

UPGRADING YOUR LIGHTING SYSTEM

So, you say your headlamps aren't bright enough, and you want to do something about it? The very first thing you should do is aim them. It's amazing how much better even old tungsten sealed beams are when they're pointed where they're supposed to be! Best of all, it's free.

The next thing to do is check the electrical connections. Most importantly, make sure you have a good ground coming off each headlamp. The Lucas bullet connectors are usually pretty good, but the wire going into them isn't strain relieved and some strands may have broken over time. Check for corrosion on the spade lug connectors; if you have any doubts, replace them. Use a good crimping tool *and* solder - most "automotive" crimping tools won't make a gas-tight seal, and if gas can get in, moisture can get in, which leads to corrosion. Throw away the plastic collar on the connector (if you buy that kind) and make your own strain relief with multiple layers of heat shrink. This is another area where the economies of the automotive industry did not have long lifetimes in mind.

OK, that's not bright enough? Time to start spending some money. The cheapest upgrade you can do is to replace your headlamps with new versions of what's in there. If you're in the US, that means buying new sealed beams with tungsten filaments. If you're anywhere else, replace the bulb unit - it can't cost much.

Just for grins, check the aim again after you've made the swap. (Have you detected a theme here?) The theory is that you don't alter the alignment when changing bulbs, but manufacturing tolerances are not that tight.

The reason this can make a difference is that tungsten filaments get dimmer over time - while the lamp is on, a microscopic amount of the filament gets boiled off and deposited on the glass. This forms a barrier to the light, so the light gets dimmer! In a quartz halogen light, the bulb globe is made of quartz (to withstand the higher temperature). The bulb itself is filled with one of the inert halogen gasses (iodine or bromine), which acts to redeposit the tungsten particles emitted from the filament at incandescence back onto it instead of on the inside of the globe, which causes the characteristic glass blackening - one of the reasons, along with corrosion resistance, that we in the US got saddled with sealed beams in the 1930s.

But if you're going to go to the effort of taking your headlamp apart, I suggest that you at least spend a bit more and move to slightly newer technology: buy a halogen sealed beam (in the US), or put in a halogen capsule that's rated at approximately the same wattage as your stock capsule (that probably means 60/55 watts instead of 45/40).

This gets you an improvement in light output with relatively low expense and doesn't run you afoul of any laws (in the US, the separate bulb/reflector units that I'm about to go into aren't legal, but no one pays much attention). You also won't toast your wiring.

Speaking of wiring, you may be able to get an improvement in light output by upgrading your wiring harness and continuing to use the stock headlamps. Most British cars run the headlamp circuit unfused, and use fairly thin leads in the wiring harness to the switch, if not out to the headlamps.

If you're running "classic" separate bulb units (like the Lucas PL700 "tripods" or Le Mans, or Marchal Equilux), you'll need to get a special bulb - you can't just go out and buy an H4 bulb and plug it in. PL700s take what's known as a P45 or type A base. Halogen capsules on a P45 base are commonly available. The LeMans lamps are on a P36 base - also adaptable, but more rare these days; they need a different bulb and a special adaptor to fit the modern three prong lighting plug.

If you have British PreFocus headlamps, you may be out of luck. I've never run a car with BPF, so I have never tried to upgrade the lamps; I'd love to hear from someone who has. I believe that the solution for the Le Mans headlights is what's needed for BPF bulbs, but I'm not sure.

GET A BETTER HEADLAMP

Please note - I'm writing about 7" round headlight because they are what I know - all my cars are fitted with them. The same theories apply to smaller round or rectangular, but I have never dealt with them so I can't make specific recommendations.

There is no reason to tolerate 1930's headlights in the 1990's, be it a fine vintage car or your modern sedan. Installed responsibly, today's quartz halogen lights provide efficient lighting to the driver and are inoffensive to opposing traffic. Several car manufacturers and tuners have now engineered through loopholes in the 1930 US lighting laws and provide QH lamps as standard equipment. Few communities enforce these old laws, and most of the lights aren't even that expensive. (Most H4 lamps seem to fail to meet the letter of the law **only** because they don't have aiming bumps.) I don't believe that there is any reason not to have these superior and safer lights.

Usually the term "quartz halogen" is used broadly to refer to any light system using a QH bulb, because lens, reflector and shielding all work hand in hand with the improved bulbs. Lenses, for instance, are lead crystal, the clearest glass man can make. Reflectors in the quality lights are precisely shaped stainless steel with highly polished, aluminized coating (even more reflective than chrome), not silvered plastic. Bulb location, shielding and lens fluting are all closely controlled dimensionally to give sharp upper cutoff for better vision in weather conditions and to keep from blinding oncoming traffic.

QH headlights are usually built to European (E-code) specs, which feature a distinct horizontal cutoff low beam that gives an amazing amount of light without blinding an approaching driver. High beam range is generally twice that supplied by US Federal sealed beam.

The best, bar none, 7" round headlights in the world right now are the Marchal H4 "flat face" lamps. Unfortunately, they are no longer manufactured, and are getting rare and expensive (the only source I know is charging more than \$200 each).

What makes these lamps so very good is that they have a razor sharp low-beam cutoff; unless the fog is *very* thick, you don't need any auxiliary lamps (assuming that you've aimed the headlights correctly, of course).

After that, I would choose a Cibie Z beam, and then a Cibie "E Code". These also have a great low-beam cutoff.

Either of these lamps should get you through the worst weather without the need for an auxiliary lamp - provided you drive slowly enough for the conditions. The low-beam cutoff is critical to not letting the light reflect back into your eyes.

Hella has a good reputation and a large market presence. Unfortunately, I don't have any direct experience with them. They are not the first name that comes up with rallyists get together and talk lighting. Unfortunately, Valeo, which is now the parent company of both Marchal and Cibie, does not seem to care much about the US market any more, nor much about the lighting aftermarket in general.

There are cheaper lamps. I don't have any experience with them.

Any 7" H4 will be an improvement over the stock sealed beams. Even the sealed halogens (Sylvania makes them, among others) will be an improvement, but they suffer from many of the same problems that tungsten sealed beams do - in particular, they typically have a very poor reflector design.

One thing to note is that H4 lamps are *not* legal in the US; the ancient DOT laws against separate bulb headlamps apply, so H4 lamps are marked "for off road use only". Most jurisdictions don't care any more; maybe one day the law will get changed. If you care that much, use the sealed beam halogens and accept the results.

Hella has recently come on the market with an H4-derived lamp that they somehow claim is DOT legal. I don't have experience with these, either, but they might be worth checking out if you're in the habit of attracting cops who are looking for an excuse to write you a ticket.

Again, whatever lamp you choose, AIM IT PROPERLY!

Now, back the H4 lamps. Upgrade the stock 60/55 bulb - for courteous street driving, I recommend a 100/55. If you're careful about aiming, trust your wiring and don't think you'll attract the attention of cops, go for the 100/80 or 130/90 or higher ... but don't come back to me when your stock wiring melts. Even if you install relays, the wiring out to the headlamps in our cars is woefully small. I ran 100/80s for a while and the resistance out to the buckets was high enough that they weren't appreciably brighter than the 60/55s. (Note that most European countries have declared lamps brighter than 60/55 illegal. If people would learn to aim their lamps properly, we wouldn't have such ridiculous laws on the books.)

UPGRADING YOUR WIRING HARNESS

If you make any of these upgrades, add relays, and fuses. The stock harness in most of our cars runs all the headlight current through that teeny-tiny headlamp switch, which often comes from the factory with 18 gauge leads! If the contacts don't burn, and the wires don't melt, you'll be getting a lot of voltage drop. Not to mention that the headlamp circuit is typically unfused - a ground fault/short here will cause serious harness damage. (If your switch isn't the weak point, someplace else will be - our Morris Minor has a great harness all the way out to the fenders, but the subharness that goes through the fenders to the lamp is made up of 18 gauge wire...)

At the very least, you want a relay and fuse on the high beam circuit. The best (and easiest!) way to do this is to buy a fused Marchal 514 relay. They're bulletproof, and can easily be spliced into the high beam circuit. Find some source of unswitched 12V (brown wire, you want a heavy one). Find the blue/white wire leaving the dip switch (usually there's a connector that connects the switch, the lead out to the lamps, and the indicator - this is a good spot). Connect the brown wire to the source terminal on the relay. Connect the U/W

wire coming from the switch to the coil. Connect the U/W wire going to the headlamps to the load. Make a good coil ground. Voila! You now have brighter high beams, even if you didn't change the lamps. (If you're particularly anal, wire the new harness with appropriate colors- I would use blue/slate for the lead that splices from relay to the headlamp wire). Use heavy wire for the load connections - 14 gauge.

If you think about it for a little while, you can make up a neat two- or three-wire harness and mount the relay where it's out of the way but accessible (so you can change the fuse if it blows). In the GT6+, I mounted it on the firewall with all the other relays; there's a good source of hot at the overdrive relay, and it was easy to pass the two-wire harness through one of the existing grommets.

Now, if you're having fun, you can rig a parallel relay for the low beams. If you're going to do this, then consider not using two Marchal relays, but two unfused relays, sharing a single source, which you fuse. Lucas makes a very nice metal relay with a separable plastic base (it's called a 28RA) - you can snap the bases together to make up a multi-unit block, and there is available a fuse holder that snaps to the end (holds a modern blade-style fuse). These are all available from British Wiring.

Sometimes this isn't good enough, because the harness out to the lamps is not up to the task. One fellow with a TR3 measured more than a volt voltage drop from the switch to the lamps. In this situation, you want to mount the relays out at the lamp end of the harness; there's usually a spot near the grille where one wire becomes two, and this is the place to splice in to minimize that sort of voltage drop.

AUXILIARY LAMPS

Now we can go on to auxiliary lamps: there are two basic kinds, with variations on each.

Fog lamps have a short but wide beam with a very sharp cutoff to reduce light reflection off the fog into the driver's eyes; they're used to illuminate the road immediately in front of you without reflecting back off the fog or rain and blinding you. They should be mounted as low as possible, ideally below the bumper. They're also useful as cornering lights for racing because of their broad lateral pattern.

Driving lamps have a narrow but long beam, to light up the road beyond where your main beams reach ... several thousand feet ahead of the car. They have a broad beam that lets you see around curves far ahead. You want these when you're headed down your favorite straightaway at night at an illegal speed. They are best mounted above the bumper. *Spot* or *pencil beams* are an extreme variant of driving lamps, and do just what they sound like they do. They provide a tunnel of light over a mile ahead, but give no lateral vision. These are of little use alone (use them in conjunction with driving lamps) and are a waste of time unless you intend to drive over 100 mph. The old rallyist term of "follow the bouncing ball" of light is an earned reputation. Primary use is racing, high speed rallies, and off road. But then they would prove just the thing if you live 50 miles down a straight lonely road in Nevada!

All these lamps should be individually switched, but everything except fogs **must** be interlinked to the high beam dip switch so you can cut them all with one motion when meeting another car. (This is the law in most European countries - it may well be the law in some States. It's also a good idea.) Fog lights, aimed correctly, will help your vision and not harm your fellow motorist's vision at all. Wire fog lamps so you can turn them on with just the parking lamps, in case the weather is so bad that your well-aimed low beams still make the fog too bright to see what's going on. **None** should be used in heavy traffic situations.

Note that you don't have to fit these in pairs. A rallying acquaintance yearns for the days of running his Volvo 122 with one each of the Marchal 902 fog and driving lamps (switched individually, of course).

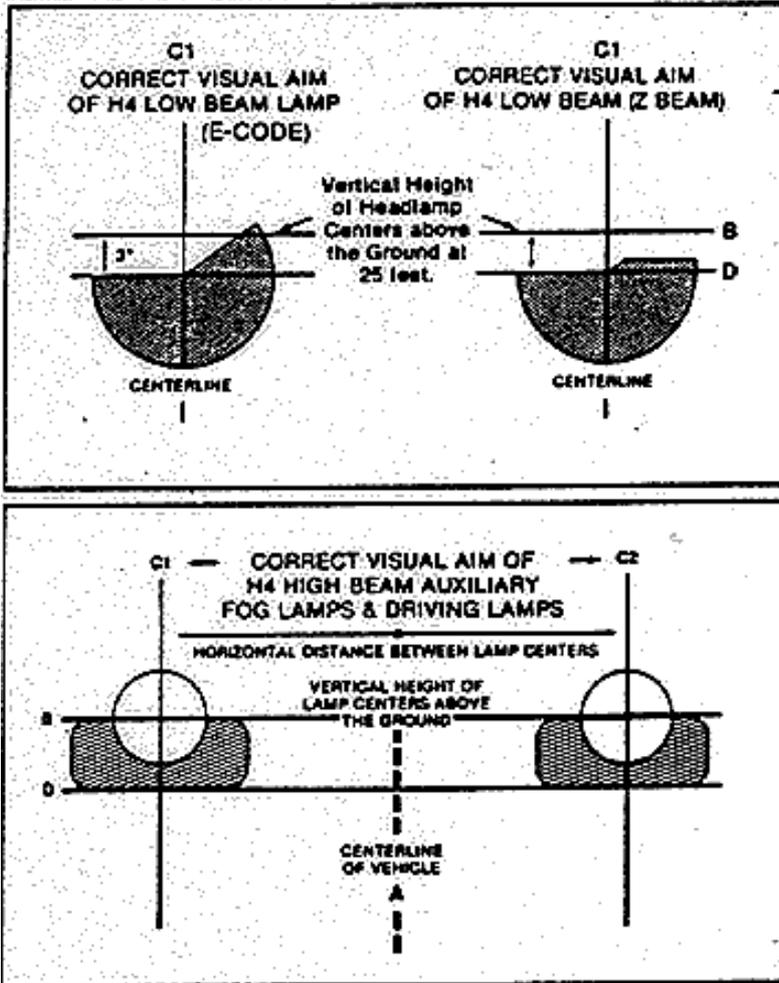
Use relays and fuses. If you're clever and careful, you can put it all together without cutting the original harness. My TR4A has a set of four relays and a Lucas two-fuse box in the driver's footwell: the low and high beams are on individual relay circuits, the driving lamps on another, and the fourth relay is a changeover - I can select just the high beams, just the driving lamps, or both together, when the dipswitch is in the "main" position. It took a weekend to figure out exactly how to splice into the original harness, but the result looks as if the factory intended it that way.

AIMING YOUR HEADLAMPS

If you haven't figured it out yet, I think that aiming is important. Your lights are dangerous and ineffective when improperly aimed. There are specialized machines that aim headlamps very accurately - but these tend to be in the hands of "official, certified" shops who will either call the light cops or charge you for aiming and even give you a certificate saying they're aimed, but not do anything. So it's best to just learn to aim them yourself.

The basic goal is to get the beams parallel to your direction of travel, low enough that they don't blind oncoming traffic, and the same height. You should see the low beam cutoff on the cars in front of you.

First, find a level stretch of driveway that is adjacent to a wall or garage door (to act as the aiming screen). Prepare the car in normal travel trim (*i.e.*, luggage, fuel and passenger load simulated). Roll the car up to the wall. Mark the headlight centers both vertically and horizontally with a heavy felt tip on the screen. (You might want to use a large piece of cardboard and save it to be re-used *on the same car*; these days I tend to stick a couple of Post-Its on the wall and be done with it.) Mark the center of any auxiliary light as well. Now, roll the car **straight** back, 7 metres. Scribe a straight line between the headlight centers (line B). Measure down 7 centimetres and draw another horizontal line (D). Do the same for your auxiliary lights. One at a time, aim the lights as follows (turn off or cover the lights not being aimed):



Low Beams. The correct visual aim for low beams is with the top edge of the beam at horizontal D. The point at which the cutoff begins to rise to the right should be located straight ahead of the lamp at the intersection of D and C.

High Beams. The correct visual aim for high beams is with the center of the high intensity zone at horizontal, straight ahead of the lamp as indicated by circles C1 and C2. When aiming high beams on a four headlamp system, cover the adjacent headlights.

Horizontal aiming. Slight leftward aim (-2,5 cm.) increases seeing distance down the road, but excessive leftward aim increases glare to oncoming traffic.

Auxiliary Lamps. To aim your lamps, turn the lamp to be aimed on and cover or turn off all other lamps. Loosen the nuts on the mounting bolts and move the lamps until the light falls into the place recommended by the aiming diagram.

For Fog Lamps: light should fall between lines B and D as indicated by shaded rectangles.

For Driving Lamps: light should fall straight ahead of the lamps at the intersection of lines B and C1 and C2 as indicated by circles.

Tighten the nuts on the mounting bolts securely when aiming is completed.

... AND BE SEEN

Now that you can see what's in front of you, it's time to wonder if the people behind can see you! You can do many of the same things to check out your brake and tail lamps - clean up the wiring harness, polish the reflector, clean the lenses - but most of our cars have small bulbs and poorly designed reflectors, leaving them all but invisible from the rear.

QH technology comes to the rescue again, but with a catch. You can buy QH light capsules fitted to traditional bulb bases, but rated at higher wattages. They draw a bit more current, provide a lot more light, and *put out a lot more heat*. This latter is of concern to those of us whose cars have small taillights with plastic lenses, because these bulbs have been known to melt them. You can buy them from the usual suspects, but be careful; you might want to test them with a scrap lens first.

And if you've significantly increased your wattage with upgraded headlamps and QH taillamps, it's time to start wondering if your generator is up to the task of running all this stuff...