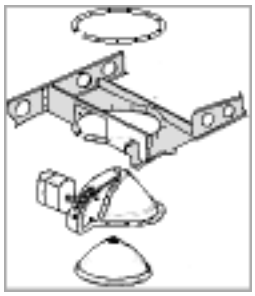
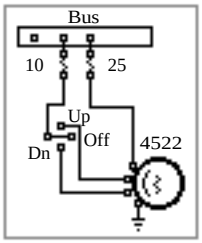
Grimes Swing-Down Landing Light
for the 140 and 120 planes, with mention of the 140A's alternative

What is "The Option"?:

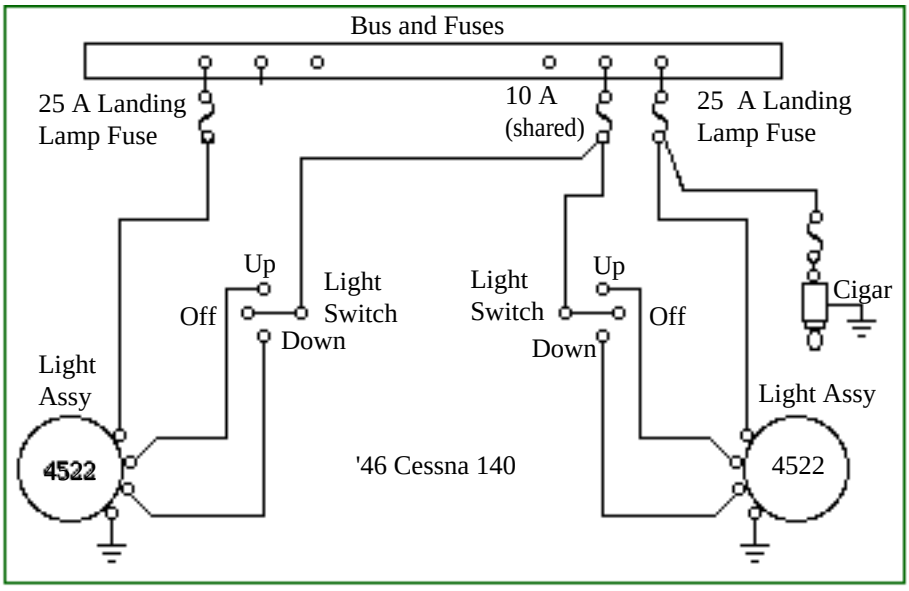


The Cessna 120 and 140's had the option of one landing light or two of the "Grimes Type". They were mounted on a bracket in the underside of the wing, flush with the bottom skin and outboard of the strut attach points. The light assembly used a swing-down mechanism to get pointed in a useful direction, with a motor having one field winding to power it down against the wind resistance and another field winding, oppositely wound, to power it back up. Many took advantage of the option and had a single one installed, usually on the left wing. Although the down/up motor power requirement was minor and of short duration, the lamp takes 250 watts when on, using more current than the first two sizes of generators could supply even with the engine at high speed and no other electrical device on. Nevertheless, it was far more reliable during final approach and touchdown than the three flares which were an option for finding a landing place. If not modified, the Grime's limitation was that it lights only at a particular extended position; if the beam angle is correct for a three-point landing, it is likely to be less than optimum for a wheel landing or for taxiing.



The basics of the first circuits are indicated in the small sketch; one small fuse for the motor current, one large fuse for the lamp power, the switch on the instrument panel with the three options of Center Off, Up, or Down and light on and the light assembly whose internal features carried out the commands. In the next figure, you can see how the designers started to expand the loads of the right side's landing lamp fuse since so few owners elected to purchase the plane with a second light assembly on the right wing.

1946 Cessna 140 Landing Light Circuits:

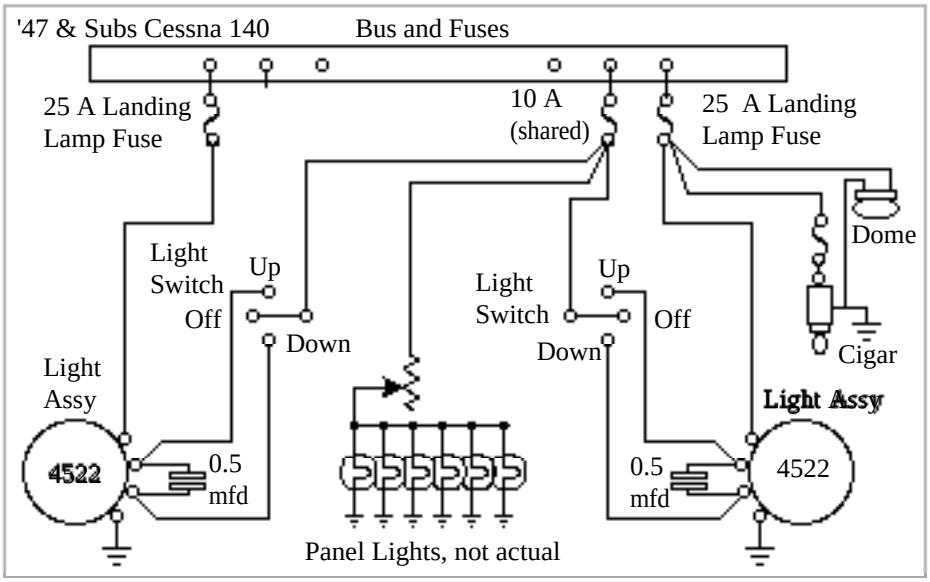


The 1946 140 landing light (s) circuit would be as shown, if you had elected to get both lights. The circuit does have one extra; I have added the AD-mandated fuse in the cigar lighter circuit in the right light's wiring though the fuse should be shown at the bus end). A 25 Amp fuse supplied power for the lamp of the light (this was always powered when the bus was powered, not switched) for the left and another 25 amp fuse supplied power for the right lamp as well as the cigar lighter. A switch marked Retract/Off/On (referred to as Up/Off/Down elsewhere) was part of the equipment on the instrument panel for each of the right and left

lights and both were supplied power from a shared 10 amp fuse. Three wires are routed to each light from the wing/fuselage shoulder, two of small gauge and one of a significantly larger gauge. Like wires run from the wing shoulder to the switch to supply the Retract and Down power for the light motor, and the one of a more significant gauge was to supply power to the 250 watt 4522 type lamp. There were a few changes the next year when the dome light was added and capacitors attached to the motor terminals to cut down on radio noise during the up/down cycles.

1947 and Subs Cessna 140 Landing Light Circuits:

The 1947/1948 wiring was almost the same, but now the planes also had a dome light fed off the right landing light's 25 amp fuse, along with the cigar lighter (again showing the AD-mandated fuse for it and Cessna shows no switch for the dome light but there was one). In addition, these later planes had a 0.5/0.5 MFD non-polarized capacitor across the two motor terminals with the common terminal to ground for radio noise suppression. Those were the days of low frequency radios and motor noise would have been significant; whether the motor static can be heard today in the VHF radios only the users know. I have depicted the capacitors as Cessna incorrectly shows them but later describe how they must be connected if they are to do anything.



Another change was to let the common 10 A fuse supply the panel lights and both Retract/Down switches. By this time, Cessna had changed to six panel lights with a rheostat for dimming. The panel light rheostat is indicated without an off position because that is how Cessna shows it but actually had an Off position.

If anyone had this circuit with two landing lights, I would hope they also had at least the 35 A generator because the two lamps, if on at the same time, would draw 40 amps!

Later serials were made without the right side wiring.

120:

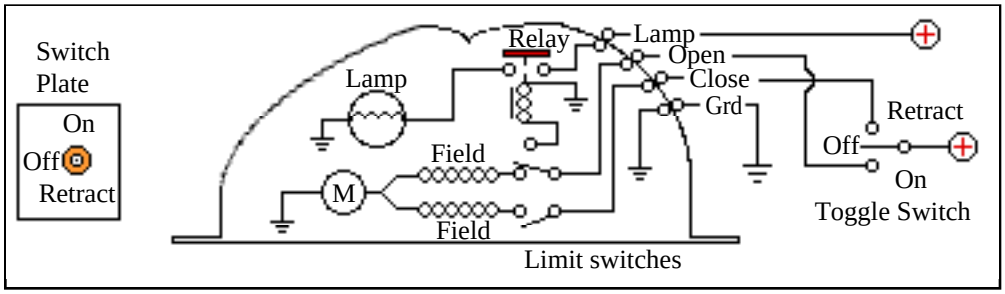
For the 120's, the situation was different and variable. They could be purchased without any electrical system though an option was the installation of a simpler electrical system than on the 140's and it included wiring and switches for both left and right lights as well. To get lights on a 120, one had to purchase both the electrical system option and the light option (s).

Light Operation:

The operation of the light begins with moving its switch to the Down position, routing power to the motor such that the light begins its swing down. As soon as the light is in the full down position, half of a dual limit switch is made and that does two things; it removes power to the motor and enables the relay

in the light assembly. As soon as the relay is made, it applies power to the lamp and the lamp lights. Voila!

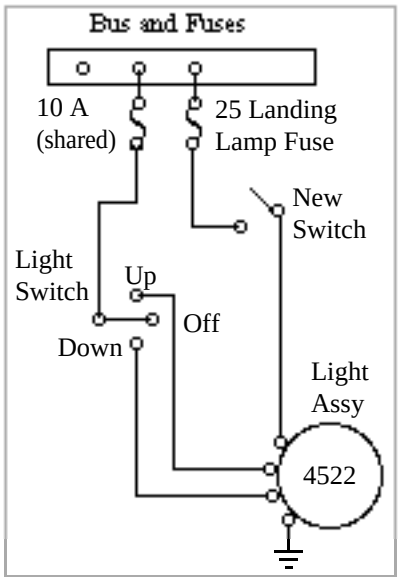
Once the function has been completed, moving the switch to Retract will start the motor moving such that the light retracts; at the first movement, the limit switch unmakes and the relay opens and the lamp is turned off. The original circuit will not allow the lamp to be on in any position except full Down. There are variations and many planes have been modified to allow the lamp to be lighted in other than the full down position. An Up limit switch stops the upward movement and resets the Down limit switch ready for the next Open command.



You can arrest the downward or upward motion by flipping the switch to Off and you can move the switch to Retract before the unit is all the way down, or to Down before it is all the way up, but nothing will happen and you must let the initial movement complete and the limit switch reverse before you can change direction. You can stop the movement anywhere you want, but the lamp only lights when full down in the "normal" lights.

Altered Circuits:

There are six versions, electrically, of the basic light assembly in the manuals from Grimes I have. There are others. For this recitation, only one is discussed, the one we would call "original" to the 140's. The basic wiring has been shown and now a bit of exploration into modifications and their features.



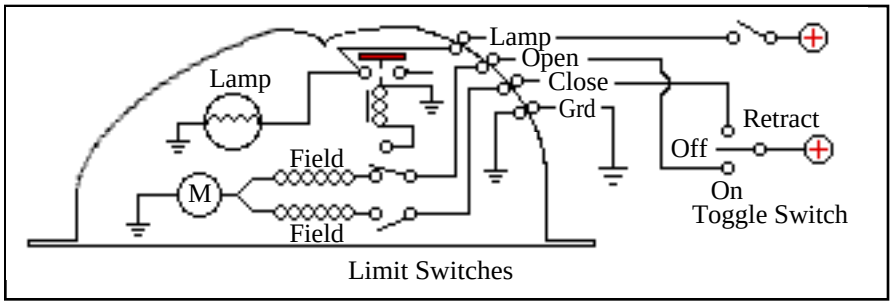
Some have opted to change the circuit to allow them to have light at any time, at any position of the light assembly, thus allowing better distribution of light while taxiing. This carries the risk of forgetting the light is not fully retracted or forgetting it is on with the resultant constant current load. One of the simplest, requiring no additional wire through the wing, is to add a switch on the panel with which you can make and break the current to the lamp; it has been shown here as "New Switch". Inside the light assembly, the relay is be shunted with wire attached to its two major terminals or bypassed so that the current provided via the Lamp wire will allow the lamp to light at any position any time the New Switch is enabled.

The switch should be a DC-capable unit of at least 25 Amperes capacity (a switch which is AC-rated is not adequate because AC voltage goes to zero twice per cycle and that allows much smaller contacts than for a DC switch). Note that the "extra" switch for the non-installed right landing light is not adequate. To keep you aware of the status, would it be wise to include a warning/alert LED anytime the new switch is enabled? Yes!

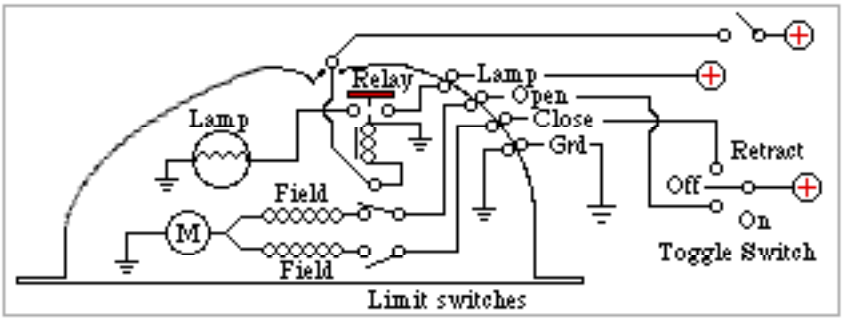
From these sketches, it is easier to consider altering how the light works; if you were to shunt or bypass the power terminals of the relay and add a switch in the Lamp power line, you could turn the lamp on, start the Open cycle and halt the cycle when you had the beam direction you wanted. To get the unit retracted, you would have to complete the down cycle and then retract, and never forget to turn the lamp off, right!? Alternatively, you could remove the wire from the switching limit switch in the Open circuit and run a wire

from the relay coil to a switch (maybe the unused right landing light switch?) on the instrument panel which allows opening and closing the relay at any time.

The figure shows how the relay can be bypassed as one of the alternatives for allowing the lamp to be on through more of the cycle. The shunt alternative can easily be imagined if you want to add the new switch. The advantage of either of these changes is that no new wires have to be run to the light assembly and no alterations of the light are necessary. Connecting the relay input power post to the coil post is also easy.



If you elect to modify the circuit so that you control whether the relay is energized to light the light at any position, you will have to add a switch connected to a new fuse to the bus for that purpose and then connect a wire from the switch to the light assembly (this is not fun with a closed wing, but could be easy if you were adding new fabric to the wing). At the light assembly, there are two choices depending on whether your light has an external connection to the relay terminal; if so, connect there, but if not, you have to make a hole for the wire, grommet it, seal it, and connect the wire to the coil of the relay.



If anyone were to revise their lights to be lit with either of these modifications, I would advise adding an "alert" lamp in the cockpit to show you the landing light lamp is powered. With the LED lamps available today which connect to 12 Volts, this would be a good revision if the light is put where it can readily be seen. Without an alert light, that 20 Amp draw can suck the life out of a battery in a hurry if left on.

Wiring confusion:

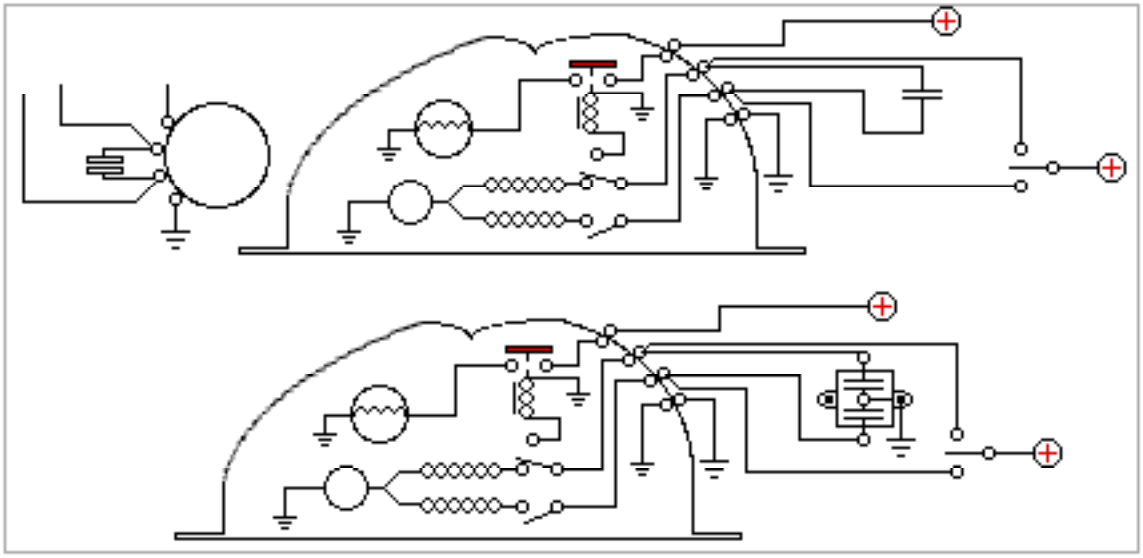
The reason for the confusion alert is that the wing assemblies first call out the wires to the landing lights, both sides, and then the wires are coded on the right wing after 9710 serial to be an option only, but the wiring diagrams do not follow the installation callouts exactly and most still show the wiring as though it is there in all the wings.

In the beginning, all 120 and 140 wings were wired for the lights, both left and right. Whether the light (s) was initially installed or not, they could later be added. If no lights were installed, the wires were safely terminated in the wings in the area for the lights. At serial 9710, the wiring in the right wing for the landing light was made an option and that non-inclusion of wires in the right wing would have affected both 120 and the 140 models; the wires for the right from the bus area to the wing root also became an option. You might have a right wing with the wires but no switch/fuse wiring to the wing root or you could have the switch/fuse wiring to the wing root but no wires in the right wing. After this many years, the variables you might find are too many to mention.

Note that, for the 140's at least, the unused right wing landing light switch and power can be used for other things, such as the relay control mentioned in the text.

Capacitor Noise Filter:

I cannot find an independent callout in the '47/'48 circuit diagram but it is reasonable that it would have been added at the time the low frequency radios became an option. The capacitor connected as shown in the Cessna diagram would have been incapable of doing anything. It is shown connected to the posts of the up and down limit switches inside the assembly; the shortcoming is that, when one switch is connected to the motor winding, the other is not, so the capacitor as they show it is never really connected to complete a circuit, as it must be to do any filtering. It is reasonable that a mechanical draftsman in that era would not have been aware of the nuance which makes all the difference. A terminal of the capacitor must go to ground to do any good. The clue as to what was really there is in the label of the capacitor in the wiring diagram: 0.5 --- 0.5 MFD (Mallory A6450). I believe it would have looked a lot like this...two 0.5 MFD capacitors in a metal can, each having a pole connected to the can, and the can connected to ground. That would work and the sketch following shows its connection; the top shows how Cessna depicts it but note that there can never be a closed circuit for the capacitor and the bottom shows how a three-pole 0.5/0/5 capacitor would be able to filter the noise of the motor.



Lamp, the 4522:

The lamp used on most is a 4522, 5-3/4 inch diameter, 250 Watt, 13 Volt, PAR 46 type, supplied by GE and others and it is available via most aviation parts catalog houses. The Approximate Initial Maximum Beam Candlepower is 290,000 (the more common 4509 used in the leading edge lights is 110,000) and the beam width is 12 degrees horizontally and 10 degrees vertically. What that means is that, at the center of the beam, the maximum brightness is 290,000 but that falls off as the angle off center increases.

There is no 12 volt, 250 watt PAR 46 type Quartz/Halogen substitute for the 4522. PAR stands for Parabolic Aluminized Reflector, same as for your auto (old). High wattage and low voltage means a fat filament. The filament of this lamp is very robust, and that explains its long life. Quite a few planes still have the original lamp.

The 4522 shared another feature with like-type military landing lights in that it has a shield built in at the side of the filament. Its purpose is to prevent glare toward the side of the plane into the pilot's eyes and prevent reflection from the prop. About 20 percent of the planes with the unit in their wing have been

mis-installed by reversing the orientation of the lamp such that the unshielded side can shoot lots and lots of bright light at the cockpit and the prop. Why they prefer to be blinded is a mystery. From one who just acquired two never-used Grimes lights, this message via email:

> There are still tags glued to the lamp face that say;
>
> LEFT WING
>
> "This light is supplied for installation in the left wing. The filament shield of the lamp is toward the pilot. To make this unit suitable for right wing installation merely rotate the sealed lamp 180 degrees."

Substitutes:

From a fellow 140 owner, this suggestion: Use a 100 watt, same-sized lamp instead of the 250 Watt 4522. You will have to search for it, but the three part numbers for it are a clue as to where: 4537, 4537-2, 4537X, PAR 46 (same size as the 4522), same screw terminals, with a beamwidth of 11 degrees horizontal by 6 degrees vertical. The 4537 is for aircraft and has the same shield as the 4522, the 4537-2 is coded for a spot lamp, and has no shield, and the 4537X is a marine type and has no shield.

Mounting Brackets and Kits:

All planes were to have light brackets on the left wing whereas the right wings had the brackets up to serial 9169, after which the right bracket was an option. The mounting brackets could be purchased for left or right wings for later installations. Kits were available for both wings with or without the mounting brackets; these kits included the lights and fuses and switches and some kits included the wiring as well.

Sources:

Grimes has been reluctant to help anyone for years with respect to their older lamps or parts, but there are suppliers of parts and overhaulers of the light assemblies:

Art Sloan 209-757-1478 California
Av lite Paso Robles CA avlite@tcsn.net
Old one....Avits Aviation Products Not sure this one exists.
16858 Stagg St. Van Nuys CA 91406

The Really Old Grimes: before the model using the 4522 sealed beam lamp, there was a version which used a bulb. Parts for that one are virtually impossible to get, as are drawings or specifications.

Position Adjustment:

These lights have an adjustment which permits selection of a Down position between 65 degrees and 90 degrees of the face of the case; that means that you can adjust the Down position to where you like it for best landing direction or best taxiing direction or a compromise. The light is factory set to an extended position of 90 degrees, plus or minus three degrees. Many on planes now flying have never been adjusted for the best position for the plane they are on and the light is largely wasted on empty sky. A very desirable feature of altering the switching so as to have the lamp lighted when you want it is that you can quickly find the best full down position for the landings you make and then adjust the unit so that is the full down position.

With the light extended, remove the adjustment screw plug from the control unit assembly.. Using a screw driver, turn the screw inside the control unit one turn for one degree change in opening. To increase the opening, turn the screw clockwise; to decrease, turn the screw counterclockwise. Caution: Never turn the screw more than three turns before closing and opening the light for further adjustment. Never try to make it extend beyond the 90 degree angle.

Caution:
For those who would troubleshoot the light in the wing, keep in mind that the 25 amp fuse supplies power all the time to the lamp wire in the wing anytime the electrical bus is energized. There is no way to switch off the power to the wing for the lamps unless its respective 25 amp fuse is removed or the master is off.

Reality of Changes:
It is impossible to state an "absolute" about any feature of our planes because their configuration changed during the build and many have been modified since their manufacture without mention in the log books. In the beginning, all the wings were built with the wiring to the landing lights, left and right, but by serial 9710, you got wiring in the RH wing only if you elected to purchase the option for it. There were kits for the landing lights after the plane left the factory and they varied depending on whether the plane had been made with the landing light brackets in one wing (the left) or neither, or both. If the plane had been purchased without the landing light bracket, then it might or might not have the wire; once determined, you could get the kit with or without the wires. This is mentioned to point out that you won't know what your plane has until you look in the root of the wing and see wires or not.

A lot of wings have been exchanged between planes and a lot of wings were metallized; whether anyone metallizing a wing took the trouble to add the wires on the "maybe" that some future owner would like the lights is a question that can only be answered by looking. We know, for a fact, that working on getting wires in a wing that lacks them is tough. To sum. Your plane may or may not have the brackets installed and some will have both left and right. Some planes will already have the wiring from the wing roots to the light areas with the ends "stowed" which means protected with the ends of the wire neatly in a coil, secured to a rib next to where the bracket opening would be. Don't count on anything being there unless you confirm.

140A Leading Edge Lights:
The 140A planes were offered the option of two fixed 4509 type lamps in the left leading edge; if not purchased initially, a kit could be procured and installed. Each lamp requires 100 watts of power and both are either on or off at the same time by way of a single switch on the instrument panel. Most owners are unaware (the Cessna manual says nothing) that the light positions can be angled differently to give them the optimum or most desirable patterns for landing or taxiing or both. Most appear maladjusted, with the inboard unit canted to be the taxi light and the outboard to be the landing light; this means that a lot of the inboard beam is blocked by the light recess' rib structure. To give the best service, the outboard light should be canted inboard to serve as the taxi light and the inboard light should have the more straight-ahead landing light orientation.

The 4509 lamps take 100 watts each, and exhibit a pattern that is 12 degrees horizontal and 6 degrees vertical. There have been countless statements about altering the orientation such that the filaments are vertical instead of horizontal in order to reduce the vibration effect, without any awareness or discussion of what you give up in utility of the beam width change and most "recommendations" for this change are meant for planes with the lamps mounted in the shaky cowl or on the jarring gear, not when mounted in the wings. The approximate Initial Maximum candlepower for these lamps is 110,000 and they have a rated average lab life of 25 hours. The alternative, much more robust, is the Q4509, the Q standing for Quartz/Halogen. These lamps have a rated average lab life of 100 hours (yes, four times as much) as the 4509, and have a higher maximum beam of 140,000 candlepower, but at the cost of a smaller beam width, 7 degrees by 7 degrees.

Be aware that the load of the two lamps, always on together, is 200 watts or 17 Amperes, a terrific burden for a plane using the generators.

Be forewarned that there appears to be a design or operational flaw in the Q lamps. Very soon after they are first used, the reflector above the small halogen bulb inside starts to blacken and gets progressively worse quite rapidly, eventually making most of the reflector black. The maker has yet to acknowledge the problem.

Now 2005 and wiser, the Q lamps have their reflectors blacken if the lamps are left on all the time to serve as anti-collision lights. The lamps get too hot behind the plex fairings. After lots of interfacing with GE reps, it was found that GE never checked a landing light for lifetime or shortcomings except when they were

cycled five minutes on and five minutes off in open air in the lab. The blackening of the reflector when the lights are on all the time can be reduced if cooling air passes over the lamp. Holes in the fairing? Trying such now.

Finally:

The 250 watt load for a single lamp means a 20 amp draw. Starting with 12 amp generators, 15 amp, 20 amp, then 25 amp generators, and an option for 35 amp generators. All the planes require a 25 Ampere-hour battery. If you do the math, one landing light being on would take all the output of the 20 amp generator. Left on, it would quickly deplete the battery, not even considering the avionics and exterior/interior light loads. To compound the situation, the landing light load is highest when the generator is putting out almost nothing since the light is usually only on in the pattern while descending at near-idle.

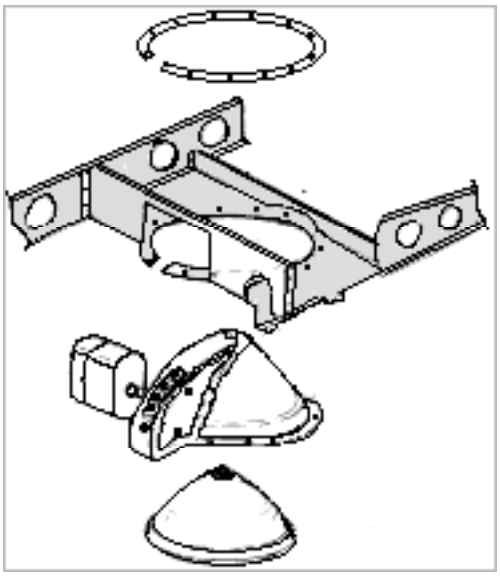
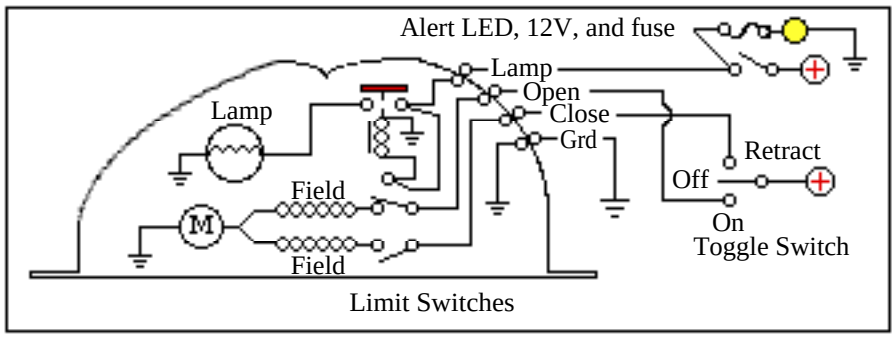


Figure 62/pp119 of the Cessna 120/140 Parts Catalog shows the best representation of the landing light, bracket, fuses, and switches but realize that many of the light assemblies did not look exactly as shown. Note on the parts callout for that figure that some planes had both left and right light brackets as part of the wing assemblies and some did not. The kits were set up to accommodate planes with one or both brackets. The kits included the fuses, holders, light assemblies, and switches.



The simplest change; connect a wire between the input power terminal and the relay coil as shown. When the new switch in the Lamp circuit is closed, the relay closes and the power is applied to the lamp, whatever the position of the light itself. And the alert light recommended to prevent forgetting that the lamp is on is also shown wired from the new switch in the Lamp circuit. The extra fuse for it is to do what fuses do; protect the wire to the LED.

The Grimes lights are very desirable today, 2005, and an owner is cautioned to take good care of them, including lubricating them. In the International archives, there are other strings about where to go for repairs and what lubricants should be used. Keep them well. And, there are lots of models, with variations of circuits, so be guided by the part number on yours, not by “they should be” per the parts manuals.

Incandescent lamps are rated “average lab lifetime” and for the 4509 and the 4522, the lab average lifetime is 25 hours. That is neither a guarantee or a promise or reality for the specific lamps you might own. If you are unfortunate enough to own a plane wtih the lamps mounted in the cowlng, a five hour lifetime is “good”. With the 4522 mounted in the wing, away from vibration and used only for minutes at time, lifetimes are measured by how many years they are in the plane before burnout and that has turned out to be decades for most users. How do they get the average lab lifetimes? By putting a hundred bulbs in the lab, holding the voltage at a steady 13 volts, and cycling them On for five minutes and Off for five minutes. When 50 percent of them have stopped working, that number of hours is...the average lab lifetime.

Neal

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