SOME THOUGHTS ON PRISM AND CENTERING OF UNCUT SV LENSES

Written By: D. B. Whitney on May 30, 1991

In the case of finished uncut single vision lenses, centering and prism must be considered simultaneously, since one directly affects the other. However, it seems to me that there are two questions that should be asked separately. These are:

1. How much prismatic error should be allowed to be passed on to the wearer, and how much of this should the manufacturer or Rx laboratory be allowed to use up in the uncut lens?

2. How closely must the point at which the maximum allowable prism occurs coincide with the geometric center of the uncut lens?

The first question recognizes the need to hold to prism tolerances which will provide the wearer with comfortable vision. The second question recognizes that the edging operation requires a lens of sufficient effective diameter that the finished eyesize and shape will cut out satisfactorily from the uncut lens.

Once having established these two numbers, they can be combined in a single statement which recognizes the interaction between the two. If the answer to #1 is 1/6 prism diopter and to #2 it is2mm, then such a statement might read:

> Within a 2mm radius of the geometric center, there shall exist a point at which the prism does not exceed 1/6 prism diopter.

This one statement does it all; once the two tolerances have been set, there is no need to vary them depending on the power of the lens, either sphere or cylinder. The same statement is valid, regardless of the index of the lens material. Admittedly, such a statement doesn't address the case where a prescription laboratory is fabricating an uncut lens with prescribed prism. For such cases, provision should be made for widening the tolerance on prism as the amount of prescribed prism increases.

Those who argue with the above approach may not fully recognize the way in which prism and centering interact, especially in low power lenses, and most especially in the weak minus range. Whenever the front and rear surfaces are concentric, the resulting lens will either have no prism anywhere on the lens, or will have prism everywhere on the lens. Since zero prism is virtually unattainable, lenses having concentric surfaces can be expected to have prism, and that prism can be expected everywhere on the lens. There will be no optical center.

Attached are three charts showing the powers of lenses having concentric surfaces for three different index materials. A plano lens, of course, has concentric surfaces when these surfaces are flat. As the curves are steepened, the concentric situation occurs in the weak minus power

range. The steeper the curves, the thicker the lens, or the higher the index, the more minus such lenses will be.

It must be remembered that the concentric situation is not limited to spheres. Compound lenses will have this effect if any meridian is concentric – that's **any** meridian, not just one of the two principle meridians. Therefore, any lens in which one principle meridian is plus and the other minus will have some meridian where the surfaces are concentric.

The first chart titled 'PsmAllow3a' shows the amount of prism introduced at a point horizontally displaced 2.0mm from the optical center of a lens having a sphere power of +0.25 diopters and a cyl power of –0.50 diopters. Note there are two cylinder axis orientations where the amount of horizontal prism introduced by this horizontal decentration is zero. One of these is where the cyl axis is about 58°, and the other is where the cyl axis is about 122°.

The second chart titled 'PsmAllow3a' shows the same lens, but with a horizontal displacement of 20.0mm rather than 2.0mm. Note that, while the prism numbers are about ten times larger, the same situation occurs at cylinder axis of about 58° and 122°. This tells us that, at those cylinder axis, no amount of horizontal decentration will introduce any prism. An important corollary to this finding is that if horizontal prism is present for lenses oriented at these cylinder axes, that prism cannot be reduced at all by decentration of any amount.

Of course, the decentration doesn't have to be horizontal for this kind of situation to occur -- it can be in any direction. In our particular example (+0.25 = -0.50), the critical meridians will be about 55° and 122° away from the cylinder axis, regardless of how that cylinder axis is oriented.

What the above discussion is intended to show is that one cannot expect the optical center of an uncut lens to be close to the geometric center if **any** meridian of that lens falls in the weak minus range. Further, Prentice's Rule does not apply in this power range -- something which is still not widely recognized.

All of the above means it is important for any uncut lens standard to allow an adequate tolerance on prism (item 1 on page 1), since decentering won't help on a significant number of items, many of which are in the heart of the Rx range.