ORLab Technical Note

Ophthalmic Product Series

Issue 3

December 2009

A series of technical notes to aid understanding of standards, reasons for failure to comply and hints on avoiding the problem.

Prism in non-prescription sunglasses and eye protectors

In Technical Notes 1 & 2 we have dealt with two of the most common reasons for failure to comply with AS/NZS1067:2003 and the Consumer Product Safety Standard is the refractive power. In this note we address another cause of failure is the presence of prism imbalance between the two lenses. As explained in TechNote 2, the design of an unpowered lens is not simply a bent sheet with equal thickness, not equal front and back surfaces. So a nominally afocal ocular varies systematically in thickness and this gives it a small prism effect away from the geometrical centre. Figure 1.

Figure 1: Cross section of an afocal ocular

Therefore the afocal ocular can exert a prismatic effect away frm the geometrical centre in the absence of actual refractive power. If two lenses are not mounted with their centres at the same height in the frame, then a prismatic imbalance can occur. The vertical tolerance is only 0.25$^{\Delta}$ so there is not much scope for error. So even non-prescription sunglass and eye protectors may fail this vertical requirement, but not often.

The second way in which a non-prescription lens can cause a prism effect is by tilting it. This may occur in the vertical, where the angle is referred to the "pantoscopic angle". In this case, the tilt is the same for both eyes and the prism created for each eye is the same and in the same direction and, therefore, not an imbalance.

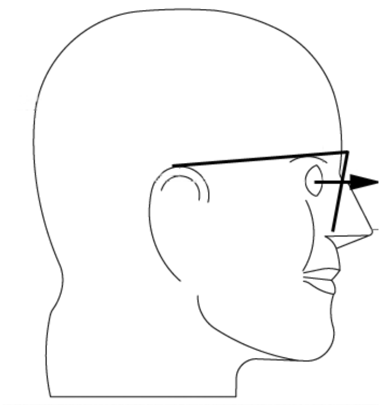

Figure 2: Side view showing pantoscopic tilt angle.

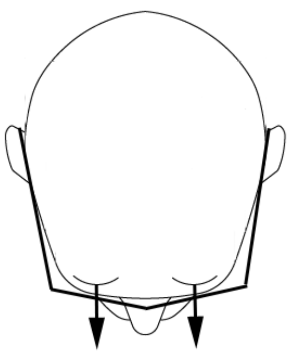

Figure 3 Plan view showing dihedral angle.

This may also occur in the horizontal, where the angle is referred to the "dihedral angle" or "wrap angle". In this case, the tilt is in the opposite direction for the two eyes and the prism created for each eye is the same but in the opposite direction and, therefore, additive to create an imbalance. The greater the angle, the greater the prism imbalance.

The dihedral angle produces base out prism and this is better tolerated by the wearer so the limit is generally 1.00$^{\Delta}$ compared with the limit of 0.25$^{\Delta}$ for base in. Figure 3 shows how the head width of the headform can affect the dihedral angle and, thence, the prism. If the frame is not flexed out to the actual head width, the dihedral angle may be greater and, as a consequence, the prism is greater. It is important to use the correct head width when measuring prism.

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What to do if pairs of lenses fail

Excessive prism in the vertical is inevitably due to the incorrect centring of the lens when edging. Typically, left and right lenses are edged on different instruments, possibly by different operators. It is essential that the two processes be carried out in the same way.
Excessive prism in the horizontal may be addressed two ways, unless redesign is a possibility. Prism in an opposite direction may be induced by decentring the lens and making use of the effect illustrated in Figure 1. This is a low cost solution, which may need nothing more than a larger uncut lens and a change in centring by the operator(s). It can often create enough equal and opposite prism to bring the nett prism within allowed limits. It is not necessary to remove all the prism. It is important that the decentration be in the correct direction. Some things seem obvious, but don't always happen!
If sufficient compensating prism cannot be included by decentration, then use of lenses with prism included in the lens can be considered. Again, it is not necessary to remove all the prism, merely reduce it below the allowable limits. This is particular easy to do in the one-piece from products since it can be included in the design of the mould. It is a no cost solution.

Got a technical question you need help with? Submit it to orlab@unsw.edu.au.

Uncertainties and compliance

Whenever compliance is being assessed it is necessary (and obligatory for a NATA accredited laboratory such as ORLAB) to take the uncertainties of measurement into account. If a pair of lenses have been measured as, for instance, 0.75 base out with an uncertainty of ±0.03D it means that the power is known to lie between 0.78 base out and 0.72 base out. The method used does not allow anything more precise. If the requirement is 1.00 base out, then all possible values lie within the allowed tolerance and the lens passes. Similarly a lens measured as 1.25 ± 0.03 base out , it is in the range 1.28 base out to 1.22 base out, all values are outside the permitted tolerance and the lens fails. However, if the lens is measured as -1.01 ± 0.03 base out, then some of the possible values lie outside the allowed tolerance and some possible values lie within. So it cannot be unequivocally stated whether the lens passes or fails. We would report this as "Borderline". This is clearly an unhelpful situation for industry and we strive to make all our uncertainties of measurement as small as possible, at the same time as containing the costs of making the measurements. We accept that borderline results are often more annoying to industry than failures. For us, they also involve lot more rechecking than clear passes and fails.

A compliance authority (like ACCC, SAI Global or BSI Benchmark) may make some interpretation and decision in these cases. A test authority (such as ORLAB) may not.

[1] ISO technical report ISO-TR 28980-2007 Ophthalmic optics - Spectacle lenses - Parameters affecting lens power measurement.

[2] ISO 9342 Optics and Optical Instruments – Test lenses for the calibration of focimeters.

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