OPTICAL BOOT CAMP

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HOMESIGHT EYE CARE
VISION EXPO EAST 2022
NEW YORK, NEW YORK

On behalf of Vision Expo, we sincerely thank you for being with us this year.

Vision Expo Has Gone Green!

We have eliminated all paper session evaluation forms. Please be sure to complete your electronic session evaluations online when you login to request your CE Letter for each course you attended! Your feedback is important to us as our Conference Advisory Board considers content and speakers for future meetings to provide you with the best education possible.

VISION EXPO

FINANCIAL DISCLOSURE

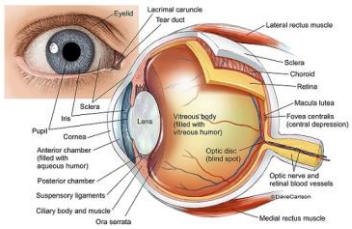
- Shana Barrett Zeitlin, O.D. has no financial interests to disclose.

GOALS

- Learn various types of ophthalmic lenses and modifications used for optimal vision correction
- Understand how errors in lens measurements and frame selection contribute to patient complaints
- Learn dispensing tips to improve overall patient experience and ensure good outcomes

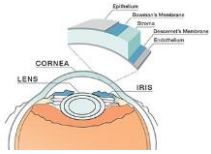
BASIC ANATOMY AND OPTICS

OCULAR ANATOMY



REFRACTIVE POWER OF THE EYE: CORNEA

- Relaxed (non-accommodating) total eye power: ~60 diopters (D)
- Cornea (~40 D)
- Due to orderly arrangement of collagen fibrils in the cornea, it is highly transparent
- The refractive index of the cornea is n≈1.3765±0.0005

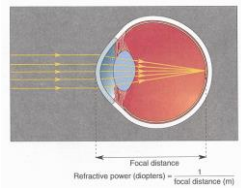


REFRACTIVE POWER OF THE EYE: LENS

- Lens (about 20 diopters)
  - Can fully accommodate to over 30D!
    - Adolescents 12–16D,adults at age 40 4–8D,adults over 50 less than 2D
  - Accommodation: the eye changes focus from distant to near images
    - Produced by a change in lens shape
  - Lens substance is most flexible during childhood and the young adult years
  - Gradually becomes less flexible with age and cannot change shape to accommodate

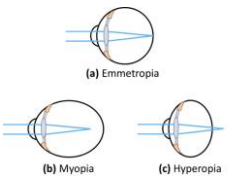
BASIC OPTICS OF THE EYE

- In the eye, the image always needs to be formed on the retina
- If, for various reasons, the eye fails to focus the images on the retina (either in front or behind the retina), eyeglasses are needed to change the focal length so that the image can still be formed on the retina



AXIAL LENGTH

- Hyperopic eyes typically have shorter axial length (or less refractive power)
- Myopic eyes have longer axial length (or more refractive power)



OPHTHALMIC LENSES

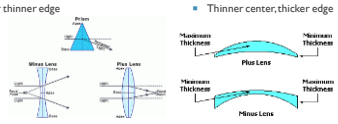
PLUS AND MINUS LENSES

Plus lenses

- Convex in shape
- Converges light
- Accommodative system must relax in order to keep an image clear
- Makes images appear larger
- Thicker center thinner edge

Minus lenses

- Concave in shape
- Diverges light
- Accommodative system must stimulate in order to keep an image clear
- Makes images appear smaller
- Thinner center, thicker edge



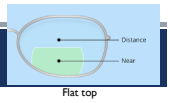
SINGLE VISION GLASSES

- Only one point of focus
- Can be made for distance only (DVO), reading/near only (NVO), computer, etc. depending on the patient's needs
- Monovision glasses
- Reading over CL

WHY DO WE USE MULTIFOCAL LENSES?

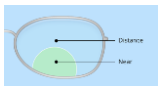
- Multifocal eyeglass lenses contain two or more lens powers to help you see objects at all distances after you lose the ability to naturally change the focus of your eyes due to age (presbyopia).
- Over age 40 (ish), the crystalline lens of the eye becomes less flexible and unable to change shape to focus up close
- Need more plus power to magnify objects up close
- Usually are prescribed for adults over age 40 to compensate for presbyopia
  - In some cases bifocals are prescribed for children and young adults who have eye teaming or focusing problems that cause eye strain when reading
  - In these cases, the bottom portion of the bifocal lens reduces the amount of focusing effort required to see near objects clearly

BIFOCALS

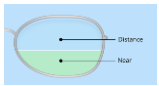


Flat top

- Bifocal means two points of focus (bi=two)
- Typically distance in the top (carrier) and near in the bottom (seg or inset)
- The lens segment (or "seg") devoted to near-vision correction can be one of several shapes:
  - A half-moon — also called a flat-top, straight-top or D segment
  - A round segment
  - A narrow rectangular area, known as a ribbon segment
  - The full bottom half of a bifocal lens, called the Franklin, Executive or E style



Round seg



Executive

BIFOCALS

Advantages

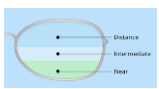
- No distortion
- Wider reading area
- Easier to measure/fit
- Lower cost

Disadvantages

- Only two points of focus
- Image jump
- Visible line
  - The line in a round-seg bifocal tends to be less noticeable than the lines in flat-top and Executive styles
- Cosmetic issues-- can make people "look old"

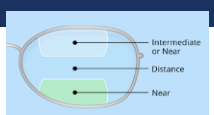
TRIFOCALS

- Similar to bifocals, but with a midrange capability
- Trifocals have three points of focus
- Usually for distance, intermediate and near vision
- The intermediate segment in trifocal lenses is directly above the near seg and is used to view objects at arm's length
- Intermediate/midrange usually used for computer distances



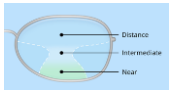
OCCUPATIONAL LENSES

- Designed for performing a particular job or hobby and are not meant for general-purpose wear
- Ex. Double-D
  - Upside-down flat-top segment for near or intermediate vision in the top third of the lens
  - Has a second flat-top segment for near vision in the bottom third
  - Center of the lens is for distance vision
  - Useful for patients who have to view at close distances from different head positions (ex. Mechanics)
- Occupational lenses can also be a traditional lens type with the rx set for a particular purpose
  - Ex. Computer single vision or computer bifocal/PAL



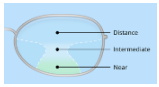
PROGRESSIVE ADDITION LENSES (PAL)

- The power of progressive lenses changes gradually (*progressively*) from point to point on the lens surface
- Seamless progression of additional plus (magnifying) power
- This provides the correct lens power for seeing objects clearly at virtually any distance
- Some people call PALs a "no-line bifocal". This is not a completely accurate term, but some patients will use it! Don't get PALs confused with a blended bifocal



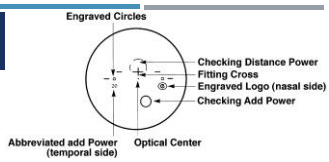
PROGRESSIVE ADDITION LENSES (PAL)

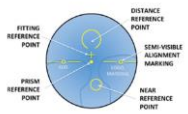
- Have a "corridor" through which patients will see well
- Will have some distortion on the sides of the lenses
- Educate patient to turn head/point nose at what they're viewing
  - Ex. Sideview mirror
- Many different brands– more expensive/newer typically have wider corridor and less distortion
  - "Digital" of "free-form" progressives
- Can be more difficult to neutralize by lensometry



PAL LENS MARKINGS

- Engraved/laser etched
  - ADD abbreviation
  - Logo
  - Circles – for alignment
- Temporary markings
  - To help with lens verification
  - Optical center
  - Distance power verification
  - ADD power verification





LENS MATERIALS AND COATINGS

LENS MATERIALS

- Index (n) → higher numbers typically thinner and lighter
- Crown glass (n=1.523)
  - Resists scratches, not easily affected by environmental factors, low in chromatic aberration
  - Heavy, not impact-resistant
- High-index glass (n=1.6-1.9)
  - Abbe values close to polycarbonate (=higher chromatic aberration)
  - Heavy, must be high rx to get thick enough for impact resistance
- CR-39 (n=1.498)
  - Very commonly used plastic, roughly half the weight of crown glass
  - More impact resistant than glass, but there are much better plastic choices for impact resistance

LENS MATERIALS

- High index plastics
  - Many different materials are in this category
  - Consider both index and Abbe value, impact resistance, lens thickness
- Polycarbonate (n=1.586)
  - Very soft, requires anti-scratch coating
  - High impact resistance – more likely to bend/dent than shatter
  - Excellent choice for safety lenses
- Trivex (n=1.53)
  - Lens of choice for drill mounts- won't crack/split
  - Abbe 43, which is much better than polycarbonate– better optics and less aberrations

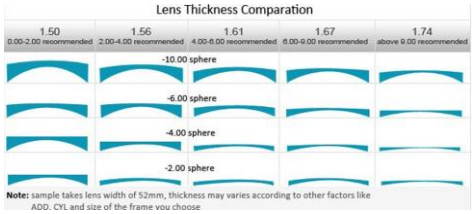
ABBE VALUE

- The most commonly used number for identifying the amount of chromatic aberration for a given lens material
- Lower Abbe = more likely that color fringes will be seen through the lens and that visual acuity will be reduced in the periphery of higher powered lenses
- Polycarbonate is a commonly used material but has a low Abbe
  - Aberrations are common in polycarbonate lenses!
  - Much worse in higher powers (over 4D)
  - Trivex is a better choice for shatter-resistant lenses

Lens Material	Category	Index (Nd)	Abbe
Hard Resin	Plastic	1.498	58
1.5 Glass White	Glass	1.523	58
1.5 Glass PGX/PBX	Glass	1.523	57
High Index "55"	Plastic – High Index	1.537	47
Trivex	Plastic – High Index	1.53	45
Polycarbonate	Plastic – High Index	1.586	30
High Index "1.6" - SF	Plastic – High Index	1.60	42
High Index Plastics 1.66	Plastic – High Index	1.66	32
High Index Plastic 1.71	Plastic – High Index	1.71	36
Thin & Lite 1.74	Plastic – High Index	1.74	33
1.6 Glass White	Glass – High Index	1.601	42
1.6 Glass PGX	Glass – High Index	1.604	42
1.6 Glass PBX	Glass – High Index	1.601	46
1.7 Glass White	Glass – High Index	1.701	40
1.80 Glass White	Glass – High Index	1.802	35

https://www.2020mag.com/article/does-material-abbe-value-influence-your-patients-vision

LENS MATERIALS



SAFETY GLASSES AND FRAME MARKINGS

- Must have "Z87" or "Z87-2" and the name or logo of the manufacturer stamped on the frame front and on both temples
- Specified by ANSI (American National Standards Institute)
- If a pair of glasses has safety lenses but is not in a frame with these markings, they are not safety glasses
- Safety glasses will have polycarbonate or trivex lenses for shatter resistance

LENS COATINGS: SCRATCH-RESISTANT

- Layers of resin that protect the lens from surface scratches
- Plastic surfaces are not as hard as glass, and are more susceptible to scratching
- Typically factory-applied and molded/cured with the lenses, creating scratch resistance that is truly part of the lens
- A MUST with polycarbonate!
- So not interfere with tints
- Will not crack/peel off of the lens

LENS COATINGS: ANTI-REFLECTIVE

- Increase light transmission and decrease glare
- Improve vision
  - Increase amount of light entering the eye
  - Eliminate ghost images
  - Decrease reflection
- Night driving, computer use, TV
- Cosmetic appeal: makes lens itself less visible
- Most commonly applied by lens manufacturer
- Newer versions offer smudge-resistance by using a layer of silicone

LENS COATINGS: BLUE BLOCKERS

- Some claim to reduce eye strain, improve sleep, prevent retinal disease
- Blue light is part of the visual light spectrum
  - Much of the light from electronics/screens hits our eyes in the blue light spectrum
- Studies that show blue light may play a role in the regulation of the sleep cycle (circadian rhythms)
- NO evidence that blue light is a culprit in causing cataracts, macular degeneration, or glaucoma
- What about eyestrain?
  - Again, no concrete evidence from studies, but may subjectively help some patients
  - Computer vision syndrome and dryness

OPHTHALMIC LENS MEASUREMENTS

INTERPUPILLARY DISTANCE (PD)

- Anatomic PD – distance from the center of one pupil to the center of the other pupil (mm)
- Distance PD – alignment when patient is looking at distance
- Near PD – alignment when patient is looking at near
  - Eyes converge when looking at something close-up

METHODS OF MEASUREMENT

- PD ruler (mm)
  - Can have some degree of error
- Pupillometer
  - Typically more accurate
  - Better for monocular PD

BINOCULAR PD VS. MONOCULAR PD

Binocular

- Most common way to measure
- Least amount of equipment
- Can be done with a mm ruler

Monocular

- Faces are not always symmetric
- Place the optical centers of the lenses directly in front of patient's eyes
- Best way to do this is with a pupillometer

Steps in Measuring the Binocular Distance PD

1. Dispenser positions at 40 cm (16 in).
2. Dispenser closes right eye, subject fixates on dispenser's left eye.
3. Dispenser lines up zero point on subject's right eye at the pupil center, left pupillary border, or left limbus.
4. Dispenser closes left eye, opens right eye; subject fixates right eye.
5. Dispenser reads off scale directly in line with left pupil center, left pupillary border, or left limbus.
6. Dispenser closes right eye, opens left; subject fixates left eye.
7. Dispenser checks to make sure zero point is still correct.

Figure 3-1. Position of the dispenser for beginning the PD measurement using just a PD ruler.

Figure 3-3. When the subject has dark irises, the outside edge of the limbus may be used as the zero reference point and the inside limbal edge of the other eye as the measuring point.

NEAR PD

- Required for single vision reading lenses and progressive lenses
- Near triad: accommodation, pupils constrict, eyes converge
- Typically about 3-4mm smaller than distance PD
- Can be measured by mm ruler, but better to measure with pupillometer

Steps in Measuring the Near PD

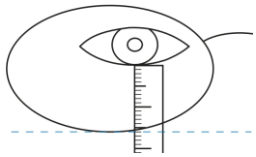
1. Dispenser places his or her dominant eye in front of subject's nose at the subject's near working distance. This is the distance for which the near prescription is intended—normally 40 cm (16 in).
2. Dispenser closes the nondominant eye.
3. Subject fixates dispenser's open eye.
4. Dispenser places zero point of PD rule at center of subject's right pupil.
5. Dispenser reads scale marking at center of subject's left pupil.

MEASURING FOR BIFOCALS

- A true **bi**focal has **two** points of focus, typically distance and near
- Measuring should be done with the actual frame
- The frame must be carefully positioned at the height at which it will be worn

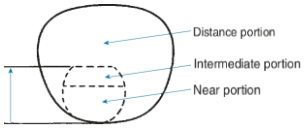
Steps in Measuring Bifocal Height Using Lower Lid or Limbal Method

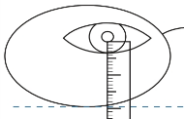
1. Fitter positions himself or herself on the same level as the subject.
2. Subject fixates the bridge of the fitter's nose.
3. Holding frame in correct wearing position, the fitter places the PD rule vertically in front of subject's right eye. The zero point is at lower limbus and the ruler scale is positioned downward.
4. For a rimmed frame, the fitter reads the scale at the level of the lowest point where the inside of the groove would be. For a rimless frame, the reference is the level of the lowest point on the demo lens.
5. Repeat for left eye.



MEASURING FOR TRIFOCALS

- A true **tri**focal has **three** points of focus: distance, intermediate, and near
- Measure with actual frame, positioned at the height at which it will be worn
- No specification for lower seg line is necessary
- Measure to the bottom of the pupil (UNDILATED), and subtract 1mm





UNEQUAL SEG?

- One eye may be higher or lower than the other
- Both eyes should be measured independently for bifocal or trifocal heights
- Make sure frame is straight on the face– a crooked frame will cause errors

VARIATIONS OF SEG HEIGHT

- Posture
  - Patient "walks tall" → normal seg may be too high, interfere with distance vision
    - Height → a tall person may need smaller/shorter seg, but shorter people are ok with a normal seg
- Occupational need → desk work, may need higher/wider seg for more near vision
- Round seg →need about 1mm higher than flat-top bifocals
  - Rounded top has a smaller, and therefore less useful reading area at the top of the seg
- High plus → use flat-top bifocal, make seg as high as possible
  - Minimize prismatic effect by keeping near and distance optical centers as close as possible

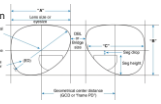
FRAME MEASUREMENTS

WHY IS THIS IMPORTANT?

- Frame measurements specify the frame's parameters
- Ordering: get what you expect from a frame catalog
- Sizing: patients come in all different shapes and sizes. Some frame styles come in different sizes to fit larger or smaller faces
- More parameters specified = less chance of a mix-up

BOXING SYSTEM: DRAW A BOX AROUND THE LENS!

- Horizontal midline (datum line): horizontal line halfway between top and bottom of lens
- Geometric center/boxing center: the point on the horizontal midline halfway between the vertical box lines
- "A" dimension/eyesize: horizontal length of the lens
- "B" dimension: vertical measure of the lens
- ED effective diameter: double the distance from the geometric center to the apex of the lens bevel farthest from it
  - Determines smallest lens blank size when cutting lenses
- DBL/bridge: distance between lenses
  - DBL is, technically, slightly different than bridge, although these terms are commonly interchanged
- Geometric center distance (GCD): distance between the 2 geometric centers
  - AKA distance between centers (DBC); frame center distance; ***frame PD***



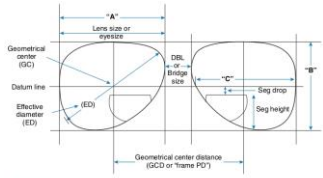
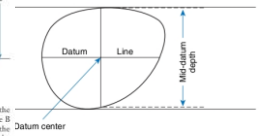
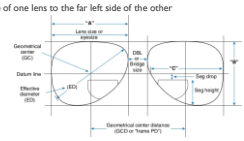


Figure 2-2. In the boxing system, the A dimension is the horizontal boxing width. If the frame is properly marked, the eye size will be equal to the A dimension of the frame. The B dimension is the vertical boxing length. The C dimension is the width of the lens along the horizontal midline. This dimension is seldom used today. The C dimension should not be confused with the "C-size" of a lens. The C-size of a lens is the distance around the lens (i.e., its circumference). The dispenser uses the C-size to ensure that a lens ordered by itself (without the frame) will be exactly sized for that frame.



MEASURING A LENS

- All measurements are in millimeters (mm)
- Horizontal dimension: begin at the inside of the groove on one side and extends across the lens opening to the farthest part of the groove on the other side
- DBL: distance across nasal inside eyewire grooves at the narrowest point
- Geometric center distance (GCD): distance between the 2 geometric centers
  - Can be measured more easily as the distance from the far left side of one lens to the far left side of the other lens
  - Can be calculated by adding the eye size to the DBL
    - Ex. 51□17 frame → GCD is 68



GEOMETRIC CENTER DISTANCE AKA FRAME PD

- Distance between the 2 geometric centers
- Can be measured more easily as the distance from the far left side of one lens to the far left side of the other lens
- Can be calculated by adding the eye size to the DBL

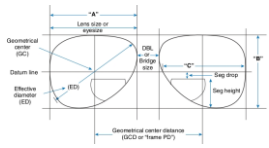


Figure 2-3. To measure the horizontal dimension of a frame, the measurement begins at the inside of the groove on one side and extends across the lens opening to the farthest part of the groove on the other. We cannot see the inside of the groove when looking from the front. This means we can estimate where it will be and hold the ruler so that the zero point is at the position of the left-hand side of the groove. Then we need to read the ruler at the position where the groove will be on the right. If the opening itself is measured, then about ½ mm per side needs to be added to the measure to allow for the depth of the groove. This may vary somewhat, depending upon the depth of the groove.

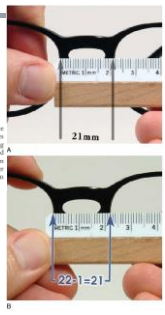
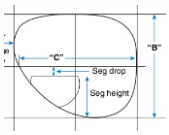
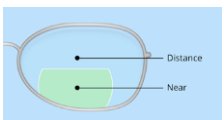


Figure 2-5. **A**, The DBL or bridge size is measured on the frame as the distance from the inside nasal eyewire grooves across the bridge area at its narrowest point. When measuring the bridge size, we cannot see the inside of the groove and must estimate its location. **B**, If the measurement is made from lens opening to lens opening, then approximately ½ mm per groove must be *subtracted* from the measure depending upon the depth of the groove.

SEG(MENT) HEIGHT

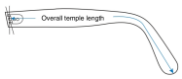
- Most common visible segment is in a bifocal lens
- Distance between the line and the bottom of the box in the boxing system
- Seg drop: distance below the horizontal midline





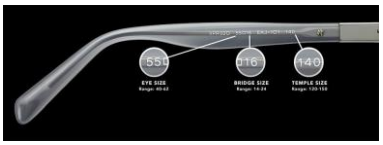
MEASURING TEMPLE LENGTH

- Overall temple length: from the center of the center barrel screw hole to the posterior end of the temple, measured along the center of the temple
- Measure around the bend, not in a straight line (unless the temple is straight)
- Comfort cable temples are measured by stretching the cable temple along the ruler



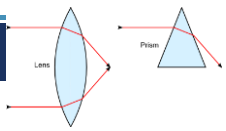
FRAME MARKINGS

- Eye size and DBL/bridge can be found on the inside temple, inside nose pad, inside bridge, or upper outer section of eyewire
- Frame manufacturer, style, color
  - Can be marked with words or numbers



DISPENSING TIPS

WHAT IF YOUR PD IS WRONG?



- Normally when spex are made, the lenses are positioned so the **optical center (OC)** of the lens will line up with the pupil of the eye (if no prism is prescribed)
- When light goes through the optical center of the lens, it does not bend, but travels straight through
- If the light does not travel straight, but bends, you get a prismatic effect
- Therefore…. If the optical center is not aligned with the patient's pupil, there will be induced prism. Things will look weird!

PRENTICE'S RULE

- The amount of prism induced by improper lens placement depends on:
  1. The power of the lens
  2. The distance the OC is displaced

$$\Delta = cF$$

Prism diopters of displacement

Dioptric power of the lens

Distance from OC in ***centimeters (cm)****

$$\Delta = cF$$

Prism diopters of displacement

Dioptric power of the lens

Distance from OC in ***centimeters (cm)****

Example 1
Lens power is +2.00
OC is 6mm away from pupil
How much induced prism?

c=6mm=0.6cm

Δ = cF
Δ = (0.6)(2.00) = 1.2 prism diopters

Example 2
Lens power is +2.00
OC is 2mm away from pupil
How much induced prism?

c=2mm=0.2cm

Δ = cF
Δ = (0.2)(2.00) = 0.4 prism diopters

Example 3
Lens power is +8.00
OC is 6mm away from pupil
How much induced prism?

c=6mm=0.6cm

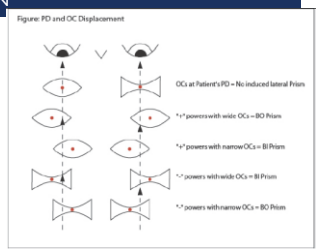
Δ = cF
Δ = (0.6)(8.00) = 4.8 prism diopters

Basic themes:
Larger displacement = more prismatic effect
Higher power lens = more prismatic effect

What if these were minus lenses? Amount of prismatic effect is the *same*. Base direction would be different.

PRISMS AND "BASE" DIRECTION

- Base direction for **plus** lenses is toward the **center** of the lens
- Base direction for **minus** lenses is towards the **edges** of the lens
- BI = base in
- BO = base out
- BU = base up
- BD = base down



FOR ALL MULTIFOCALS…

- Take 3 minutes to explain to a patient how a PAL works, and why frame selection is important
  - Larger "B" dimension = better adaptation
- SAFETY: these lenses make objects at your feet ***blurry*** unless you remember to tilt your head down
  - This can be a safety issue for some wearers when they are walking down stairways or off sidewalk curbs
  - Always educate patients to move their heads when going down stairs, curbs, etc!
- Increase pantoscopic tilt for better adaptation

FRAME ADJUSTMENTS FOR SEG HEIGHTS

- Pantoscopic tilt: along the horizontal axis

Seg Adjustments Listed in Order to Be Tried	
Segs Seem High	**Segs Seem Low**
1. Increase pantoscopic tilt.	1. Narrow pads.
2. Decrease vertex distance.	2. Bend pads down by adjusting pad arms.
3. Spread pads.	3. Increase vertex distance.
4. Move pads up by adjusting pad arms.	4. Reduce pantoscopic tilt.
5. Stretch bridge (plastic frame).	5. Shrink bridge (plastic frame).

THANK YOU!

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