continuing education course

Approved by the American Board of Opticianry

Average Math for the Above Average Dispenser

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PREFACE

This continuing education course for opticians was prepared under the auspices of the National Academy of Opticianry and is designed to be convenient, cost effective and practical for the optician.

The skills and knowledge required to practice the profession of opticianry will continue to change significantly in the future, as advances in technology are applied to this eyecare specialty. Higher rates of obsolescence will result in an increased tempo of change and opticians at all levels will have to devote more time to acquire the necessary skills and knowledge to meet these changes. The National Academy of Opticianry recognizes the need to provide a Continuing Education Program for all opticians to be taken by home study. This course has been developed as a part of the overall program to enable opticians to develop and improve their technical knowledge and skills in their chosen profession,

The National Academy of Opticianry

INSTRUCTIONS

Read and study the material presented in the following pages. After you feel that you understand the material thoroughly, take the test following the instructions given at the beginning of the test. Upon completion of the test, mail the answer sheet to the National Academy of Opticianry, 8401 Corporate Drive #605, Landover, MD 20785

CREDIT

The American Board of Opticianry (ABO) has approved this course for Continuing Education Credit toward certification renewal. The number of credit hours for this course is one (1) hour. This course may be eligible for credit to meet the Continuing Education Requirements of various states. To earn this ABO credit you must achieve a grade of 80 percent or higher on the test. The Academy will notify all test takers of their score and issue certificates of credit to those who pass. The test passer must then forward the certificate of credit to the ABO.

AUTHOR

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INTENDED AUDIENCE

Average Math for the Above Average Dispenser is intended for ophthalmic dispensers at the basic to intermediate levels.

COURSE DESCRIPTION

Average Math for the Above Average Dispenser will bolster the self confidence and overall effectiveness of the dispenser by imparting a practical working knowledge of three essential optical formulas.

LEARNING OUTCOMES

Upon completion of this course the student should be able to:

- Learn the importance of making decisions of prismatic concerns and not merely on the number of millimeters that job is off.
- Learn to compute prismatic errors in horizontal and vertical meridians.
- Learn that changing vertex can effect lens power, and how when those changes are necessary how to compensate.
- Be able to compute the finished edge or center thickness of any given job when certain variables are known.

Average Math for the Above Average Dispenser

Michael DiSanto, ABOM, FNAO

Effective dispensing means much more than picking a frame, plugging in a pair of lenses, bending the temples and collecting the money.

A dispenser is a designer, an architect that can calculate what the end result will look like much before the product is actually fabricated. Anyone can scratch out some numbers on an order form and send it off to the lab with the hope that somehow everything will be OK, but it takes a skilled professional to calculate an excellent end result. In today's optical marketplace it is no longer enough to meet someone's expectations --- to be a leader we must consistently exceed the patient's expectations.

This course will review some basic math skills that are a must for the "ABOVE AVERAGE DISPENSER". The professional dispenser is concerned with such things as **QUALITY OPTICS, RESPONSIBILITY TO THE PATIENT, and ANTICIPATING and AVOIDING PROBLEMS.** The following course will show that the formulas discussed can help the professional dispenser to meet and exceed their goals.

A): When Quality Optics is Important

Everyone who dispenses eyewear will list as their primary goal the desire to provide the best quality product.

The lenses that will be provided will match the examined prescription within the confines of very tight optical tolerances. In the optical industry the tolerances most used are the ones set by ANSI. The very best lenses will be free of obvious flaws (scratches, pits, and waves), power & axis errors, and induced prismatic effect. Of all of the potential problems the highest percentage of non-adaptation rejects occur due to unwanted prismatic effect. Prismatic effect can be a problem horizontally if the ground centers do not match the measured pupillary distance, or it can be a problem vertically if there is power difference from eye to eye in the 90 degree meridian. The question then becomes, "HOW TO WE CHECK FOR PRISMATIC ERRORS"?

Since prismatic effect is controlled by POWER in the 180 or 90 degree meridian plus the distance that the eye moves through that meridian it makes no sense to accept or reject a job only by the number of millimeters that it may vary from the prescribed pd. Where there is low power there is little prismatic effect, but where there is more power less tolerance should be the rule.

<u>PRENTICE RULE</u> - A basic formula for computing prismatic effect.

We should never accept or reject a job based on the number of millimeters that a job strays from a given prescribed pd , but rather on the prismatic effect created by that deviation.

PRISM = Decentration X Power (Divided by 10)

SITUATION #1: A JOB COMES BACK WITH CENTERS THAT DO NOT MATCH THE PD.

Example: A pair of +5.00 diopter spheres ordered for a pd of 62 $_{mm}$ is received with the optical centers at 66$_{mm}$. Assuming that each lens is off by 2 $_{mm}$, what is the overall prismatic effect?

2 $_{mm}$ X +5.00 (Divided by 10) = 10/10 which equals 1 diopter of prism induced, base out each eye for a total effect of 2 diopters in the pair.

Since the tolerance for Horizontal Prism is .6 of a diopter this job should certainly be rejected.

When dealing with cylindrical lenses it is important to determine the power in effect at axis 180. 0nce determined use that as the power variable in the equation. WIDE OR NARROW Pds ARE CONCERNED WITH HORIZONTAL PRISM.

SITUATION #2: DETERMINING THE NEED FOR SLAB OFF CORRECTION

By using the PRENTICE RULE plus the knowledge of canceling and compounding prisms it is possible to determine the prismatic imbalance at a given reading depth.

Example: The patient's Rx is OD -1.00
OS +1.75 Reading add +2.00 Reading depth 12$_{mm}$.

Using the PRENTICE RULE compute the differing amounts of prismatic effect in each eye as the patient drops their view from a correctly centered distance gaze to a reading depth of 12$_{mm}$.

RIGHT:

Prismatic Effect = <u>-1.00 (Power in 90^o meridian) X 12$_{mm}$ (Reading Depth)</u>
Divided by 10

<u>ANSWER: 1.2 Diopters of Prism BASE DOWN</u>

LEFT:

Prismatic Effect = <u>+1.75 (Power in 90^o meridian) X 12$_{mm}$ (Reading Depth)</u>
Divided by 10

<u>ANSWER: 2.1 Diopters of Prism BASE UP</u>

When added together 1.2 Down and 2.1 Up equal a total imbalance of 3.3 Diopters of imbalance at the reading depth of 12 $_{mm}$. This person, *on paper,* is a candidate for a slab off.

B): When Thickness is an Issue

Everyone today wants thinner lenses. We are overwhelmed with different high index materials. Patients are glad to pay us more if we can deliver them a thinner product. Often there is a gap between the product that they are expecting and the product that we deliver. Result --- unhappy customer. They somehow imagined that the lenses we were making for them were going to be thinner than they turned out.

What do you tell someone when they ask the simple question "HOW MUCH THINNER WILL MY NEW LENSES BE"?

The factors that most influence thickness are Frame Size, Decentration, and Lens Material. Showing someone a DEMO is a good idea, but it never really shows them what theirs are going to look like. Telling them things like "They will be 20% thinner" doesn't help because the real intangible is **"20% THINNER THAN WHAT?"**

By using the Lens Thickness Formula the dispenser can factor in all of the variables in order to give the patient an exact and simple answer to their logical and simple question of how thick their new lenses will be.

At the completion of the dispensing situation the dispenser should have all of the data at hand to make a quick and accurate assessment of the lenses that they have just designed.

Finished Lens Thickness Computation

Step 1—Compute the decentration. Double it, and add that value to the effective diameter of that shape. (This number represents the smallest hypothetical blank necessary to cut out that given job)

Step 2—Using the following formula compute the saggital value or thickness value.

$$\textbf{Sag (Thickness)} = \frac{\textbf{Radius Squared} \times \textbf{Dioptric Power}}{2000 \times (N - 1)}$$

Radius = 1/2 of the number computed in Step 1

Dioptric Power = Strongest meridian of the lens. (Working with this number will always give maximum thickness. Depending on location of power, the real lens may be slightly thinner)

2000 = Constant

N = Index of refraction of material being used.

1 = Constant

Step 3—Add 2 $_{mm}$ to the above answer to bring the lens within safety tolerance. That answer is the approximate finished thickness of the job. If the lens is plus, the answer refers to center thickness. If the lens is minus, the answer refers to edge thickness.

Example:

Material—CR-39 (Index 1.49)
Rx = - 5.00 sphere right eye
Customer pd. = 30$_{mm}$ right eye
A box = 54$_{mm}$
DBL = 20$_{mm}$
Frame pd. = 74$_{mm}$
E.d. of shape = 62$_{mm}$

From the data given we can figure the decentration in the right lens to be 7_{mm}. We must double the decentration to get 14_{mm} then add that to the E.D. for an answer of 76_{mm}. 76_{mm} is the smallest circle of glass from which this job may be cut. Taking the radius of this 76_{mm} circle (half the diameter) or 38_{mm} we can use the Saggital Value Formula.

$$\frac{38^2 \times -5.00}{2000\,(1.49 - 1)} = \text{Sag or thickness value}$$

$$\frac{1444 \times -5.00}{2000 \times .49} \quad \frac{7220}{980} = 7.36_{mm}$$

7.36_{mm} represents the finished edge thickness of this job with a zero center thickness. In reality we know that the job would most probably have at least a 2.0_{mm} center thickness. Add 2.0_{mm} to 7.36_{mm} far a finished edge of $\underline{9.36_{mm}}$. Armed with this single fact we can now better direct our patient's choice to bring about the best result—a cosmetically pleasing end product.

If the finished thickness we compute will not be satisfactory then we should re-combine our choice of material, size, shape, and style. We are the architects who must assume responsibility for our design.

C): For Higher Powered Lenses / Vertex Compensation

All lenses have two dioptric power values. One is the actual power which may be measured in a lensometer, and the other is the effective power which only the wearer perceives. The same lens may be perceived in different ways by the same wearer depending on variations in vertex (fitting distance). Vertex affects the power of all lenses; however, the effect is most notable in lenses of greater dioptric power. As lens power increases, so to will the effect of vertex on power. Vertex is synonymous with fitting distance.

Vertex Effect			
Lens Type	**Fitting Situation**		**Perceived Effect**
Plus Lens —	Increased Vertex	=	Strengthening Effect
Plus Lens —	Decreased Vertex	=	Weakening Effect
Minus Lens —	Increased Vertex	=	Weakening Effect
Minus Lens —	Decreased Vertex	=	Strengthening Effect

The degree to which plus and minus lenses are affected is equal, but the direction of the effect is opposite. It is important for us to realize that strong plus lenses fitted too far away give an overly strong effect, while minus lenses fitted too far away give an overly weak effect. Facts like these can help us solve existing problems and avoid future problems.

A refractionist's prescription conveys the dioptric power necessary to correct a given condition of the eye. In order to achieve the exact result with a pair of spectacles the dioptric power and the fitting vertex should equal the prescribed power and the examined vertex, or compensations should be made. Remember this procedure is only necessary in higher dioptric powers or in situations where a noticeable difference exists between examined and fitting vertex. The problem may also be apparent if the vertex between the old and new lenses vary.

In the case of the new prescription, note or check with the refractionist as to the examined vertex, then measure and match or compensate the fitting vertex. In the case of matching new lenses to old lenses, measure the old vertex and match or compensate the fitting vertex.

Vertex is easily measured through the use of an instrument known as the distometer. The distometer measures in millimeters the distance from the back of the lens to the eye.

Distometer Procedure

1) With glasses in wearing position instruct patient to close eyes. (Measurement will be taken from back of lens to closed lid. l_{mm} can be added to compensate to open eye.

2) Gently depress plunger to expand measuring legs until one touches the back of the lens, and one gently touches the closed lid.

3) Read the millimeter scale plus one millimeter for the fitting vertex.

Since the effective power value of a lens cannot be measured in a lensometer, a simple formula exists for determining the actual dioptric effect on the wearer. The formula reads:

$$\frac{\text{Diopters}^2}{1000} = \text{The amount of compensation necessary per millimeter per millimeter of displacement.}$$

The answer to this formula should be multiplied by the exact number of millimeters the lens varies from the set to be matched. This answer should then be either added to or subtracted from the actual power value depending on the situation.

SITUATION	COMPENSATION
Plus lens fitted farther away	Subtract answer
Plus lens fitted closer	Add answer
Minus lens fitted farther away	Add answer
Minus lens fitted closer	Subtract answer

Example # 1: (Compensating a Spherical Lens)

The refractionist's Rx reads a pair of + 10.00 spheres, with an examined vertex of 15_{mm}. Upon fitting the individual we determine that the new lenses will have a fitting vertex of 10_{mm}. Remembering that moving the plus lens closer we must compensate and fit with a stronger plus lens.

$$\frac{10 \text{ diopters}^2}{1000} = \frac{100}{1000} = .1 \text{ diopters of change per millimeter of movement.}$$

In this example there is a 5_{mm} displacement.

5 ($_{mm}$ of movement) x .1 diopters = .5 diopters of compensation.

Thus in this case, with the lenses fit at 10_{mm}, the lab will have to grind a pair of + 10.50 spheres to achieve the same effective power value that the refractionist got in the trial frame at 15_{mm}.

Example #2 (Compensating a Sphero-Cylinder)

The Rx now reads - 10.00 - 4.00 x 90 o.u., with an examined vertex of 15_{mm} and a fitting vertex of 10_{mm}. The compensation procedure is the same, but now we must work the formula twice, once for each meridian. We should view cylinders as two separate lenses.

Sphere Compensation

$\frac{10 \text{ diopters}^2}{1000}$ = .1 x 5_{mm} of movement = .5 diopters of compensation.

Since this is a minus power moving the lens closer will have a strengthening effect, therefore the answer should be subtracted to read - 9.50.

Cylinder compensation (in the 180 meridian we have -14.00 diopters of power)

$- \frac{14 \text{ diopters}^2}{1000} = \frac{196}{1000}$ = .196 x 5_{mm} of movement = .980 diopters

We can subtract the one diopter from the 14 diopters since moving the lens closer will have a strengthening effect. We should now combine the two answers.

Power in cylinder meridian	=	-13.00
Sphere power	=	-9.50
		-3.50 New Compensated Cylinder.

Compensated Rx now reads:

-9.50 - 3.50 x 90 fit at 10_{mm}.

This equals in effective power the refractionist's Rx

- 10.00 - 4.00 x 90 examined at 15_{mm}.

Vertex compensation is an advanced tool which we should utilize when working with greater refractive powers.

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