Landing Light Comparisons, 4509 Vs Q4509 Vs Whelen Q4509 Lamps
Leading Edge Installations

Purposes:

1. There are three competing sealed beam landing and taxi lamps in the leading edge recess of the left wing for use on our small planes. They are the plain GE 4509, the GE Q4509, and the Whelen Q4509. No resource explains all the parameters, and no resource presents a full comparison. The information that follows allows an evaluation of the three choices.

2. "Advice without analysis" recommends leaving the landing/taxi light (s) on all the time, in order to increase the conspicuity of your plane by other planes during flight, including daylight. The consequence has been significant reflector blackening of the Q lamps which degrades the intensity of the beam. When installed behind the leading edge plexiglass cover, there is no cooling air striking the lamps. This was not a problem for decades because the landing lights were used just for landing and taxi for a few minutes at a time. Extended in-flight usage causes the reflective material on the inside of the lamp to be burned off by the higher temperatures within the lamp over long periods of ON time.

History:

For decades, the lamp used in most leading edge wing landing light installations was the 4509 and along came the Q4509 which had an extended life, a changed beam width and greater intensity over part of the beam. Sometime within the last couple years, Whelen has been selling their version of the Q4509, claiming even greater life but not explaining what changes were made to create the longer life. They also forgot to mention that the price was three times the Q4509 or 7.5 times that of the original 4509. There are several misleading statements involved, making a selection based on claims very difficult.

The Q4509 made things better than the 4509 if used as the 4509 had always been...for landing, but it has limitations the maker never tells one about if they are used as traffic averters and left on all the time. Explaining that was the original intent of this article but the scope has been expanded to a comparison and explanation of what "lab lifetime" means and what reality is with respect to usage.

It is easy to get lost in the numbers, so here is a matrix you will find nowhere else, using the makers' numbers, to show the differences. The rightmost column is what none of the sellers ever let you see, that being the cost per hour IF the lamps last as long as the "lab lifetimes".

Type	Watts	Max CP	Beamwidth Degrees	Filament orientation for beamwidth	Lab Life	Filament	Cost and Cost per hour usage
4509	100	110,000	12 X 6	horizontal when viewed from the front, left to right	25	C-8	$9.90 40 cents per hour
Q4509	100	140,000	7 X 7	horizontal front to rear when viewed from either side	100	C-6	$25.00 25 cents per hour
Whelen Q4509	100	140,000	7 X 7	horizontal front to rear when viewed from either side	250	C-6 type	$75.00 30 cents per hour
4519	100	30,000	40 X 7	filament horizontal	25	C-8	
4595	100	60,000	14 X 6		300	C-6	

The last two entries are there to suggest how less apparent brightness but with a much greater beamwidth could be much better for taxiing in installations with two lamps behind the plexiglass.

There is no magic "life". There is no guaranteed life for an airplane landing lamp (or any incandescent lamp).

The Hype:

There have been many claims about the original GE Q lamp having four times the lifetime and twice the light output, but the information not included was that the brighter maximum slice of the light beam is partially brought about by a decreased beamwidth. And, a four times longer "average life" than for the 4509 is true but a four times guaranteed lifetime is not. Q's exhibit 27% more intense light at the centers of the beams than for the basic 4509's. The Max beams are not "max" across the beamwidth, going from the peak to ten percent brightness on each side of the center.

Not long ago, Whelen presented their Q4509 version, claiming that it would last ten times as long (as the normal 4509 but they failed to mention that), 250 hours average, at a cost 7.5 times that of the plain 4509. It might seem strange to you to realize that, although the Q version by GE and others have been on the market for ten years at least, Whelen makes no comparison with them. If they had, they would have said that their lamps have the same output as the GE Q but the Whelen version has an "average life" 2.5 times (NOT TEN) as long as the original Q for 3 times the cost of the GE Q. Note that they do not state that their lamps have any greater intensity than the original Q!!! because...they don't. But if you listen to the rumor mill, those tellers of tall tales make the claim that they do.

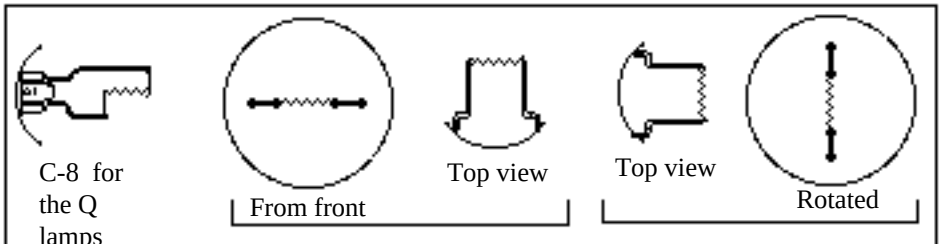
Lifetimes and the "Average Lab" Lifetime:

The longer lifetime of the Q is a very welcome result of the change to the design, though the "lifetime" definition is never researched by the dealers or users, and almost never understood. At the makers, a hundred lamps of the same type are in a lab at a constant 13 volts. When 50 percent of the lamps have failed, the number of hours at that point is called the "average lifetime" forevermore. The lab tests show that, on average, the GE Q outlasts the non-Q by a factor of four, 100 hours maybe instead of 25 hours maybe. Those who take the average lifetime as a guarantee do so in defiance of their experience in home or trouble light incandescents. Vibrate them enough or at just the right frequencies and true lifetimes are a few hours.

Having explained "average lab lifetime", I found a surprise while discussing the problem with the GE reps at the FAA-sanctioned A&X refresher seminars: NEVER has GE tested the lamp lifetimes when they were on continuously; the normal lab test was five minutes on and five minutes off, in open air. That means that even their "average lab lifetimes" are hokey. It means that anyone who leaves his lamp on continuously is being the true lifetime tester.

Filaments and why they matter:

All 4509's are identified as PAR 36, that code means Parabolic Aluminized Reflector, and the "36" is really a bulb 36 times 1/8th inch or 4-1/2 inches in diameter. The filament, relatively robust, is positioned to be horizontal to provide the light beam whose shape is also determined by the reflector The beamwidth of the 4509 was optimized for a landing light, twice as wide as it is high (12 degrees by 6 degrees).



C-6 filaments for the 4509's. On the left,viewed from the front and to its right the filament viewed from above. On the right, with the lamp rotated 90 degrees and its view from the top.

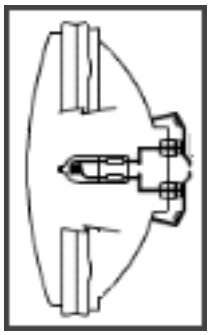
Note that if the Q lamp is rotated by 90°, the filament orientation would still be horizontal, front to rear. For the 4509, some rotate them 90° to have the filament vertical, trying to get greater vibration resistance of the filament when vertical versus when horizontal and accepting the penalty of the loss of beamwidth.

Halogen or Quartz?

To pre-empt the arguments about whether a "Halogen" type or a "Quartz" (Q) type is the better, let that comparison be nipped in the bud; they are the same except for the H/Q prefix. From the GE manuals for sealed beams, it can be noted that the H is used for sealed beam lamps for autos, trucks, tractors, fork lifts, and building emergency lights and the Q is used for aircraft. Sometimes, their listing is: "For airline use" for the Q and sometimes: "Halogen Quartzline for aircraft landing light". Comparing features, the Q & H lamps look exactly the same, with the little "quartz-Halogen" peanut sized bulb inside the big PAR bulb. All the Q/H lamps have peanut bulbs with Quartz envelopes and blends of Halogen gases inside the peanut. Together, they do the magic of the new lamps.

4509:

For decades, the lamp of choice for small airplanes has been the 4509, and it has served admirably, though with a shorter lifetime than many would like. Those most pleased with the utility and life had the lamps mounted in the leading edge of the wing whereas those with the lamps mounted in the cowl were less than happy. The vibration and landing shocks when mounted in the cowl were so much greater that desperate measures were used to increase the lifetime, such as cushioning the mounting, rotating the lamp 90 degrees, etc.. The beamwidth of the lamp, with the filament horizontal as intended, is 12° X 6°. Few of the writers who recommended rotating the lamp by 90 degrees so as to position the filament vertical mentioned what that did to the beam width which is projected on the ground...it is halved. Some users would have cared, but many accepted the reduction in utility just to keep from replacing the lamp too often. The Q version promised to make things a lot better!



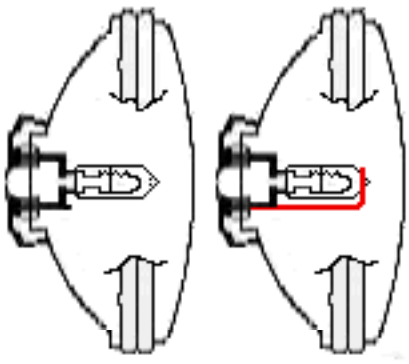
The Standard GE Q:

The Q version of the aircraft 4509 landing light made by GE (and others) is a great improvement on the basic 4509 with respect to the hoped-for lifetime but at a cost of a reduced beamwidth and at 2.7 times the price. The beamwidth was changed to 7° X 7° so its orientation makes no difference in that regard. The Q version has a factor of four longer average lab lifetime than the 4509.

The Q signifies that the Q4509 lamp has a peanut-sized Quartz-Halogen (Q-H) bulb inside the 4-1/2 inch diameter sealed beam glass bulb. The "magic" of the Q version is the little quartz-Halogen peanut bulb; its quartz glass walls are much thinner than plain glass can be and stronger than plain glass, so less light is lost by absorption, the walls can be hotter because they must be for the halogen cycle to take place, the Halogen pressure is higher, and the filament is hotter so the light is brighter though the wattage is the same. We tend to think of quartz as the crystalline material generally found with inclusions of gold, but the quartz of the Q lamps is amorphous, not cyrstalline, and its surface temperature for the tungsten cycling (see below) is at least 250° Celsius (482° F), much higher than glass could sustain. The combination of a reduced beamwidth and a greater luminous output means a higher beam intensity at the center, though not as much as so often reported.

The New Whelen Q 4509:

This diagram illustrates the only obvious change in the Whelen Q lamp when comparing it to the GE Q lamp...the new stabilizer for the peanut bulb, accentuated in red in this figure. The "peanut bulb" appears to be a bit larger and the filament may be more robust, but these observations are subjective. We have no hands-on experience with the Whelen, mostly because of reluctance to pay $75 for one.



Side views of the Whelen. On the left, the "peanut" bulb on the inside with the stabilizer removed for clarity. On the right, the very critical stabilizer wire from the base to around the seal teat of the peanut bulb, shown in red.

The Phantom Brightness Increase:

The additional brightness of the Q is nearly always mis-stated as “double” or “four times as much” but that has never been true; the “true” is even conditional and never mentioned. The brightest portion of the beam is stated as being 110,000 footcandles for the 4509 and 140,000 footcandles for the Q4509 and for the Whelen Q4509, hardly “double” but actually an increase of 27 percent but even that is not really true. If the statement had been complete, it would have included the note that some of that extra brightness comes from the reduction of beamwidth and some from the additional brightness of the Q-H bulb. Let me restate the “max”; the Q4509’s output is 140,000 footcandles at the point of the greatest intensity, and it is NOT the same intensity throughout the entire beamwidth. The whole usable output, the beamwidth, is from the 10 percent of the max on one side to the 10 percent point on the opposite side for all of the versions of the bulbs. None of the newer lamps “double” the intensity as is so often stated. Both Q brands have the same beamwidth and intensity.

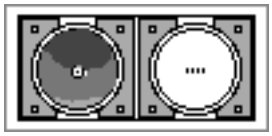
Physics:

There was a misstatement made in Pilot Magazine by an "expert" about the Halogen in a lamp acting as a "light amplifier". Mary Mattocks, a physics instructor whose husband is a pilot, read the article, disagreed, and corrected the explanation of the magic mechanism of the Q-H lamps this way, probably the most elegant explanation, better than GE's.

"In a normal bulb, the temperature of the tungsten filament cannot be raised too high because the tungsten would evaporate and permanently deposit on the glass envelope much too quickly to give the bulb a useful life. In a Halogen bulb, the tungsten filament is driven to a higher temperature and the tungsten does evaporate, but the envelope is much closer to the filament and therefore hotter. The envelope has to be made of quartz to withstand these temperatures, but there is a point to this added cost. At this hot quartz surface, the Halogen in the bulb reacts with the evaporated tungsten to form another gas (an iodide of tungsten) that drifts around inside the bulb. Any of this gas contacting the higher temperature filament breaks down into its constituents again, thereby depositing the tungsten back on the filament and freeing the Halogen to go back for more. Thus the Halogen acts to pump evaporated tungsten back to the filament, thereby extending the bulb's lifetime, even at these high temperatures.

In addition, at these higher operating temperatures, a much higher percentage of the power is radiated in the visible part of the light spectrum. Comparatively less of the power is wasted as heat, giving greater efficiency."

And Mary Mattocks closes with: "Longer life with greater efficiency, truly brilliant."



The Reflector Darkening Problem:

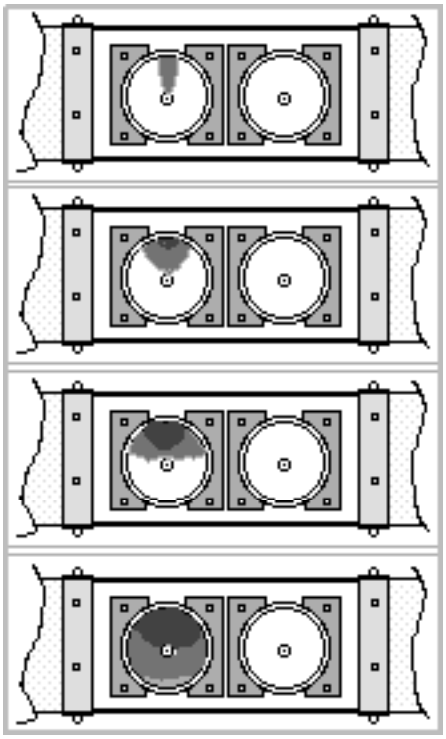
Many plane owners with the leading edge light installation changed from the 4509 to the Q4509 in order to get more life, though a few changed because they thought they were getting “four times” the light, the latter based on seductive word of mouth of “experts”. The lifetime for the Q model often equals the promised four times that of the plain 4509 based on burnout but when the lamp is behind a contoured plexiglass fairing in the leading edge of the wing and left on all the flying time rather than just for landings, a new failure mode comes in to play. This image indicates the short term result of using the Q on the leading edge behind a fairing. The Q is on the viewer’s left and the 4509 is on the right, with its reflector still pristine, but that of the Q vaporized to gray and black, non-reflective. The tiny peanut Quartz-Halogen bulb within the landing light bulb is often still clear and working, but its light doesn’t do much good without the reflector.

The unproven theory of the this reflector damage is that the lamps need to be “out in the breeze” if left on continuously in order to not exceed the reflector temperature which causes the indicated damage. Nothing in the GE Lighting manuals make any reference to a mounting consideration other than to avoid shock and vibration. If these Q lamps mounted behind the plexiglass need to have cooling vents in the fairing, no such recommendation is noted. Within a few hours of usage start, the dark “flare” pattern starts to reduce the reflectiveness of the quartz-Halogen bulb, with the degradation continuing until the whole reflector is “burned” to gray/black.

Some planes with the lamps behind a plexiglass cover in the cowl have small holes in the plexiglass. The darkening described here has been reported on Usenet by owners of bigger, newer planes as well.

From surveys, very limited, the Q works just fine when its face is presented to the wind while flying as long as it is also away from the centers of highest vibration. As a contrast, the aluminized reflector of those installed behind the plexiglass leading edge covers on the wings start to blacken almost immediately if on all the time.

It used to be that landing lights were used only on landing at night and they tended to last years when installed in the leading edge but with the use of landing/taxi lights all the time in flight to increase visibility (conspicuity) of the plane by others, the Q lamps behind the fairing soon lose their effectiveness as the reflectors degrade.



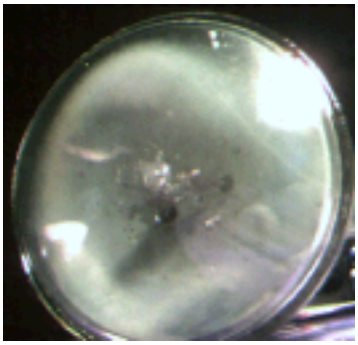
Here is the appearance of a Q lamp after a short time, as little as three flight hours if the lamp is left on to alert other planes for maximum visibility day or night. Note the "flare" of darkened reflector of the inboard landing light, the outboard light left untouched for comparison.

The "flare" of darkened reflector will continue to grow proportionately to the usage and is worse for the plane with the lights used all the time as recommended for safety. Those who use the lamps only upon landing at night seldom see the same result.

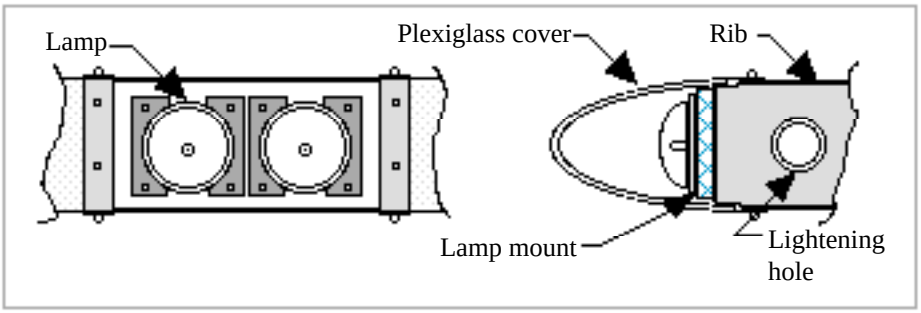
The reflector gets increasingly blackened, actually shades of gray and black as suggested here, and the light projected is naturally decreased, although the little Q-H bulb inside is as pure in appearance as when brand new so you still have light, but no effective beam or anything near rated brilliance.

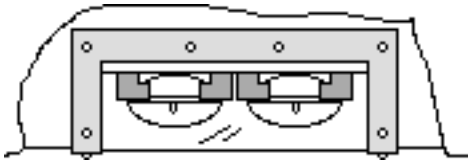
Within a surprisingly short time, there is effectively no reflectance left from the reflector, and the only "beam" is one drastically reduced in intensity. The pictures later in the report show the lack of any reflectance and the now-gray reflector also has "freckles" or black spots.

These two pictures indicate the destroyed reflector, including the "freckles" of black; note that the little Quartz-Halogen bulb inside is still pristine.



150 Kits & 140A Option:



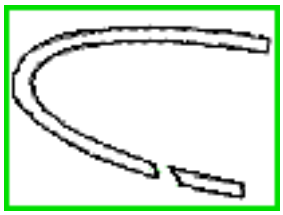


Many of our planes which have the leading edge lighting have used the kits from the 150 Cessnas though many have made the change based on the 140A optional leading edge installation (using that as a guide makes getting the 337 for the change easy....usually). In the "used to be", one was able to purchase everything except the hole in the wing from the likes of Aircraft Spruce and even Cessna. Today, most get a kit from an expired airplane. Wag-Aero is the only catalog of those I have which lists the plexiglass leading edge fairing ($41).

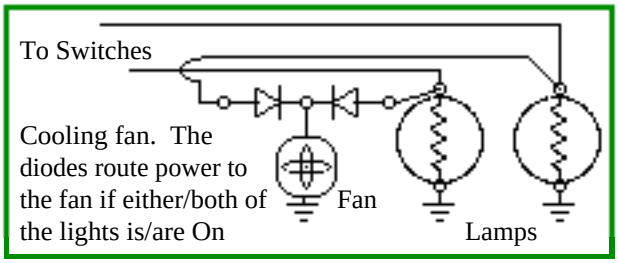
When the entire kit was purchased from Cessna for the 150, it came with instructions on how to install and how to adjust the lamps for the best use. Contrary to the adjustments (if any) the installers make, the outboard lamp should be the taxi light and the inboard should be the landing light and they need to be aimed at night and with multiple trial flights to achieve the best utilization. With the plane parked about 50 feet from a tall hangar, the aim of the landing light for me is about 12 feet up on the wall, left of center. How you land, three point or wheelies, will also determine where you want the beam to be aimed.

This figure indicates the usual installation; the leading edge of the wing has a cutout in which are mounted two X4509 lamps and that cutout is faired to the same shape as the leading edge with a plexiglass cover. No guideline appears in the GE Miniature and Sealed Beam Lamp Catalog for the designer or user to make sure that the lamp is "in the breeze" when mounted on the plane.

Possible Solutions:



The Q bulbs are getting hot enough behind the plexiglass fairing that the aluminized reflector is being destroyed and that means the big bulb is getting hotter than the makers expected. Options that come to mind are to install a 12 volt computer fan so that it blows on the landing lights all the time the lamps are on. Cool air is "free" if one can use it, and putting holes or slots in the plexiglass fairing are obvious choices to provide cool air. Sizes, angles, and how many holes are unknowns. Holes would seem natural at the bottom side of the fairings because the pressure is higher than at the top, and holes on the bottom could be slanted such that no water is ingested. I have taken liberties with the thickness of the plexiglass in order to accentuate the angle of the holes How big? How many? Only experiments will tell.



One of the suggestions to keep the lamps cool in continuous use is to add a fan so picture a small computer fan mounted on the rib within the lightening hole in the picture. Four ounces perhaps, made for thousands of hours of run, 12 Volts, 70 milliamps (0.070 A), and 2-1/2 inches square and an inch deep.

STC:

There is presently some controversy as to whether there is a valid authorized STC for the wing light installation. The name of record for the STC has gone through about four addresses, none of which elicit an answer, and the phone number of record is no good and the FAA is still listing the information which has not been valid for years.

Having written that in December, now March, and Garry Fancy of Canada kept trying to contact the owner of the STC and DID! Al Snyder Skycraft corp. Rt.1 Hampton airfield North Hampton NH 03862
Ph. 603 -964-1450 Fax 603 -964-7604

The STC covers both the 120 and the 140. If you buy and want to use the STC, take plenty of time and read it about ten times, working out the errors and the misleading cross-outs.

Errata:

In the 2004 Aircraft Spruce catalog, this "stretch" of the truth: "..the Whelen Q 4509 a true 150,000 cp beam upgrade". Nonsense. The extra 10,000 cp is whiffenpoof. What it means is that the writer did not understand beamwidths nor how to copy the 140,000 cp Whelen claims.

Cessna, on there new planes, is still installing the 4509 for the landing light, but they have advanced to using what appears to be the 24 volt version of the wide angle 4519 for the taxi light. At least they are back to installing them in the leading edge rather than in the shakiest part of the engine cowl.

Neal

Neal F. Wright
cougarnfw@aol.com

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