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The Influence of ABBE Number in Diopter Measurement

-Advantages of Green LED light Lensmeter: no need for ABBE compensation

During daily glasses and lens measurement process, we may find the diopter allowance of test sample measured on two same type qualified autolensmeter, that one detected data is qualified while the other is unqualified. Why is this?

Are there any other reasons, except operational, environmental and instrument value display errors? First we need understand two concepts: vertex power and dispersion index (ABBE number).

Vertex power is reciprocal of the tested lens' paraxial top focal length （in meters）. A lens has two vertex powers. Usually the back vertex power is defined as the vertex power of lens, in diopter, dimension in m-1 (D).

ABBE number is important indicator of dispersion, which is also called dispersion index. It is used to indicate the inverse ratio index of transparent material's dispersion. ABBE number is a measure of the image clarity level. There are refractive differences when different wavelengths of lights are refracted on same transparent medium. And white light is composed of different colored lights with different wavelength. So as a result dispersion happens when white light is refracted on transparent medium. The smaller ABBE number is, the stronger dispersion. Usually the ABBE number of optical lens is from 30 to 60. Generally there is a rule, the bigger the material's refractive index is, the smaller the ABBE number is, then the dispersion is more serious. If ABBE number is bigger, the dispersion is smaller, so the image clarity is much better.

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When these two concepts are clear, let's check if there is a certain relationship between the lens diopter and ABBE number. What error occurs during diopter measurement under different ABBE number? I did some contrast experiments as below:

Standard Diopter	Refractive index	Standard ABBE number	ABBE number set on instrument			Absolute value of error
			58	41	32	
-2.00	1.49	58	-2.01	-2.02	-2.03	0.02
-2.00	1.56	36	-2.06	-2.08	-2.09	0.03
-2.00	1.60	32	-2.04	-2.05	-2.06	0.02

Standard Diopter	Refractive index	Standard ABBE number	ABBE number set on instrument			Absolute value of error
			58	41	32	
-5.00	1.49	58	-5.05	-5.08	-5.10	0.05
-5.00	1.56	36	-5.00	-5.05	-5.07	0.07
-5.00	1.60	32	-4.99	-5.01	-5.03	0.04

Standard Diopter	Refractive index	Standard ABBE number	ABBE number set on instrument			Absolute value of error
			58	41	32	
-10.00	1.56	36	-10.10	-10.14	-10.18	0.08
-10.00	1.60	32	-10.09	-10.13	-10.17	0.08
-10.00	1.67	32	-9.99	-10.00	-10.05	0.06

Through the data above, we can find out that same diopter lens measured with different ABBE number settings has an error of almost 0.08D. Further more, the error will grow bigger as the diopter getting bigger. Take lens -10.00D by 1.60 refractive index as example, the standard ABBE number is 32, if the autolensmeter is set with wrong ABBE number 58, the measurement result is -10.12D and qualified. While when ABBE number set at 32 will bring the result to be -10.20D and unqualified（according to GB10810-1996《Spectacles lenses》standard requirement tolerance is10.00±0.18）, in this case different measurement results will be caused.

The autolensmeter is an objective optical lens-measuring instrument. Its working principle is to use diode LED as light source, and show the dioptric effect of detected lens on CCD through optical system and get result by optical signal transforming to electrical signal. The light source plays a big part in the

whole measurement system. The wavelength of light source will directly influence the measuring result. As wavelengths of light diode LED made by different manufacturers can not be exactly the same, the instruments will cause fixed error. Manufacturers set “ABBE compensation” column in instrument menu to lower the error. ABBE compensation is adjustable for error correction.

Different lenses made of different materials are different in refractive index, thus in ABBE number. In practical application, because of not only most glasses and assembly enterprises but also some laboratory employees are not very clear about the ABBE compensation’s influence on diopter measurement, and they do not set different ABBE number according to different lenses and as a result that caused certain error in diopter measurement.

In conclusion we already get known that different lenses made of different materials are different in ABBE number. During daily work, the precise measuring method is setting different ABBE number to meet the requirement as indicated according to different refractive and different dispersive index lenses. Only in this method the measuring result will correct error and also is most qualified.

Inspection authorities don’t know the ABBE number of the detected lens, which causes difficult operation. So the suggestion is that inspection authorities may record the type and related parameters of the lens, which are used in opticians. Or the opticians provide related lens packing as the basis of measurement. This will avoid the wrong judgment caused by ABBE number and get more precise measurement result.