



Daniel Stern Lighting

Why & How to Aim Headlamps and Auxiliary Lamps

No matter how good (or bad) your headlamps and fog lamps might be, they'll work effectively and safely only if they're correctly aimed. Lamp aim is *by far* the main thing that determines how well you can (or can't) see at night—it's even more important than the output and beam pattern of the headlamps themselves. Here's a real example of how crucial it is: if you're using the shine-on-a-wall method, aiming a particular kind of low beam just 2.3 cm (0.9 inch) lower than it should be cuts 26 m (85 feet) off your seeing distance at night!

But in North America most people don't know or care much about lamp aim, figuring—very incorrectly—that if they're not getting flashed at night the lamps are OK. Most states and provinces long ago stopped requiring periodic aim checks. The few remaining areas mostly use an unreasonably sloppy go/no-go standard that can only catch vehicles with lights pointing down on the bumper or up in the trees.

U.S. and Canadian Federal law doesn't require new vehicles to come with the lamps correctly aimed, so even a brand-new car doesn't necessarily have the lights pointing where they should. It's such a problem that the Insurance Institute for Highway Safety checks, but doesn't adjust the aim of the headlamps on cars they test. They do it this way because most new cars don't get the aim corrected before delivery, and since poor aim worsens the headlight performance rating, this test-as-received policy of IIHS is an effort to push automakers and dealers to do a better job.

So "close enough" really isn't good enough; make the effort to get the lamps aimed carefully and correctly, very preferably with an **optical aiming machine**. That's a device that looks a bit like a TV camera. It gets wheeled in front of each headlamp on your vehicle, adjusted to height, and the optics within the machine permit highly precise visual aim checking and adjustment—definitely the most accurate way to aim lamps. To get an idea of what a proper lamp aim job looks like (on any make or model of vehicle), see [this VW document](#).

It can be difficult to find a shop that has one. And even dealerships that have one often don't bother using it; if a customer comes in and complains about the lights, they get randomly raised (if the complaint is "can't see") or lowered (if it's "getting flashed"). Keep calling around until you get the right answer. "We shine them on a wall/on a screen" or "Yeah, we can try and level 'em out for you" or "The headlamps on that vehicle aren't adjustable" are examples of wrong answers. Really beat the bushes before deciding nobody near you has one; ask at high-end body shops and auto dealer service departments, but if you have no luck, try talking with the companies who make the aiming machines. They should be able to tell you who has their machines in your area. Check with [American Aimers](#) and [Lujan-Sniper](#). Call Hella USA at **1-877-22HELLA (1-877-224-3552)** and ask who has a Hella Beamsetter.

If you just cannot find someone who has an optical aiming machine and is willing to use it correctly, you will have to make do with the distant second-preference method of putting the vehicle on flat, level ground and shining the lamps on a wall a certain distance away. It has to be done as carefully and precisely as possible, so here are detailed instructions:

Find a location that has a vertical wall and enough **flat, level** ground for the length of the vehicle plus 7.6 m (25 feet). This is surely the hardest part of the whole procedure; it's not common to find really, truly flat, level ground that long. Do the best you can.

To prepare for aiming, the car should have about half a tank of fuel, weight in the trunk and passenger compartment equal to the most frequently carried load (this may be a full trunk, or it may be an empty one, or anything in between), and weight in the driver's seat equivalent to the most frequent driver. All of the tires should be checked when cold to make sure they're at the correct inflation pressure. Jounce each corner of the car firmly (grasp the bumper and push down several times rhythmically) to ensure that the suspension is settled into a normal position.

The wall will be used as an aiming screen, so it should be of a light colour. You'll need to make marks on it, so if it is a wall you're not allowed to deface, use removable tape. Pick a dark or bright colour that will contrast with the light wall so you can see the marks clearly from a distance. Measure 7.6 m (25 feet) straight back from the wall, and mark this position on the floor or ground. Align the front of the vehicle with this floor mark, and then bring the vehicle straight forward, right up to the wall. **If you're working on a motorcycle** it will have to be held upright and steered straight ahead, so you might want a helper. Make a mark **V** on the wall directly in front of the centre of the vehicle. Good

references for the centre point include such things as hood ornaments, grille badges and license plate brackets. It can sometimes be helpful to go behind the car and sight through the backglass and windshield.

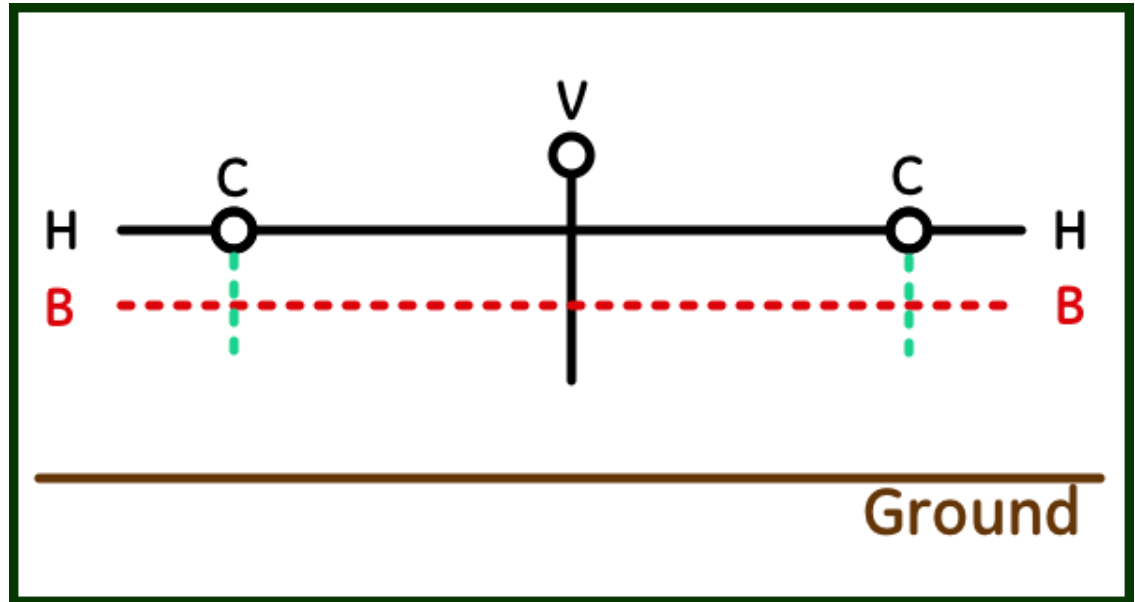
Next, make a mark **C** on the wall directly in front of the axis of each lamp. The lamp axis is often marked with a dot, cross, bulb type designation or name brand, but if not, it is directly in front of the bulb. There is one axis for each lamp, so a vehicle with four lights will have four axes and a vehicle with two lights will have two, plus any auxiliary fog and/or driving lamps that may be present.

Now, move the vehicle **straight** back from the wall until the headlamps are above the floor mark. Walk to the wall and make additional marks: Extend the **V** mark with a vertical line downward at least 15 cm (6 inches). Next, connect all of the **C** marks with a horizontal line we'll call **H-H**. Then, measure downward—this measurement is represented in turquoise here—from each **C** mark that represents the axis of a lamp that produces a low beam or a fog beam (no need to do this for lamps that produce only a high beam) per the following tables:

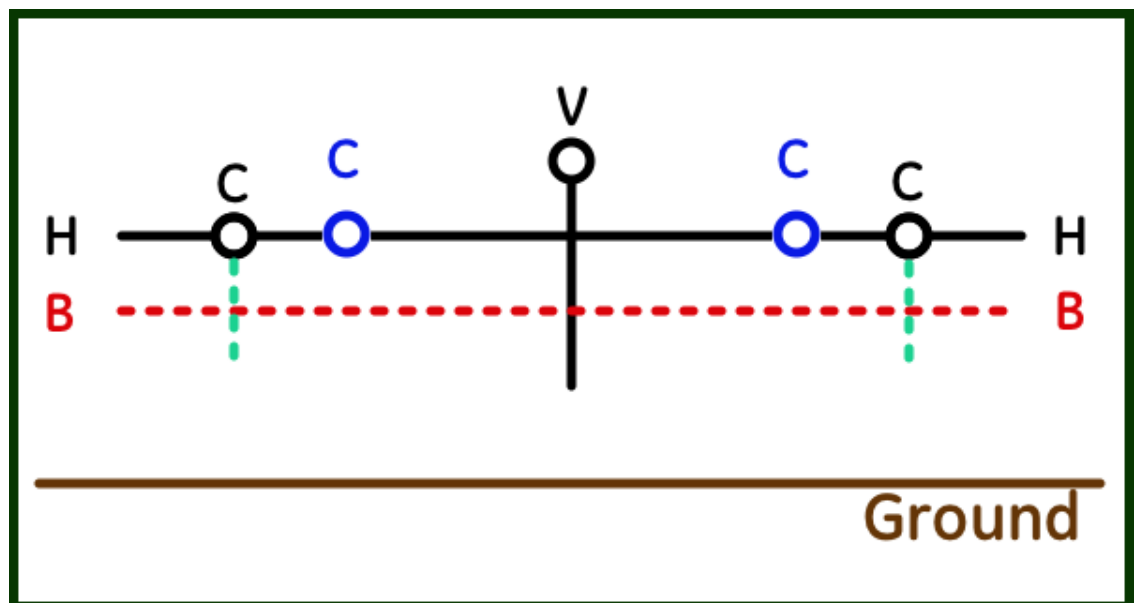
U.N. (ECE, European, "E-Code") lamps	
and	
U.S. ("DOT", "SAE") lamps marked VOL	
Up to 34.5" (80 cm)	2.1" (53 mm)
35" to 39" (89-99 cm)	2.5" (64 mm)
39.5" or higher (100 cm)	3" (76 mm)
U.S. ("DOT", "SAE") lamps marked VOR	
and	
older U.S. lamps without a "VOL", "VOR", or "VO" mark	
Up to 34.5" (80 cm)	N/A, do not measure downward
35" to 39" (89-99 cm)	2" (50 mm)
39.5" or higher (100 cm)	3" (76 mm)
All lamps producing only high beam	
and	
Driving (auxiliary high beam) lamps	
Any mount height (80cm)	N/A, do not measure downward
Fog lamps	

Up to 18" (46 cm)	1.5" (38 mm)
18.5" to 28" (47-71 cm)	3" (76 mm)
28.5" or higher (72 cm)	4" (102 mm)

Connect these two newly-measured points with a horizontal line we'll call **B-B**, represented here in red. After you've done all of this, your wall will be marked like this for a system of two high/low beam headlamps (or for a pair of fog lamps):



Or like this for a system of two low- or low/high beam plus two high-beam lamps:



Notes for the table and figures shown so far:

- The visual aim procedure for lamps listed above as "N/A, do not measure downward" does not require the lower B-B horizontal line; just connect your **C** marks with a horizontal **H-H** line.
- The 4-lamp diagram shown here is drawn for two lamps on each side of the car arranged side by side. If your vehicle has two lamps on each side stacked atop each other, canted, or otherwise arranged, your marks for the high beams—represented here by the blue dots—will follow that arrangement.
- U.S. ("DOT", "SAE") headlamps designed before 1998 won't have a "VOL", "VOR", or "VO" marking. Instead they'll have either three small cones on the front of the lens in a triangular pattern, or a small spirit bubble level built into the top of the headlamp housing, visible with the hood raised.

Now draw a vertical line through through the centre of each **C** point. Do the same with the **V** point. These lines make it easier to see the reference marks when you are standing 25 feet away, adjusting the aiming screws on the car. You now have an accurate plot on the wall of the height and separation of the headlamps (if your car is level, the ground is level, and the wall is vertical). Note that the "B-B", "C" and "V" designations are for purposes of clarity in this descriptive article. It is not necessary to draw the letters on the wall—just plot the points. Of course, you may use the letters in your aiming procedure if it will help you.

Low Beams: Vertical Aiming

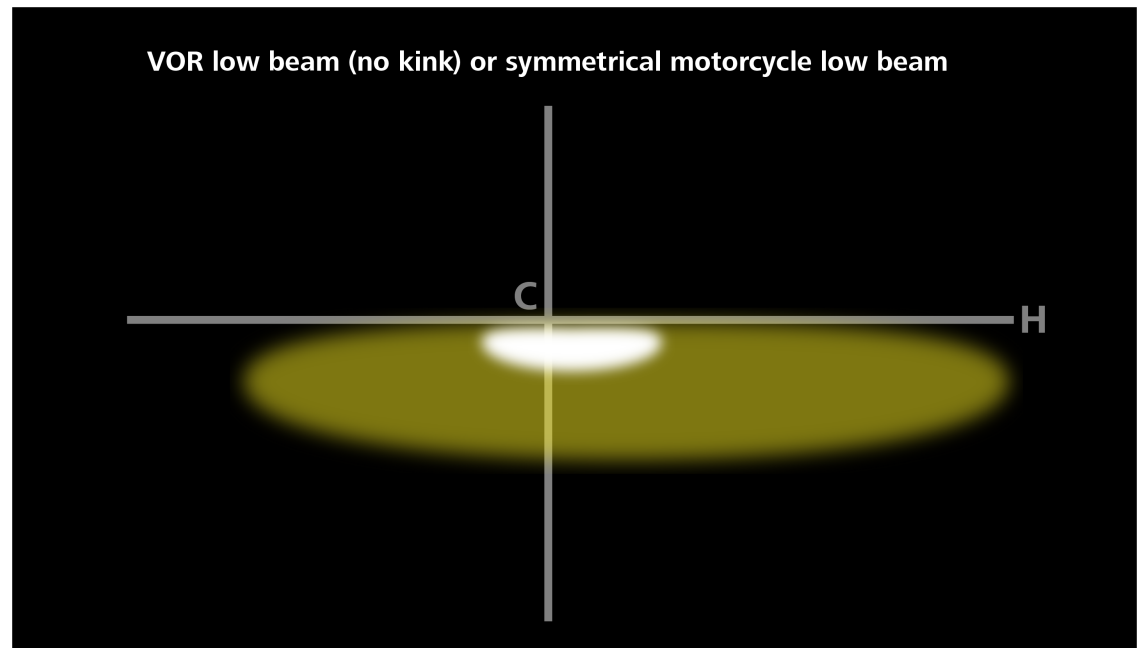
Important note: These instructions are written for countries with right-hand traffic (vehicles flow on the right side of the road). To use them in countries with left-hand traffic, such as the U.K., Australia, and Japan, read "left" for "right" and vice versa.

The low beam pattern of a visually-aimable headlamp has a distinct horizontal "cutoff" at the top of the beam pattern. It may be hard/razor-sharp, or it may be softer/fuzzier. Below the cutoff is bright light, and above is dark. Vertical aim is done by measuring and adjusting the height of this cutoff relative to the reference marks you put on the wall.

For U.N. (ECE, European, "E-code") and U.S. **VOL** headlamps, the cutoff to pay attention to is at the top of the left half of the beam pattern, and it should be aligned with the **B-B** line.

U.S. (DOT, SAE) **VOR** headlamps can have a straight-across cutoff line extending all the way across the top of the low beam, or a staircase-shaped cutoff that's lower on the left and higher on the right side of the beam, or just a squared-off top edge of the high-intensity "hot spot" (brightest part of the beam). Whichever style it is, the cutoff to pay attention to is at the top of the right half of the beam pattern. It should be aligned with the applicable horizontal line per the table above.

Motorcycle headlamps often have a straight-across cutoff line at the top of the low beam; they get aimed this same way (again, you'll need a helper or other means of holding the bike upright and steered straight ahead). A low beam with a flat-across cutoff gets aimed like this:



For older U.S. headlamps, the ones with the three lens bumps or the spirit level, you will have to do your best to place the top edge of the low beam's high-intensity "hot spot" on the applicable horizontal line per the table above.

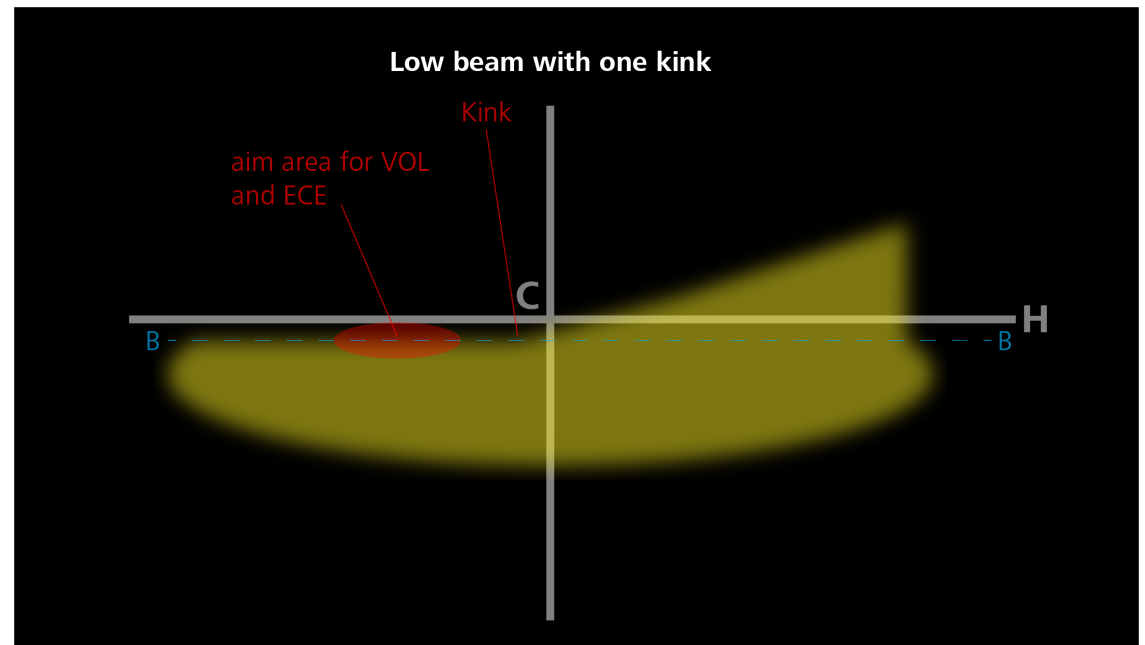
Low Beams: Horizontal Aiming

The technical specifications for U.S. (DOT, SAE) VOL, VOR, and VO headlamps are such that in most cases these lamps cannot be aimed horizontally; no provision for horizontal aim adjustment is provided. American regulators writing the rules in the mid-1990s declared there is no way "without damaging the beam pattern" to define a visual cue, such as a kink in the cutoff, to allow for accurate horizontal placement of a headlight beam. They did not comment at that time on the fact that cars get in fender-benders that knock the headlamps out of horizontal alignment, but they did say the low beam patterns they were defining were wide enough that horizontal aim wouldn't really matter. Time—and scrutiny by the likes of IIHS and Consumer Reports—have not borne this out. Notably, the European beam pattern introduced in 1956 (and still in use) was designed to allow for horizontal and vertical aimability, and that's been working fine for over six decades now. And even in North America, there are plenty of situations where horizontal aim can and should be checked and corrected. Vehicles that have had a different-

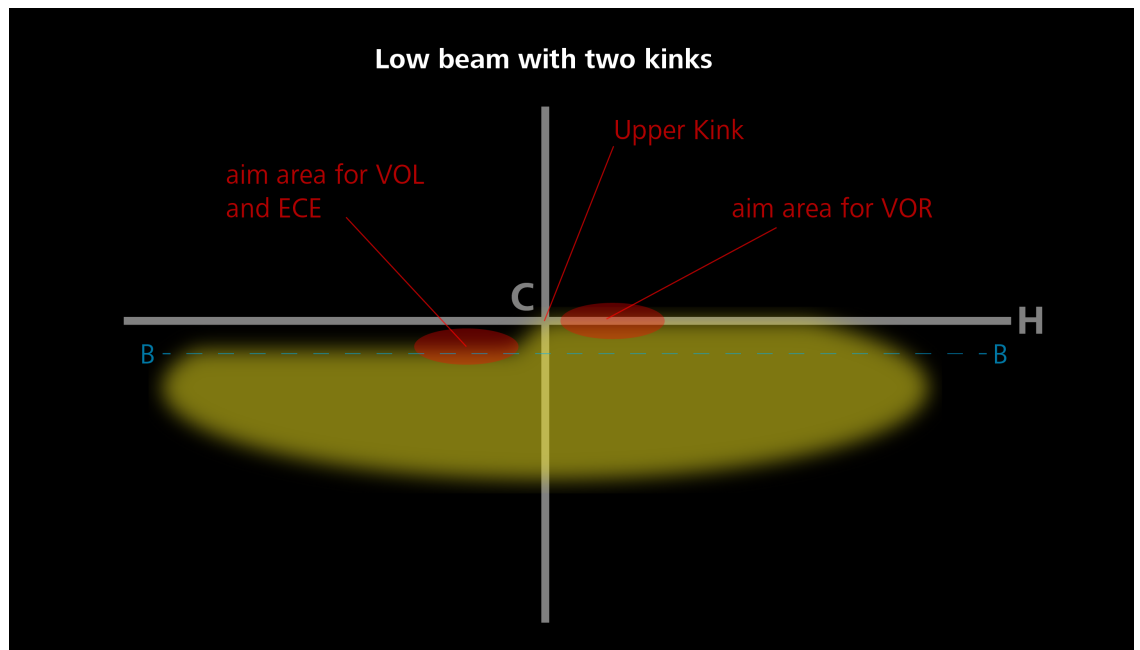
than-original type of headlamp installed, for example.

U.N. (European, ECE, "E-code") and VOL headlamps have one or two kinks in the cutoff line. If there's just one kink, it's where the cutoff bends upward from horizontal. If there are two kinks, the cutoff line will look like a stairstep.

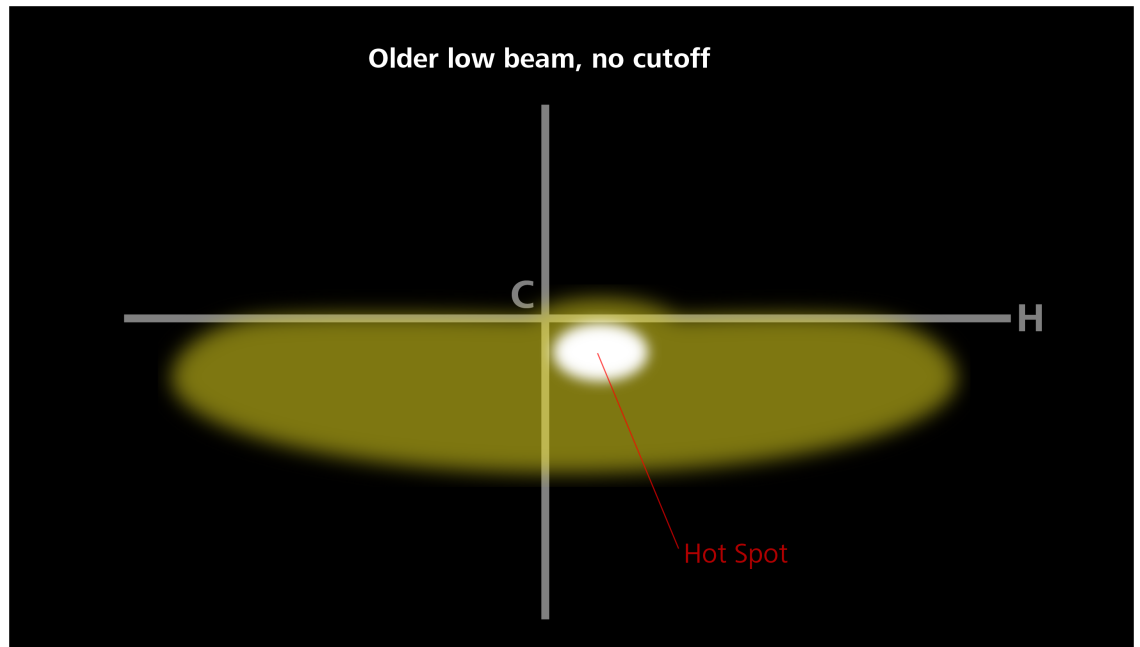
For the kind of cutoff line with a single kink, adjust each headlamp so that its kink lines up (left to right) with the **C** mark, then adjust the horizontal aim slightly leftward so the angled, ramp-shaped part of the cutoff line approaches your **C** mark. It's best if the angled/ramp part of the cutoff line just barely touches the **C** mark; this slight leftward nudge of the aim increases seeing distance down the road relative to European practice, but don't overdo it; excessive leftward aim will result in excessive glare to oncoming traffic, and it will pull the high beams out of optimal alignment. The beam, with correct vertical and horizontal aim, should look like this:



For the kind of cutoff line with two kinks forming a stairstep, adjust the *upper* kink so it lines up (left to right) with the **C** mark in front of the headlamp you're adjusting. By placing the upper rather than lower kink in line with the **C** mark, you will obtain optimal seeing distance without creating other problems. The beam, correctly aimed vertically and horizontally, should look like this:



For older U.S. headlamps, the ones with the three lens bumps or the spirit level, you will have to do your best to place the left edge of the low beam "hot spot" on (or slightly overlapping) the vertical line extending down from the **C** mark in front of the lamp you're aiming, so the correctly-aimed beam (vertically and horizontally) looks like this:



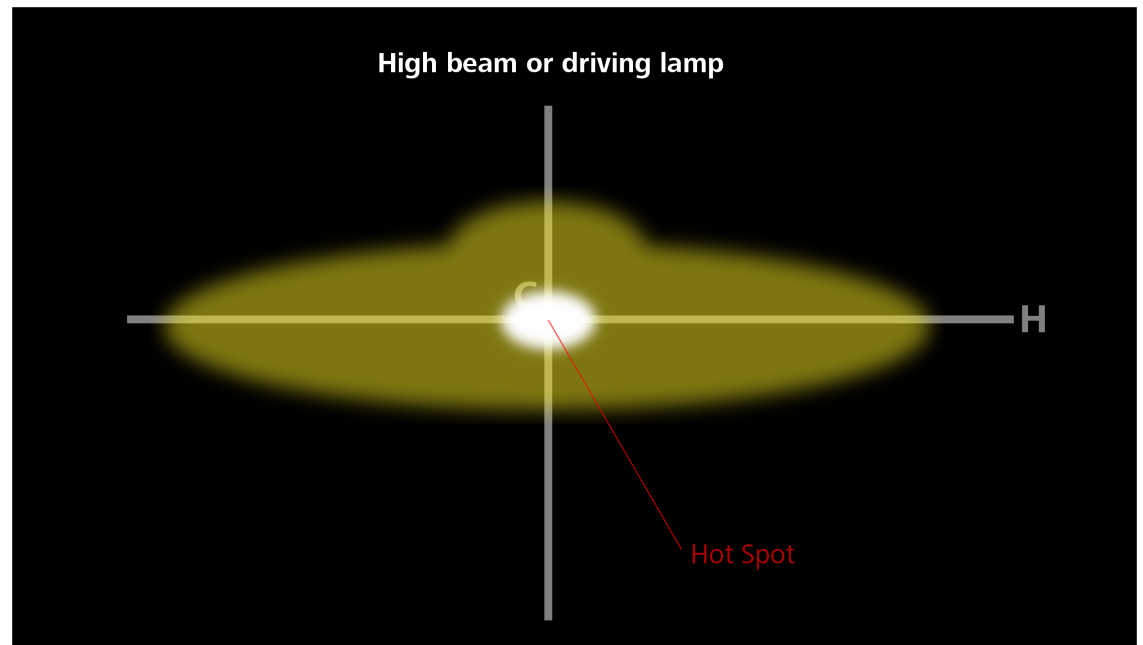
The Volkswagen PDF linked near the top of this page contains more images of various low beam patterns; study it to get an idea of what you're looking for.

After adjusting a high/low beam headlamp on low beam, do not attempt to readjust it on high beam. All high/low beam headlamps are meant to be adjusted on the low beam setting only; the high beam adjustment is correct when the low beam adjustment is correct. If you are

experiencing a problem where setting the low beams correctly places the high beams too high, but setting the high beams correctly places the low beams too low, you are dealing with a faulty or poorly-designed headlamp.

Driving Lamps and High-Beam-Only Headlamps In 4-Lamp Systems

These instructions apply to headlamps that produce only a high beam, and to all "driving" (auxiliary high beam) lamps. These must be adjusted so that the bright, central "hot spot" of the beam is straight ahead of the lamp in both the vertical and horizontal planes. Pay attention to the "C" points you've plotted—make sure you're looking at the "C" point for the lamp you're working on, and not the one for the lamp next to it. Use the intersection of the horizontal and vertical lines at point **C** for each headlamp as "cross-hair sights" to centre the high beam hot spot, like this:

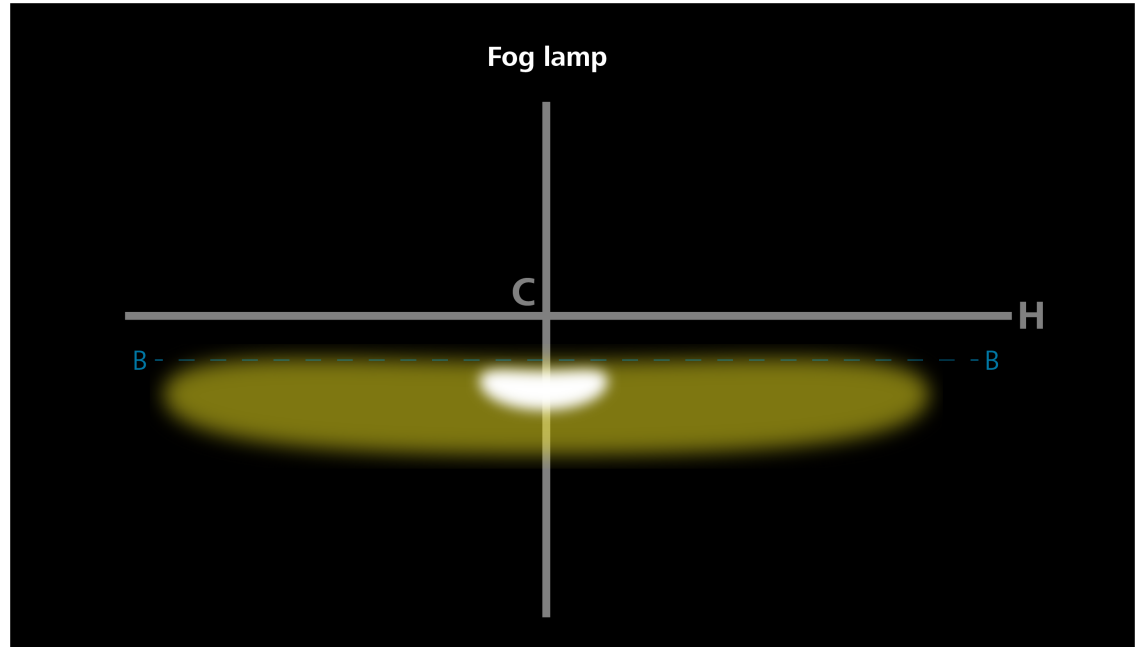


Pay attention to just one lamp at a time. It is best to unplug the headlamp you are not working on, so light from its beam pattern doesn't mislead you or make it hard to keep track of hot spots and cutoffs. Also be sure to disconnect or cover the adjacent high/low beam lamp when you are aiming its high-beam-only neighbour.

Fog Lamps

Fog lamps are aimed using a procedure very similar to that used for low-beam headlamps. The cutoff extends clear across the top of the beam pattern. Simply align the fog lamp so that the cutoff at the top of the beam falls on the appropriate **B-B** line for the lamp mounting height, as

listed in the table above. Fog lamps' horizontal aim is less crucial than that of headlamps, and there's some leeway. Generally the fog lamps get pointed straight ahead, but you can "crosseye" or "walleye" them a bit—not too much—if that's necessary to get the coverage you need on the roads you drive. A properly aimed fog lamp looks like this on the wall:



Daniel Stern Lighting (Daniel J. Stern, Proprietor)

Use tech@danielsternlighting.com to send me email

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