure, it is just a little more complicated as you will be looking for an oil pressure and an ammeter indication right after start up. The split switches are direct replacements for most of the single rocker switches, mounting and terminal locations are identical, so if you have an earlier model it can be converted come replacement time. Check with your mechanic to see how he would accept the approval. Several mechanics surveyed during the classes considered this to be a minor alteration with only a logbook entry required for return to service. Another advantage of the split switch configuration is that it allows you to turn off the alternator should there be a charging system problem and still keep the battery on line so you have power available to the radios if needed.

The start sequence goes like this for airplanes equipped with the split master/alternator switch and belt driven alternators.

Master switch on, alternator side of switch off and look at the ammeter for a negative deflection indicting you are operating strictly off the aircraft's battery. The high volt or low volt warning light should be on. This alerts you to what a negative discharge on the ammeter looks like and that the warning light is working.

Start the engine and once you have oil pressure increase the throttle to 900-1000 RPM. Turn the alternator switch on and look at the ammeter. The indication should be a higher than normal positive charge indication that begins to taper back towards zero in 30 to 45 seconds and the red warning light should be out. With no load on the electrical system other than the fuel gages, engine instruments, turn coordinator and master contactor, the total current draw placed on the alternator is about 3 amps. This plus some for the battery will give an ammeter indication just slightly to the right of the zero. The resolution on the ammeters is not that good so each individual airplanes indication will be different but you should see something just on the plus side of zero once the battery is topped off. It is not necessary to wait for the ammeter to come back to this final condition as long as you see the ammeter tapering back to the normal indication.

The time it takes for the ammeter to swing back gives you an indication of the condition of the battery. As the battery ages it will take longer for the ammeter to reach the "normal" resting point. This tapering indication also tells you the charging system is working normally. Using this procedure you have checked the visual reference indicators, ammeter and warning light, and know the system is working and can now move on to the next phase of your pre-takeoff checklist.

Turning the alternator off and back on under load to see if it is working is not the preferred way testing the charging system, as this places an unusual load on the regulator, alternator and entire electrical system. Turning on the landing and taxi lights and seeing a change in the ammeter indication would be the correct procedure.

If the ammeter indication pegs out on the plus side or does not begin to come back right after the alternator switch is turned on, this is an indication the starter contactor has failed and the contacts have welded closed there by keeping the starter motor energized. The battery is supplying the high current draw of the motor. The voltage regulator or alternator control unit senses the low bus voltage and puts the alternator to maximum output trying to compensate. All the amperes the alternator can deliver are passing through the ammeter to the bus and back to help the battery feed the starter motor. This is why you see the abnormally high ammeter indication. With this indication you would want to shut down and get the problem resolved before it takes out the starter motor, alterna-

tor and regulator.

With the alternator turned off at start up there is more battery capacity, as three amperes are not flowing to the alternator field circuit. This is a minor advantage but under cold temperature starting conditions, an additional three amps maybe enough to get the engine started.

The main reason this procedure is taught in the CPA Systems and Procedure courses is that we are trying to make the operator understand the concept that all airplanes come equipped with an emergency backup electrical system, the aircraft's battery. The sooner you can recognize the charging system has failed and minimize the load placed on the battery, the longer your emergency backup electrical system will work. If you look at the ammeter and the warning light before and after start up, you are putting these items in your scan, which hopefully will also happen during flight conditions. Looking at the electrical load analysis charts in the service manuals you will find that with one radio on, the transponder on and the items mentioned above when the master is on, 4-6 amperes is all that the battery has to carry. If the battery is in good shape it should be able to handle that load for at least one hour. This should provide enough time to find a safe place to land. The key here is recognizing the failure as soon as possible and taking action to turn off non-essential items instead of waiting for a total electrical failure that shuts everything down which most assuredly will get your attention.