Stand Magnifier Choice

Gregg Baldwin, OD
2021

Retinal image size magnification or minification

Retinal image size magnification or minification is an eye's retinal image size relative to that produced by a standard eye. Only when intra-ocular variables are relevant must a standard eye have intra-ocular components. Therefore, when considering magnification from extra-ocular lenses, the eye can be considered a single refracting surface. When the arbitrary standard retinal image size is factored out with a second known eye, the result has meaning as a comparison of two known eyes.

Afocal angular magnification or minification

Afocal angular magnification or minification results from two separated refracting elements that together focus a distant object at infinity. A Galilean telescope is a well known example of such a system. When its diverging "eyepiece" lens is closer to the observer than its converging "objective" lens, it produces afocal angular magnification. When the telescope is reversed, (or when the lenses are interchanged), it produces afocal angular minification.

Myopic distance correction

The correction of a myopic distance refractive error with a diverging lens at the spectacle plane produces afocal angular minification in the same way as a reversed Galilean telescope. The afocal angular minification is therefore known to equal the distance of the myopic eye's front focal point to the spectacle plane, divided by the distance of the eye's front focal point to the eye's presumed single reflecting surface.

Myopic distance correction removal

The removal of a myopic distance spectacle correction results in an eye focused for a near object at its front focal point, as well as the absence of the afocal angular minification associated with distance correction. Near magnification then becomes the inverse of that ratio, and relative to the distance corrected eye, rather than either the myopic eye, or an eye without myopia. If an additional converging lens is then added at the spectacle plane, so that the near object is in focus for a non-myopic eye, this does not change the afocal angular minification removed, if we change the condition to which it is relative, or the eye to which it is compared. The inverse of the distance correction minification ratio then becomes the near magnification relative to a non-myopic eye.

Similarly, the removal of any hypothetical myopic distance spectacle correction at any hypothetical vertex distance, (along with its associated afocal angular minification), using a converging lens, results in near magnification at the eye's new front focal point, relative to the distance corrected eye. If an additional converging lens is then added at the vertex distance so that the near object is in focus for a non-myopic eye, the inverse of the distance correction minification ratio then becomes the near magnification relative to a non-myopic eye.

Near object angular subtense magnification or minification

Any near object location involves an object angular subtense magnification or minification ratio when referenced to an arbitrary object distance from the eye, (generally chosen to be 25cm). Under axial, (or near axial), conditions, this object angular subtense ratio involves angles small enough to be represented as a tangent ratio. Since the object's height is constant, this tangent ratio becomes an inverse object distance ratio, as measured from the eye. In this way, object angular subtense magnification or minification equals the reference distance to the eye, divided by the object's actual distance to the eye.

Combining near object axial angular subtense magnification or minification with near magnification due to removal of afocal axial angular minification

In order to be seen clearly while using a distance correction and no ocular accommodation, any near object requires either a pinhole correction or a converging lens with its front focal point at the near object. When a pinhole is used, there is no magnification from near correction, and magnification is simply the object angular subtense magnification or minification ratio.

When a converging lens is used with its front focal point at the near object, parallel light leaves the converging lens from the object, and the image size is therefore the same regardless of the object/eye distance. The ratio describing object angular subtense magnification or minification, when combined with the ratio describing near magnification due to a converging lens producing parallel light, produces a ratio product which factors out the object's actual distance to the eye. These combined factors equal the reference distance to the eye divided by the object's distance to the converging lens, confirming that when parallel light leaves a converging lens from an object, the image size Is the same, regardless of the object/eye distance.

Virtual image enlargement

When a converging lens has an object closer than its focal point, it has a virtual image beyond that focal point which is larger than the object. An additional converging lens, (represented as ocular accommodation, uncorrected myopia, or a spectacle add), must then produce parallel light rays from the virtual image to maintain clarity. This describes the optics involved with stand magnifier magnification.

Stand magnifier constants

The two optically significant constants associated with a particular stand magnifier are its, "enlargement factor," E, and its lens to virtual image distance.

Enlargement factor

A stand magnifier's converging lens always has its object at a constant distance inside its focal point, and therefore has a virtual image at a constant distance beyond its focal point. This results in the virtual image being enlarged by a constant factor.

As long as the power of a spectacle add producing a clear image is not changed, adding a stand magnifier, (and moving the object so its new virtual image lies at the previous object distance), does nothing to magnification other than multiply it by the particular stand magnifier's constant enlargement factor. Therefore, a stand magnifier's enlargement factor equals the magnification it produces with a specific spectacle add, divided by the magnification produced by the spectacle add alone.

Lens to virtual image distance

The focal length of a spectacle add that produces a clear image with a stand magnifier's lens at the spectacle plane specifies the stand magnifier's constant lens to virtual image distance. Since the virtual image can not be brought closer, this spectacle add is also the stand magnifier's maximum usable spectacle add, and it provides the stand magnifier's maximum magnification.

Calculation of the enlargement factor with the stand magnifier lens at the spectacle plane

If we use aspheric trial lenses to determine the high plus spectacle add that produces the same apparent magnification as the stand magnifier at the spectacle plane with its maximum usable spectacle add, the ratio of magnification from that high plus spectacle add to that from the stand magnifier's maximum usable spectacle add without the stand magnifier equals the stand magnifier's constant enlargement factor.

Since the magnification produced by any spectacle add equals the reference distance divided by the object to spectacle plane distance, (or the reference distance times the power of the spectacle add), the reference distances can be factored out of the magnification ratio determining the enlargement factor, which then becomes simply a ratio of spectacle adds producing the same apparent magnification, one without the stand magnifier, and one with the stand magnifier at the spectacle plane.

Calculation of the enlargement factor with the stand magnifier lens further than the spectacle plane

When a stand magnifier is used with a spectacle add that is less than its maximum usable spectacle add, the stand magnifier's virtual image, (and therefore the stand magnifier's object and lens), must be moved away from the spectacle plane to produce a clear image.

Magnification is then reduced due to the lower powered spectacle add. Multiplying the magnification from the lower-powered spectacle add by the stand magnifier's constant enlargement factor specifies the magnification of the combined stand magnifier and new spectacle add.

Equivalent power

Since reference distances can be factored out when comparing magnifications, multiplying the lower powered spectacle add by the stand magnifier's constant enlargement factor specifies the hypothetical spectacle add required to provide the same magnification as the stand magnifier and spectacle add combination. This hypothetical spectacle add is known as the, "equivalent power," of the combination, and clinicians sometimes talk in terms of this. However, near magnification, (and distance magnification for that matter), remains a comparison requiring a reference distance.

Changing reference distances

If a particular stand magnifier and spectacle add combination produces 4X magnification when compared with an object at a reference distance of 25cm, and we wish to consider a 50cm reference distance instead, we simply multiply 4X by 50/25, for a value of 8X.

The Object Angular Size/Central Scotoma Cross-section Ratio

As an object is brought closer, the cross-section size of an affecting central scotoma decreases in a linear fashion, since it represents the base of an isosceles triangle with its constant vertex angle located at the eye, and its axis along the optical axis. As a separate function, as an object is brought closer, its angular subtense at the eye is increased exponentially, since it represents the vertex angle of an isosceles triangle with a constant base moving toward the eye along its axis, which is also the optical axis. Therefore, as an object is brought closer, the ratio of its angular subtense to central scotoma cross-section increases exponentially.

Determining the distance refraction of a low vision patient can be difficult due to a large, "Just Noticeable Difference," JND, which represents the spherical diopter change required to produce a subjective change in vision. ([2]) With adults, this can sometimes be addressed by performing the distance refraction at 1 meter using a large target, and optically compensating by subtracting +1 diopter. This takes advantage of an increase in the angular subtense/central scotoma cross-section ratio as a target is moved closer to the eye. This exponential increase can be even more useful when using a Coil 4206 non-lighted stand magnifier, which produces its image 1 meter away, yet uses an object only centimeters from the eye.

Non-lighted stand magnifiers

The following table lists commonly prescribed non-lighted stand magnifiers with my measurements of their maximum usable spectacle adds. It then lists my measurements of their resulting maximum magnifications and fields of view, (specified by the numbers of newsprint letters seen, "n", or by the centimeters of text seen, "cm").

The table also lists their calculated enlargement factors, followed by the distances the stand magnifier lenses must be moved from the spectacle plane before producing noticeable blur, with the visual fields at those distances. (The Reizen "6x" stand is the "hollow dome" model).

Peak "15x"	+5 max ⇒ 15X/6n	E = 12	0cm/6n
Peak "10x"	+5 max ⇒ 10X/12n	E = 8	1cm/10n
Coil 4212	+2 max ⇒ 10X/12n	E = 20	18cm/1n
Coil 4210	+2 max ⇒ 8X/16n	E = 16	15cm/1n
Agfa "8x"	+4 max ⇒ 8X/12n	E = 8	8cm/8n
Coil 5123	+3 max ⇒ 7X/16n	E = 9.3	10cm/12n
Coil 5428	+7 max ⇒ 6X/20n	E = 3.4	6cm/20n
Coil 4206	+1 max ⇒ 5X/20n	E = 20	20cm/1n
Reizen "6x"	+5 max ⇒ 5X/24n	E = 4	6cm/24n
Coil 5214	+1 max ⇒ 3X/9cm	E = 12	60cm/2n
Coil 5213	+4 max ⇒ 3X/9cm	E = 3	12cm/8n

Moving the object and stand magnifier so that the virtual image lies further beyond the spectacle add focal point has much less dioptric effect on image quality when the spectacle add focal point is relatively far away. Therefore, with stand magnifiers requiring relatively low maximum spectacle adds, the field of view can become the factor limiting usefulness at distances longer than indicated by the spectacle add, rather than image quality. When such a reduced visual field is listed as one newsprint letter, (1n), it is the factor that limits the stand magnifier's useful distance, rather than image quality.

Determinations of noticeable blur were made subjectively with my distance refraction "Just Noticeable Difference" of +/-0.25 diopters. For patients with low vision, and therefore larger "Just Noticeable Differences," blur would not be noticed as quickly if the stand magnifier lens were moved away from the spectacle plane, and visual fields would be therefore more often the factor limiting the stand magnifier's useful distance.

Reducing the spectacle add when using a focused stand magnifier

When spectacle add power is reduced linearly and object distance is increased to maintain clarity, the object angular subtense magnification and the magnification of near correction, (which when combined equals the reference distance multiplied by the add power), is also reduced linearly.

When the spectacle add power used with a stand magnifier is reduced linearly, and the stand magnifier is moved further from the eye to maintain clarity, the resulting rate of magnification reduction remains linear, but is multiplied by the stand magnifier's constant enlargement factor. Several stand magnifiers have been examined to illustrate this effect. The magnification with each stand magnifier or combination was subjectively measured with each spectacle add, and bracketed using aspheric high plus spectacle adds. The required distance of the stand magnifier's lens from the spectacle plane was calculated by subtracting the focal length of the stand magnifier's maximum usable spectacle add from that of the reduced spectacle add, for each spectacle add used. The resulting field associated with each spectacle add was specified in newsprint letters, "n," at the distance calculated. Enlargement factors were calculated for each spectacle add.

Peak "15X"

+5 max ⇒ 0cm/15X/6n	E = (15X)/(5/4) = 12
+4 ⇒ 5cm/12X/3n	E = (12X)/(4/4) =12
+3 ⇒ 13.3cm/9X/1n	E = (9X)/(3/4) = 12

Peak "10X"

+5 max ⇒ 0cm/10X/12n	E = (10X)/(5/4) = 8
+4 ⇒ 5cm /8X/6n	E = (8X)/(4/4)= 8
+3 ⇒ 13.3cm /6X/4n	E = (6X)/(3/4) = 8

Coil 5850/Coil 5428 combination

+5 max ⇒ 0cm/12X/10n	E = (12X)/(5/4) = 9.6
+4 ⇒ 5cm/12X/10n	E = (12X)/(4/4) = 12
+3 ⇒ 13.3cm/9X/7n	E = (9X)/(3/4) = 12

Calculations for the Reizen hollow dome "6X" stand magnifier were made in a different fashion. Although magnification with each spectacle add was subjectively measured and the resulting enlargement factors were calculated as before, the required distance of the stand magnifier lens from the spectacle plane was *subjectively measured,* in order to obtain a subjective clarity range. The fields were then measured at the midpoints of the clarity ranges produced. (It is worth noting that these subjective clarity ranges were made with my distance refraction JND of +/- 0.25 diopters).

Reizen "6X" hollow dome

+6 max ⇒ 0cm/5X/24n   E = (5X)/(6/4) = 3.3

+5 ⇒ 0-4cm/5X/24n   E = (5X)/(5/4) = 4

+4 ⇒ 4-12cm/4X/24n   E =(4X)/(4/4) = 4

+3 ⇒ 8-24cm/3X/16n   E = (3X)/(3/4) = 4

Choosing the maximum spectacle add for stand magnifier calculations

A +6 add was the maximum spectacle add producing central clarity with a Reizen "6X" hollow dome stand magnifier at the spectacle plane. However, clarity with an add occurs over a range. The +6 add was the high end of that range, since only the central portion of the lens remained clear as the add was strengthened above +5. As expected, the +6 add, though technically still producing a clear central image, underestimated the enlargement factor. A better criteria for choosing the maximum add for clarity with a stand magnifier lens at the spectacle plane is to choose an add that produces no more peripheral aberrations than the aspheric high-plus spectacle add producing the same magnification. For that reason, +5 is the maximum usable spectacle add for a Reizen "6X" hollow dome stand magnifier, and +4 is the maximum usable spectacle add for a Coil 5850/Coil 5428 combination.

Variations in published enlargement values

In Dr. Lewis Reich's 1991 article on compound magnifiers, ([3]), he stated that the enlargement factor for the Coil 5428 was 3.6 rather than 3.3, as stated by Dr. Freed, ([1]). Enlargement factors can be measured by clinicians themselves, and I recommend doing so, since there are such reported variations in the literature, (perhaps due to manufacturing), and since measuring them helps create an understanding of what these factors mean and how they are useful. For example, my measurement of the enlargement factor of the Coil 5428 was 3.4, which is what I use in calculations.

Stand magnifier combinations

Although Dr. Reich did not measure the Coil 5850/Coil 5428 combination, he did measure the Visolette 40mm Paperweight/Coil 5428 combination, and found a combined enlargement factor of 6.9. ([3]) He also measured the Visolette 55mm Paperweight/Coil 5213 (tilt-able 12°) combination, and found a combined enlargement factor of 4.5. When he measured the enlargement factors of both Visolettes separately, he found them to be 1.6. ([3])

The double lens system of the Coil 5850/Coil 5428 combination provides for minimal aberrations, and the Coil 5850 paperweight magnifier also has light-gathering characteristics. It is therefore possible that when a Peak 15X provides adequate magnification, but inadequate fields at usable working distances, a Coil 5850/Coil 5428 combination will suffice.

Stand magnifier lens aberrations

Although stand magnifiers with maximum spectacle adds consistent with standard bifocals can be convenient, they have more aberrations than stand magnifiers producing the same magnification with higher maximum spectacle adds. This is because stand magnifiers with higher maximum spectacle adds have a lower proportion of their magnification produced by image enlargement, and a greater proportion produced by proximity of the image.

When a hand magnifier is pulled away from an object, its image enlarges and moves toward infinity. This increases power (spherical and astigmatic) aberrations, and therefore increases power differences across the surface of the lens, resulting in an increase in the variability of magnification across the surface of the lens. For the same reason, stand magnifiers with lower maximum spectacle adds exhibit higher variability of magnification across the surface of their lenses than stand magnifiers with higher maximum spectacle adds.

Variable magnification across the surface of a stand magnifier lens can cause letters in text to move relative to one another when a stand magnifier is moved across the surface of a page. The patient's subjective reaction can range from indifference to nausea. Although an aspheric lens design minimizes this, it does not eliminate it altogether, and cannot address the problem at all viewing distances.

Different levels of variable magnification across the surface of a stand magnifier lens can be illustrated by comparing the non-lighted Coil 4206, producing a maximum of 5X with its maximum spectacle add of +1, with the non-lighted Coil 5428, producing a focused 5X with a spectacle add of +6. In order to illustrate the difference, these stand magnifier/spectacle add combinations should be held in focus and moved across a line of text.

Low maximum spectacle adds

A stand magnifier with a maximum spectacle add of +1 can sometimes be used with a distance correction to increase the available working distance. In these cases, adding distance magnification with a 2X “TV Max” clip allows for a stand magnifier with half the power and twice the field. However, since these stand magnifiers produce relatively high levels of aberrations, and because aspheric lens designs only reduce aberrations at one viewing distance, this is not always an effective strategy.

High maximum spectacle adds

A stand magnifier with a high maximum spectacle add has a virtual image that lies relatively close to the back of its lens. It can be successfully used with lesser spectacle adds for less magnification to increase the working distance, and a second pair of high-plus reading lenses can then provide for especially high magnification nearer the spectacle plane. Stand magnifiers with higher maximum spectacle adds produce less aberrations, but provide less range of focus, and are less often usable with standard bifocals.

Lighted Stand Magnifiers

Lighted stand magnifiers from “Independent Living Aids,” (ILA), have the same optical constants as "Besser" lighted stand magnifiers.

PowerMag "5X"	+5 max ⇒ 5X	E = 5X/(5/4) = 4
PowerMag "8X"	+4 max ⇒ 8X	E = 8X/(4/4) = 8
ILA "4X"	+4 max ⇒ 4X	E = 4X/(4/4) = 4
ILA "5X"	+6 max ⇒ 5X	E = 5X/(6/4) = 3.3
ILA "6X"	+4 max ⇒ 6X	E = 6X/(4/4) = 6
ILA "7X"	+5 max ⇒ 7X	E = 7X/(5/4) = 5.6
ILA "8X”	+2 max ⇒ 8X	E = 8X/(2/4) = 16
ILA "10X"	+2 max ⇒ 10X	E = 10X/(2/4) = 20
Coil "4.7X" LED	+4 max ⇒ 4.5X	E = 4.5X/(4/4) = 4.5
Coil "5.4X" LED	+3 max ⇒ 5.5X	E = 5.5X/(3/4) = 7.3
Coil "7.1X" LED	+4 max ⇒ 7X	E = 7X/(4/4) = 7
Coil "8.7X" LED	+2 max ⇒ 8X	E = 8X/(2/4) = 16
Coil "10.1X" LED	+2 max ⇒ 10X	E = 10X/(2/4) = 20
Coil "12.0X" LED	+3 max ⇒ 12X	E = 12X/(3/4) = 16
Coil "14.7X" LED	+2 max ⇒ 15X	E = 15X/(2/4) = 30
Peak "10X"	+5 max ⇒ 10X	E = 10X/(5/4) = 8
Peak "15X"	+5 max ⇒ 15X	E = 15X/(5/4) = 12

Comparing required magnifications

The magnification required to meet a near visual goal when simply using a high plus spectacle add is usually the same magnification required when using a stand magnifier with a much lower powered spectacle add, if the object distance is approximately the same, regardless of the location of the stand magnifier enlarged virtual image.

Assuming a distance correction is used without ocular accommodation, the required magnification of a hand-held magnifier is also usually the same as that of a stand magnifier, if the object distance is approximately the same, even though the hand magnifier image lies in the distance.

Binocular Stand Magnifiers

Internal magnifier lighting increases contrast and decreases the effects of glare from external lighting sources. This is normally important for those patients who are not abnormally sensitive to glare from direct light sources. However, there are patients for whom this is not necessary, and who would benefit from maintaining binocular vision while using a stand magnifier.

This is especially true for those with non-congruent central field loss, but it is also true simply due to the added familiarity and comfort binocular vision can provide for those accustomed to it. For these patients, standard prism-compensated readers with paperweight magnifiers can provide a binocular option.

Paperweight magnifiers have other unique benefits. In Dr. Lewis Reich's 1991 article on compound magnifiers, he referenced Coburn "Visolette" paperweight magnifiers, stating, "Although the transverse magnification [enlargement] produced by these devices is limited, their proximal image positions permit the use of powerful reading additions or substantial accommodation. Therefore, the maximum equivalent power can be quite significant." ([3])

As with a common stand magnifier, the enlargement factor of a paperweight magnifier, E, equals the magnification produced by a spectacle add with the paperweight magnifier, divided by that produced by the spectacle add alone. This enlargement factor can then be used to predict magnification with the paperweight magnifier when using other spectacle adds, since as with common stand magnifiers, E is a constant.

The following enlargement factors are based on my own subjective magnification measurements using high plus aspheric trial lenses, and bracketing results. The binocular maximum add does not occur at the spectacle plane, as does the monocular maximum add, due to the physical positioning required by the stand magnifier for binocular use.

——Paperweight magnifier	Diameter	Binocular max add/ enlargement
Reizen	50mm	+14 / 1.5
Reizen	65mm	+12 / 1.7
Reizen	80mm	+10 / 1.6
Reizen	95mm	+10 / 1.6
Coil 5850 "Bright"	50.5mm	+14 / 1.6
Coburn Visolette	55mm	+14 / 1.6
Coburn Visolette	40mm	+14 / 1.6

Standard prism-compensated readers are shown here with their corresponding standard prism. Remember that these powers themselves do not represent the spectacle add used in enlargement calculations, since the distance refraction must first be incorporated.

+4	6^ BI OU
+6	8^ BI OU
+8	10^ BI OU
+10	12^ BI OU
+12	14^ BI OU
+14	16^ BI OU

The customary limits of binocular convergence limit the maximum standard prism-compensated readers to a power of +14D. The larger Reizen paperweight magnifiers can not be used with powers quite that high, but this is due to the height of their dome lenses, not convergence requirements. Using approximations that are clinically useful, I created the following table for clinical reference.

———	Monocular	Binocular
3.5X	Coil 5428/ +4D	Paperweight/ +8D
4X	Coil 5428/ +5D	Paperweight/ +10D
5X	Coil 5428/ +6D	Paperweight/ +12D
6X	Coil 5428/ +7D	Paperweight/ +14D

Stand magnifier choice

The clinical stand magnifier evaluation process outlined below begins with stand magnifiers that have high maximum spectacle adds, since these produce the fewest aberrations and are therefore the best choices, all else being equal. **I have specified these using bold print.** Once these are used to verify required magnifications for non-lighted and lighted stand magnifiers, (which might be different), the outline below allows for stand magnifier choices to be made for longer working distances with smaller fields, or for specific add powers if desired.

For each lighted stand magnifier listed below, the subjectively clear dioptric range, (and corresponding range in inches), was estimated using the dioptric JND, (Just Noticeable Difference), associated with the distance acuity predicted by the required near magnification. This was meant to provide only a *relative* assessment of lighted stand magnifier working range choices for a given required magnification. It is assumed that the distance correction is used without ocular accommodation. An account of other assumptions, measurements, and calculations used for these estimations are given in the appendix. For stand magnifiers paired with their maximum spectacle adds, I simply indicate, “held close.”

4X required near magnification, (as provided by +16D hand magnifier):

50, 65, 80, or 95mm Reizen paperweight magnifier/ +10D 12^BI OU add (*Binocular*)
Reizen “6X” hollow-dome stand magnifier/ +4.00D add
Coil 5428 stand magnifier/ +5.00D add
Lighted: ILA (“Independent Living Aids”) Stand Magnifiers
4X +4.00D add held close
5X +4.75D add @ 1” - 2.5”
6X +2.75D add @ 2.5” - 7”
Coil Stand Magnifiers
4.7X +3.50D add @ 0.2” - 2.8”
5.4X +2.50D add @ 0.6” - 5.7”

5X required near magnification, (as provided by +20D hand magnifier):

50, or 65mm Reizen paperweight magnifier/ +12D 14^BI OU add (*Binocular*)
Reizen “6X” hollow-dome stand magnifier/ +5.00D add held close
Coil 5428 stand magnifier/ +6.00D add

Lighted: ILA (“Independent Living Aids”) Stand Magnifiers
5X +6.00D add held close
6X +3.25D add @ 0.7” - 4.5”
Coil Stand Magnifier
5.4X +2.75D add @ 0” - 4.4”

6X required near magnification, (as provided by +24D hand magnifier):

50mm Reizen paperweight magnifier/ +14D 16^BI OU add (*Binocular*)
Coil 5428 stand magnifier/ +7.00D add held close
Coil 5123 stand magnifier/ +2.50D add

Lighted: ILA (“Independent Living Aids”) Stand Magnifiers
6X +4.00D add held close
7X +4.25D add @ 0.2” - 2.9”
Coil Stand Magnifier
7.1X +3.50D add @ 0” - 3.7”

7X required near magnification, (as provided by +28D hand magnifier):

Coil 5123 stand magnifier/ +3.00D add held close

Lighted: ILA (“Independent Living Aids”) Stand Magnifier
7X +5.00D add held close
Coil Stand Magnifier
7.1X +4.00D add held close

8X required near magnification, (as provided by +32D hand magnifier):

Agfa “8X” stand magnifier/ +4.00D add held close

Lighted: ILA (“Independent Living Aids”) Stand Magnifier
8X +2.00D add held close
Coil Stand Magnifier
8.7X +2.00D add held close
Optelec/ Power Mag/ Schweizer Stand Magnifier
8X +4.00D add held close

10X required near magnification, (as provided by +40D hand magnifier):

Peak “10X” stand magnifier/ +5.00D add held close

Lighted: ILA (“Independent Living Aids”) Stand Magnifier
10X+2.00D add held close
Coil Stand Magnifier
10.1X +2.00D add held close
Peak Stand Magnifier
10X +5.00D add held close

Appendix: Stand Magnifier Choices - Assumptions, Measurements, and Calculations

Assumptions:

required near magnification	predicted distance acuity	predicted JND
4X	20/80	0.8D (+/-0.4D)
5X	20/100	1.0D (+/-0.5D)
6X	20/120	1.2D (+/-0.6D)

Calculations based on subjectively measured and bracketed stand magnifier enlargement factors and maximum usable adds:

4X is provided by:

ILA 4X stand	+4.00 add	held close
ILA 5X stand	+4.75 add	4.4cm focused working distance
ILA 6X stand	+2.75 add	11cm focused working distance
Coil 4.7X stand	+3.50 add	3.6cm focused working distance
Coil 5.4X stand	+2.50 add	6.7cm focused working distance

5X is provided by:

ILA 5X stand	+6.00 add	held close
ILA 6X stand	+3.25 add	5.8cm focused working distance
Coil 5.4 stand	+2.75 add	3.0cm focused working distance

6X is provided by:

ILA 6X stand	+4.00 add	held close
ILA 7X stand	+4.25 add	3.5cm focused working distance
Coil 7.1X stand	+3.50 add	3.6cm focused working distance

Incorporating predicted JND:

4X is provided by:

ILA 4X stand	+4.00 add	held close
ILA 5X stand	+4.75 add	JND range +5.15 — +4.35
ILA 6X stand	+2.75 add	JND range +3.15 — +2.35
Coil 4.7X stand	+3.50 add	JND range +3.90 — +3.10
Coil 5.4X stand	+2.50 add	JND range +2.90 — +2.10

5X is provided by:

ILA 5X stand	+6.00 add	held close
ILA 6X stand	+3.25 add	JND range +3.75 — +2.75
Coil 5.4 stand	+2.75 add	JND range +3.25 — +2.25

6X is provided by:

ILA 6X stand	+4.00 add	held close
ILA 7X stand	+4.25 add	JND range +4.85 — +3.65
Coil 7.1X stand	+3.50 add	JND range +4.10 — +2.90

Predicted clarity ranges in inches:

4X is provided by:

ILA 4X stand	+4.00 add	held close	
ILA 5X stand	+4.75 add	1.0” — 2.5”	clarity range
ILA 6X stand	+2.75 add	2.6”— 6.9”	clarity range
Coil 4.7X stand	+3.50 add	0.2”— 2.8”	clarity range
Coil 5.4X stand	+2.50 add	0.6”— 5.7”	clarity range

5X is provided by:

ILA 5X stand	+6.00 add	held close	
ILA 6X stand	+3.25 add	0.7”— 4.5”	clarity range
Coil 5.4 stand	+2.75 add	0cm — 4.4”	clarity range

6X is provided by:

ILA 6X stand	+4.00 add	held close	
ILA 7X stand	+4.25 add	0.2”— 2.9”	clarity range
Coil 7.1X stand	+3.50 add	0cm — 3.7”	clarity range

References

1) The Journal of Vision Rehabilitation; Vol. 1, No. 2, April 1987
“A New Method For the Measurement of Transverse Magnification; Initial Results in 21 Selected Stand Magnifiers,” Benjamin Freed, OD; table, p. 49.

2) The Journal of Vision Rehabilitation; Volume 1, No. 4, October 1987; Refracting the Low Vision Patient, Benjamin Freed, OD, page 57

3) The Journal of Vision Rehabilitation; Vol. 5, #2, Spring, 1991; Compound Magnifiers, Lewis N. Reich, OD, MS