Improve Your In-Camp Lighting

Add a Flip-Diffuser to Your EOS Headlamp

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This quick little project will easily remedy what is probably the only significant weakness in the otherwise excellent design of the Princeton Tec EOS headlamp. Because the beam of this light is focused primarily for navigating at night, it's really too narrow to provide the kind of floodlight that most backpackers want for working around camp. This simple add-on will solve that problem, enabling an EOS user to now switch instantly between spot and flood modes. As an added benefit, it can also help protect the lens from scratching or other damage.

This diffuser can work equally well with other products, but of the recently released headlamps that are popular with backpackers, the EOS probably needs it the most.

The Princeton Tec EOS headlamp, which many regard as a breakthrough product, has been on the market for over a year now and it's been a big hit with serious outdoors types. Its combination of bright white light, flicker-free power levels, regulated output, low weight, simple operation, long battery life, and waterproof case have made it appealing to anyone who hikes, bikes or engages in other technical activities at night. It's become popular enough, in fact, that it's recently been introduced for sale under the LL Bean private label.

About the only major shortcoming for backpackers is that while great for walking at night, its narrowly focused beam makes it less than optimal for use around camp. In particular, it's actually rather distracting to try to read with this light since the beam forms such a small area of illumination when used at close range. Because its design is otherwise so strong, however, I decided to see if I could come up with an easy EOS modification that could solve this problem.

Although there are many ways to add floodlight capabilities to a headlamp, most need to be designed in from the beginning. Ultimately, I concluded that the easiest way to retrofit existing EOS's would be a flip-type diffuser that scatters the beam so that it covers a broader area for in-camp use. I've been using the diffuser described here for several months and am very happy with its performance.

The Right Diffusion Material

After a lot of experimentation, it became apparent that while there are plenty of materials that can be placed in front of the EOS lens to broaden its beam, most of them either create too much diffusion and/or discolor the light.

When the beam becomes too scattered, it means that the diffuser is absorbing large amounts of the lamp's output, usually requiring the user to increase the power by one or two levels in order to compensate. Doing so, of course, wastes energy and shortens battery life. In my opinion, the "right" amount of diffusion maintains a bit of the beam's center focus, converting the "hot spot" to more of a soft, broad "warm spot".

Likewise, I found that most diffusion materials I tried also converted the bright white output from the Luxeon LED into a pale shade of yellow. An ideal diffuser should have little or no effect on light color, at least with this headlamp (though the bluish LED's used in some other products can often benefit from a bit of yellow warming).

The best material I've found so far is the new transparent duct tape made by Scotch (3M). Introduced mid-2004, the tape itself is mostly clear, but incorporates white fibers that run both vertically and horizontally throughout. It also works well for this project since it can serve as a durable hinge for the flip-away door. A single layer of this tape produces just the right amount of diffusion (at least for my taste) and induces very little color shift.

Having it all

Headlamps Featuring Both Flood and Spot Capabilities

A few headlamps incorporate both flood and spot capabilities into their designs. To read more about some of these lamps,
see this sidebar article

Scotch transparent duct tape

Materials Required

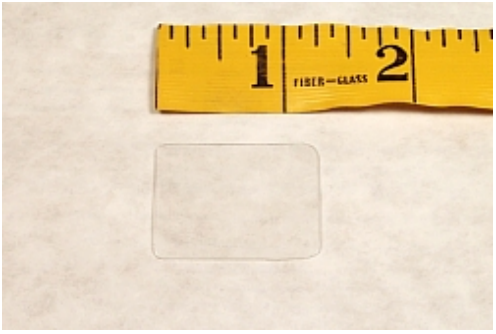
Materials required (+)

For this project you'll need (shown left-to-right above):

- A small length of Sticky-Back Velcro, ¾" wide. You'll need about an inch of each the hook-side and the loop-side. Any color will do, though black and white are the most commonly available.
- A small roll (4 or 10 yards) of Scotch transparent duct tape. Available at Wal-Mart or most hardware stores for $2 to $4 (depending on size). 3M also supplies the tape in larger, 20 yard rolls.
- A piece of clear, rigid plastic that can be cut to approximately 1" x 1¼" to serve as the diffuser door. You'll want to make sure the plastic is clear, rather than translucent, since the duct tape to be applied over it will supply all of the necessary diffusion (i.e., you don't want the door material to create any additional beam scattering). Although rigid, the plastic also needs to be soft enough to cut easily with scissors. I used a small section of a clear liquid soap refill bottle ("Equate" brand) with good results. The clear top from a salad bar take-home container also worked well.
- A pair of household scissors.

Build Instructions

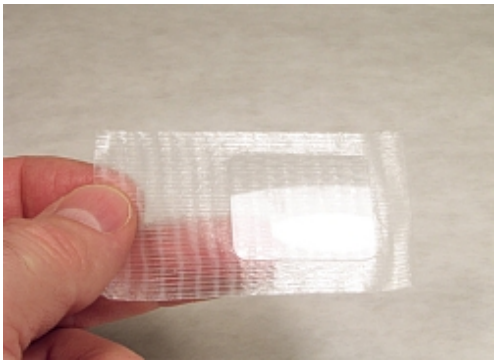
Step 1. Using your scissors, cut the clear diffuser door to about 1" x 1¼", then round the corners slightly.



Cutting the plastic door material (+)

Plastic door cut to size (+)

Step 2. Cut a piece of the transparent duct tape about 2" long (the tape is 1.4" wide) and apply evenly over the diffuser door as shown below, trying not to trap air bubbles under the tape. Now trim the edges of the tape so that they're flush with the door, leaving about ¾" of tape on the other end to attach to the EOS. Round all 4 corners of the tape strip.



Tape applied over door (+)

Tape trimmed to size (+)

Step 3. Attach the free end of the tape to the body of the EOS as shown below so that the door is centered over the headlamp lens. If you're left-handed, you may find that attaching the tape to the opposite side of the EOS body works better for you.

Apply tape to EOS (+)

Door centered over lens (+)

Step 4. Attach three thin pieces of loop-side (fuzzy-side), Sticky-Back Velcro to the underside of the diffuser door as shown below. While only one piece is really needed to serve as a latch, the other side piece will keep the diffuser level over the lens and the bottom piece will help keep the light that's reflected from the diffuser from shining into your eyes.

Loop-side Velcro on door (+)

Step 5. Attach a thin strip of hook-side Velcro (scratchy-side) to the top outside edge of the diffuser as highlighted by the top arrow in the photo (left) below. Next attach a strip of loop side Velcro to the edge of the EOS body as shown with the bottom arrow below.

Finally, attach a thin strip of hook-side Velcro to the EOS body next to the lens as shown in the right photo below.

Hook-side Velcro on top of door, loop-side at base of headlamp (+)

Hook-side Velcro next to lens (+)

You're now ready to use your new diffuser. You can either flip it closed over the lens when you need flood light, or latch it open when it's not required. If you decide you want a little more diffusion, you can add another layer of the transparent duct tape, or perhaps a layer or two of some other kind of tape.

Diffuser door latched open (+)

Diffuser door latched closed (+)

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