

New British standard for mounted lenses

Ronald Rabbetts, chairman of the BSI Spectacles Committee, explains the new standard for mounted lenses

Europe-approved international standard *BS EN ISO 21987:2009 – Ophthalmic optics – Mounted lenses* has just been published. It will replace our 'home-grown' *BS 2738: Spectacle lenses – Part 1: Specification for tolerances on optical properties of mounted spectacle lenses* and will apply from January 1 2010.

The most recent edition of *BS 2738 – 1* is dated 1998, but the first edition goes back to 1956. Although there has been an international standard on uncut lenses for many years (*8980 Parts 1 and 2*), the view of the ISO ophthalmic optics committee was that there was negligible international trade in mounted lenses, ie complete prescription spectacles, and therefore no standard was needed. This opinion altered in 2003 and a project group was set up to develop an international standard, the UK contributing two experts.

The main differences between the old standard and the new standard are:

- Cylinder axis tolerances
- Prism imbalance/relative prism error for single vision and multifocal lenses, a multifocal lens being a lens with a dividing line such as a bifocal or a trifocal
- Prism imbalance/relative prism error for progressive-power lenses (PPL) or degressive-power lenses.

Cylinder axis tolerances

The cylinder axis tolerances in the uncut finished lens standard (*BS EN ISO 8980 parts 1 and 2*), (Table 1) are based on the angular error that would induce 0.12D of unwanted cylinder. At the weak end of the range, an error equalling the tolerance of 7° on a prescribed 0.25DC induces only 0.06DC error, so it has been decided to relax the tolerance. At the higher end of the cylinder power scale, the uncut standard allows a maximum error or tolerance of 2° since it was felt that this was the most realistic manufacturing or surfacing limit.

There are two other reasons for the changes in the new standard. Although

BS 2738 Part 1 adopted the same tolerances as the ISO uncut tolerances, it was strongly argued on the project group that these should be increased to allow a tolerance for the mounting process. For this reason, the orientation of a bifocal's dividing line or the line joining the two permanent alignment markings on a PPL has been given a tolerance of ±2° from the horizontal. Some members argued that 2° should therefore be added to all the axis tolerances in the uncut standard, but this was strongly rejected by the UK and US, particularly for higher cylindrically powered lenses.

An additional reason for relaxing the axis tolerance for cylinder powers of 0.25D applies to conventional PPL, in that there is often a very small unwanted astigmatic power error on the front, moulded, surface at the distance checking zone. When combined with a low prescribed cylinder, this can give an axis and/or power error.

A tolerance has been added for cylinder powers below 0.25D. This is required for individually designed lenses where compensation for the 'as-worn' position may result in a very low powered cylinder.

The final compromise is given in table 3 of the new standard. This contains six cylinder power ranges, as opposed to the four shown in Table 1 below.

Prism imbalance/relative prism error for SV and multifocals

The reference method in the standard is somewhat clumsy, but may be the better one to use if one or both lenses incorporate strong oblique cylinders. The technique is to mark the centration point on each lens (ie the ordered position for the optical centres). The spectacles are placed on the focimeter with each lens in turn positioned at its

centration point, and the horizontal and vertical prisms at these points noted. The prism imbalance/relative prism error can then be calculated. For example, if there is 0.62Δ base out prism at the right centration point and 0.50Δ base out at the left, the net error is 1.12Δ base out. To determine whether or not this is within tolerance, the lens verifier must identify the arithmetically weakest principal power of the two lenses. For example, if one lens is +4.00/-1.25 and the other is +3.00/-0.50, the weakest power is +2.50D. Graphs are presented in the standard enabling the person verifying the spectacles to read off the allowable prism tolerance for this power, in this case 0.67Δ, and hence determine whether or not the spectacles pass. Obviously, this pair fail. If, however, the prism in the left lens had been 0.50Δ base in, the difference (0.12Δ) between the two prismatic powers rather than their sum would be used; the pair now passes. There is a similar procedure for the vertical direction.

The UK repeatedly presented a much simpler and more expeditious and accurate method, but sadly this was not understood or accepted by several members of the project group who are administrators or R&D experts, not prescription house staff, optometrists or dispensing opticians. After much perseverance and effort, the UK's technique, including a simple table giving the tolerances, is given as the second alternative method in Annex C of the standard. The BSI spectacles committee recommends that this method be used for applying tolerances to any unwanted prism or centration error for single vision and bifocal (multifocal) spectacles. It may result in slightly different tolerances, since it is based on the actual principal powers, not the arithmetically weakest. It also adopts the optical centre of the stronger lens as the reference point, rather than the two centration points.

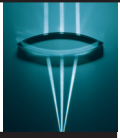
Prism imbalance/relative prism error for PPL

The majority view of the project group, supported by the international vote on the drafts, is that the correct alignment of the fitting cross of a PPL with the pupil is the most important factor in providing the designed performance

TABLE 1

BS EN ISO 8980 Part 1 and 2. Tolerances on the direction of cylinder axis

Cylindrical power, in dioptres	<0.50	>0.50 and <0.75	>0.75 and <1.50	>1.50
Tolerance on the axis, in degrees	±7	±5	±3	±2



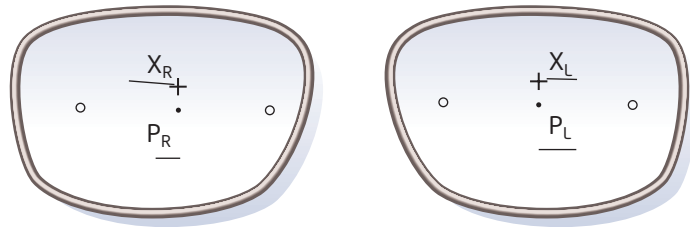
of the lens. Hence, to verify a pair of mounted PPL, the first task is to check that the fitting crosses, XR and XL in Figure 1, are placed within the specified mounting tolerances ($\pm 1\text{mm}$ each lens horizontally and vertically, but with no more than a 1mm vertical error between the two lenses) with reference to their ordered positions.

The second step is to verify that, after allowing for prism thinning and/or prescribed prism, at the mounted prism reference points (PR and PL, midway between the two permanent alignment reference marks) any prism or centration error does not exceed the tolerance given in the uncut standard *BS EN ISO 8980:2004 Ophthalmic optics – Uncut finished spectacle lenses – Part 2: Specifications for progressive power lenses*.

Provided these two steps are satisfied, any relative prism error between the two lenses should be ignored. The likelihood of the surfacing and mounting errors all being in the same direction is fairly small, but not impossible, and it is equally possible that a mounting error might reduce any unwanted prism from surfacing.

The positioning priority is reinforced by current glazing techniques. Modern

Figure 1
Fitting cross
and prism
reference
points on a
pair of
mounted
lenses



blocking devices 'home in' on the alignment reference markings, not the optical centre. The UK experts argued that if there is unwanted prism in a lens, then this could be reduced by glazing the lens 0.5mm (or perhaps even 1mm) out of place – for a 5D lens, it is 0.25Δ (or 0.5Δ respectively) which makes a significant reduction. The only way to do this is to displace the lens, for example by altering the mono-centration distance entered into the edging machine.

The same argument about blocking applies to straight and curved top bifocals, but the project group did compromise by accepting the UK view that such lenses could be displaced slightly within the centration tolerance before glazing without upsetting the optical properties.

BS 2738 Part 1 was cited in NHS regulations to control the quality of spectacles supplied in the UK. The new standard, which is 'harmonised', meaning that it has been or will be published in the *Official Journal of the European Union*, fulfils the same function under the Medical Device Directive.

This standard is obviously essential for every prescription house and optometric and dispensing establishment. It may be purchased from Customer Services, BSI on 0181 996 7000. FMO members may order copies through the FMO at a discount. ●

Acknowledgement

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