

TECHNOLOGY BEHIND THE LAMINATED TEAROFFS

SINGLE LAYER TEAROFFS

Tearoffs are universally used in motorsports as multi-layered disposable lenses. As the race proceeds, the top layer accumulates mud, rubber, fuel, oil and water, which eventually obscure the driver's vision. The top layer of tearoff is removed by the driver, which reveals the next clean layer. This is repeated through the course of the race until the driver exhausts the supply of tearoffs and is left visually impaired for the balance of the event.

An apparent solution to this problem might be to add additional tearoffs to the face shield, but experience shows that six or seven tearoffs reduce visibility to the point where it would be unsafe to enter the track. Mature drivers may only be able to tolerate a five tearoffs deep stack in Saturday night racing.

In simple terms, the driver starts the race blind with too many tearoffs, and ends the race blind with too few.

While a single layer tearoff is nothing more than simple thin piece of plastic, the Racing Optics SpeedStack7™ is a complex optical device, having all the characteristics found in a camera lens or telescope. Most single layer tearoffs use "packaging grade" clear polyester. Racing Optics starts by using only the highest quality "optical grade" Mylar™, manufactured by DuPont.

OPTICAL TRANSMISSION AND REFLECTION BASICS

Everything that is transparent to light, everything you can see through, slows down the speed of light. There are all kinds of wacky things that happen when light is slowed down, but one thing we are concerned with is reflection. The more a material slows down the speed of light, the more it reflects off the surface. To compare; air slows light and reflects it the least, water more, glass and plastics more yet, and diamonds the most. Which is why a diamond is so sparkly. For plastics used in tearoffs, about 4% of the light reflects off of the surface as the light passes from air into the plastic. There are two surfaces on each tearoff, one going in and one going out. Thus the reflection is about 8% for every tearoff used. This also means that the transmission is reduced to about 92 percent.

LOOKING IN THE MIRROR IS NO WAY TO WIN A RACE

As successive layers of tearoffs are added, the reflection increases by 8 percent per tearoff, while the transmission is reduced by 8

percent. By the time six or seven tearoffs are stacked up, the transmission is reduced to 50 percent, and the reflection is up to 50 percent. The loss in transmission would be like putting on sunglasses, and the increase in reflection is like looking in a mirror. The technical measure of this is Visual Acuity. Visual Acuity is the product of contrast ratio and light level. Where a value of ten represents perfect vision in a controlled environment such as a movie theater and a value of one is the equivalent of blindness where objects cannot be identified.

So here is a real good picture of what is going on. In order for the driver of a race car to prevent mud and debris from building up on his face shield, he has to put on sunglasses at night and look at himself in a mirror while attempting to maneuver a race car past 20 or so others at death defying speeds.

THE SpeedStack7™ SOLUTION

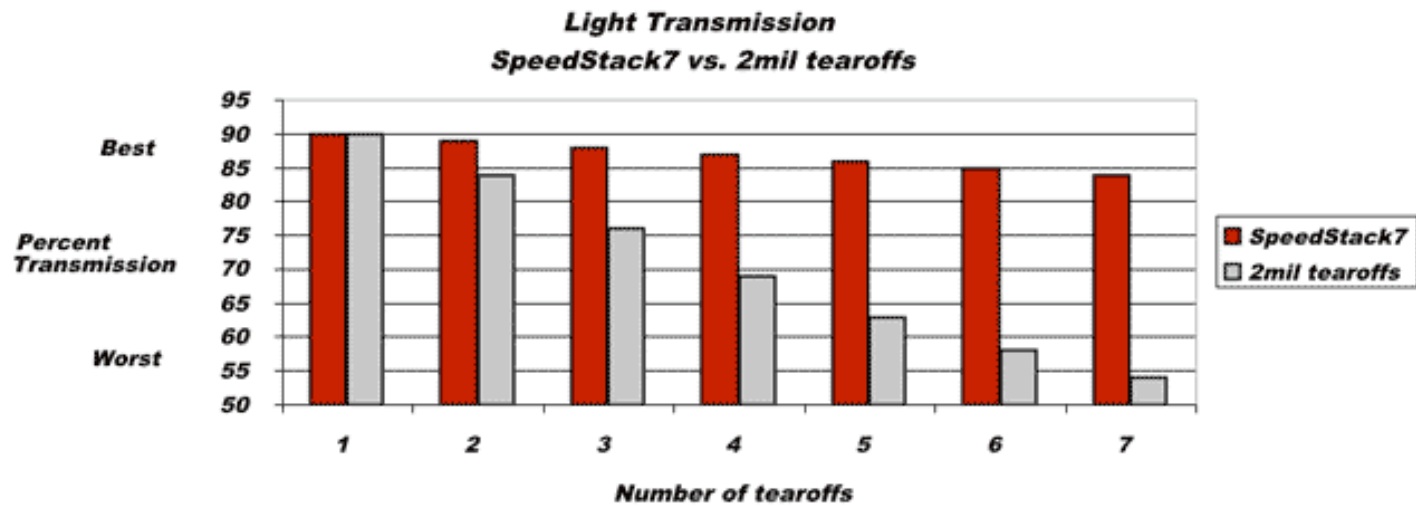
As mentioned earlier, reflection is caused by the speed of light slowing down as it enters a transparent material. When light travels through multiple layers of different materials, and keep the light at the same speed, no new reflections are created. Racing Optics has created the SpeedStack7™ (U.S. Patent 6,388,813) by optically laminating seven layers of tearoffs together. The laminated tearoffs of the SpeedStack7™ displace any air in the Stack. Thus eliminating the reflections between layers. A seven layer SpeedStack7™ has about the same optical characteristics as a single tearoff! SpeedStack7s™ can be layered, giving the driver up to twenty-one or more tearoffs for those long races. This allows the driver to have better visual acuity than ever experienced before from the start of a race to the checkered flag.

Transmission Measurements

In the first bar graph, the light transmission is measured comparing the SpeedStack7™, and a standard 2mil thick tearoff. With only one layer the light transmission of both 2mil tearoff and SpeedStack7™ are the same. As additional layers are added, the standard 2mil tearoffs decrease rapidly to about 50 percent while the SpeedStack7™ remains almost constant with only about a 10 percent change in transmission.

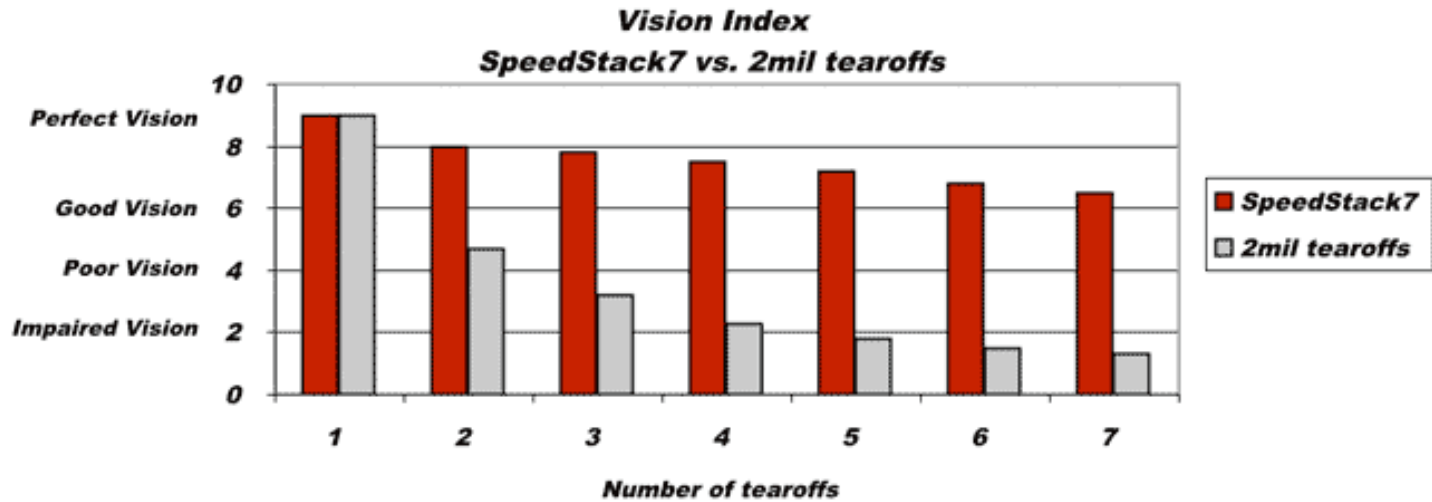
Reflection Measurements

In the second bar graph, the reflection is characterized for the SpeedStack7™, and the standard 2mil tearoffs. Again with only one layer the SpeedStack7™ and the standard 2mill tearoff are the same in reflection. As layers are added the reflection increases to over 40 percent for the standard tearoff, but the SpeedStack7™ remains constantly low in reflection with only a 3% change.



Vision Index

The third bar graph is the Vision Index. It demonstrates the effect of the combination of the transmission values divided by the reflection values. As the reflection on the inside of the face shield increases and reduces contrast ratio, it competes with outside



visibility.
