ORLab Technical Note

Ophthalmic Product Series
Issue 1
February 2008

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

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Transmittance matching

One of the common reasons for failure to comply with AS/NZS1067:2003 and the Consumer Product Safety Standard is because the two lenses do not match in the depth of tint. Most commonly this is with gradient tinted lenses.

Previously specified as a density difference and sometimes still referred to as density matching.

Consequences of transmittance mismatches

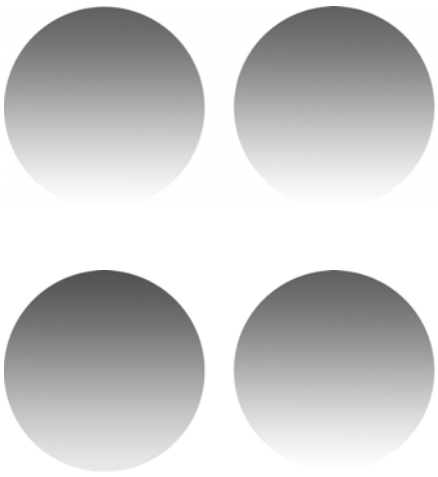
Apart from the undesirable cosmetic appearance of mismatched lenses, there is a significant safety issue in the problem. The concern is that unequal tints in front of the two eyes causes the wearer to make errors in the judgment of the distance of moving objects. They may be judged as closer or further way depending on which eye has the darker lens and the direction of travel. The safety implications in driving and a number of industrial tasks are pretty obvious.

Trivia department: the effect is named the Pulfrich phenomenon in honour of Carl Pulfrich (1858-1927) who first described it. Pulfrich only had one eye, so could not have experienced it himself, so we don't really know how he discovered it!!

All sunglass standards set limits on the transmittance difference and even with pairs of lenses that just comply, the difference is visible to the naked eye.

Reasons for unequal tints

With uniformly tinted lenses the tint may be incorporated in the material before forming the lens or dyed onto the lens afterwards. In the first case there is little scope for error unless the formulation is changed and the two lenses come from different batches. In the second case the amount of dye taken up may vary depending on the manufacturing process (CR39 is particularly prone to this) or less dye will be taken up as the dye concentration depletes with use. If pairs of lenses are chose from different stages in the dying run, they may not match.



Gradient tinted lenses are a particular problem. They suffer the same problems as the uniformly tinted lenses but have the additional issues of how they are fitted to the frame. The need to be fitted at the same height.

Since the left and right eyes are usually edged on different machines (to save time by not changing the former) and, perhaps, by different people, differences may occur and this may be seen as a consistent difference between the two lenses in all the finished sunglasses of a batch.

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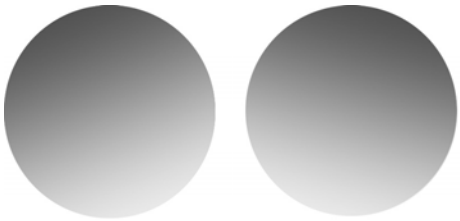
The second problem occurs when lenses are not orientated correctly in the edging machine or when the lens is not held tightly enough and clips in the mounting chuck when being edged. While the tints may be matched at the centre of the lenses of reference points, if the wearer's eyes are looking anywhere else to either side, the tints they are looking through may not be matched.



All of these problems may not be evident in the one pair sent for testing but could happen with subsequent manufacture, so some ongoing in-house checks are advised.

AS/NZS 1067:2003 and transmittance matching

Clause 2.2.2 requires that "The luminous transmittance at corresponding points within circles of 28 mm diameter centred on the reference points of a pair of lenses mounted in a frame or intended for assembly in a frame shall not differ by more than 15% of the value of the higher transmittance." and this is also applicable to the Consumer Product Safety Standard,

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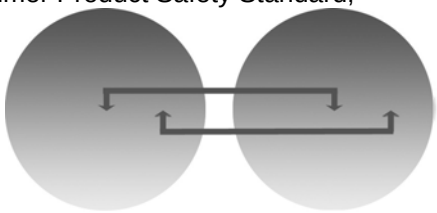
Corresponding points means those viewed through by two eyes. This the reference points are compared, pairs of points to the right, pairs to the left, etc. two of these pairs are shown in the diagram. This means that up to 5 pairs of points must be tested in a pair of gradient tint lenses.



In addition, Clause B5.2, of AS/NZS1067:2003sets out some requirements for how the measurements are made for gradient tinted lenses and B5.3 refers to gradient tinted polarizing lenses, which pose additional technical challenges.

How do I detect the problem?

Inspect the lenses against a uniform background, look at the lenses rather than at the background. Visually compare corresponding points. Look just inside the tops and bottoms of the lenses and at the two right sides and two left sides. It also helps to put the sunglasses on a white sheet of paper under a uniform bright light. If you cannot see a difference, it is most unlikely that the allowable difference is exceeded. If you can see a difference, it does not automatically mean that the difference exceeds that allowed. It is difficult to judge. Try retaining a pair that was tested and shown to have a difference at about the limit. Judge whether the difference in the pair under test have a greater or lesser difference. This method is not foolproof and no substitute for spectrophotometric testing, but will allow you to pick out obvious examples of a problem before they get out into the market.

How could my manufacturer avoid the problem?

They should use pairs of lenses manufactured at the same time. Rather than sending one box of lenses to one machine and one to the other (which could come from very different times in the dying process), split a box between the two machines. The lenses will come from much more similar manufacturing times. This is a no-cost contribution to the solution.

They should have very clear instructions and procedures on mounting the lenses in the edger which are consistent between the two machines. This should ensure that they are inserted at the right height and orientation and not slip in the chuck.. Any ISO9000 certified company will already have instructions, they just need to be checked.

Visual inspection after assembly and before they leave the factory.

Summary

There is no 100% certain way to eliminate the problem, but implementation of the suggestions above will help to minimise the risk considerably.