A Dyop® is a segmented ring visual target (optotype) whose perception of the contrasting gaps/segments spinning provides a strobic stimulus of the photoreceptors for determining visual acuity and refractions. The Dyop Visual Acuity Endpoint is the smallest diameter Dyop where the segments are clearly detected as spinning. A Dyop where the gap/segments only “twinkle” rather than definitively spin is “NOT spinning.”

A Dyop equivalent to a Snellen 20/20 (6/6) with a 10% stroke width has an angular arc width of 7.6 arc minutes with a surface area of 45.36 arc minutes squared. The resultant Dyop gap/segment visual stimulus AREA is 0.54 arc min squared (the Minimum AREA of Resolution - MAR). This Dyop stimulus AREA is smaller than the accepted Snellen/Sloan/Landolt visual stimulus AREA of 1.0 arc min squared. As a result the Dyop MAR is significantly more precise with a linear increase with the increase in the dioptrers of blur, versus the typical Snellen logarithmic increase. That Dyop linear increase relationship is valid for both for myopia (minus sphere) and hyperopia (plus sphere). The smaller Dyop MAR also creates an “optimum” acuity endpoint value for sphere, cylinder, and axis.

The smaller linear acuity endpoint increase of the Dyop arc minute diameter to blur also allows a linear ratio of the Dyop arc width to the dioptrers of power measurement. The initial Unaided Dyop Acuity (UDA) is the value of the smallest Unaided Dyop arc width diameter in arc minutes (am) where spinning can be detected. A UDA value as rounded to 8 arc minutes is equivalent to Snellen 20/20 or Metric 6/6. That UDA value can then determine an Emmetrop Comparison Value (ECV) in arc minutes and the Initial Refraction Setting (IRS) in dioptrers. Because of the linear ratio of the Dyop acuity endpoint to diopeters of blur, subtracting 8 from the UDA value will determine the ECV value. That ECV value can then be divided by 6 to get the initial +/- IRS diopeter setting, which will be plus (+) for a hyperope and minus (-) for a myope. An incorrect plus (+) or minus (-) IRS lens setting will make the spinning Dyop blurrier. For example (see the table below), a UDA of 14 am corresponds to an ECV of 6 am and 1 diopeter of sphere, either plus (+) or minus (-). (A UDA of 14 am minus 8 = ECV of 6 am; ECV/6 = IRS of 1 diopter). A UDA of 20 am will be an ECV of 12 am and two diopeters of sphere. (A UDA of 20 am minus 8 = ECV of 12 am; 12/6 = IRS 2 diopeters), a UDA of 26 am will be three diopeters (UDA of 26 am minus 8 = ECV of 18 am; 18/6 = IRS 3 diopeters), and a UDA of 32 am will be four diopeters (UDA 32 am minus 8 = ECV of 24 am; 24/6 = IRS 4 diopeters). Reducing the Dyop diameter to where spinning is NOT detected is also equivalent to adding blur to the Snellen test to reduce the acuity line response.

Before using the Dyop test, use the Setup menu to insure proper monitor calibration and patient viewing distance. The Lower Left Corner of the test screen displays the Dyop arc minute (am) diameter. The Upper Left Corner displays the corresponding Sloan, logMar, Decimal, or Metric ratio options. Use the Mouse Scroll Wheel, or a Dyop IR controller, or the Keyboard Up/Down Arrows adjusts the Dyop diameter.

Below are five “simple steps” to determine refractions using a Dyop.

1. With unaided acuity determine the smallest Dyop arc width for the Unaided Dyop Acuity (UDA). Check for false positives by alternating the Dyop rotation location and direction. That UDA arc minute value, minus 8 arc minutes, determines the Emmetrop Comparison Value (ECV). That ECV divided by six determines the Initial Refraction Setting (IRS). The incorrect (- or +) sphere will make the Dyop blurrier.
2. With the appropriate IRS diopter spherical lens (either - or +) in place, determine the axis by adding a - 0.50 diopter cylinder lens and rotate that cylinder lens to determine the maximum Dyop clarity (and reduced blur) as the optimum Axis setting.
3. With the optimum Axis determined, add cylinder in 0.25 diopter increments to determine if the spinning Dyop becomes clearer. If the Dyop becomes blurrier, reverse the selection to remove 0.25 diopeters of cylinder to find the optimum Cylinder setting.
4. With the optimum Cylinder determined, reduce the Dyop diameter to the smallest arc width where spinning can be detected, then incrementally add additional either (-) 0.25 diopeters (myope) or (+) 0.25 diopeters (hyperope) of sphere to determine if the spinning Dyop becomes clearer. If the spinning Dyop becomes blurrier, reverse the selection of either (-) 0.25 diopeters (myope) or (+) 0.25 diopeters (hyperope) to make the spinning Dyop clearer. Refine the cylinder by adding additional (+/-) 0.25 to 0.125 diopeters cylinder and (+/-) 0.25 or 0.125 diopeters sphere increments to optimize the Dyop values. Reducing the Dyop diameter also enables avoiding the preference for an under-plused refraction with a hyperope.
5. Continue to reduce the Dyop diameter to where the smallest spinning Dyop can be detected to determine the refraction endpoint and the optimum setting for sphere, cylinder, and axis. Note that when you overminus a myope OR overplus a hyperope the STATIC Dyop will seem to get “clearer” but the spinning Dyop will get less clear. You want detection of the SPINNING Dyop to be as clear as possible.

Record the Best Visual Acuity as the Best Dyop Aided Acuity (BDAA) in arc minutes or the Snellen ratio or the Metric ratio. Repeat the process for each eye and binocularly. With practice, it should be possible to have the increased precision and consistency of a Dyop refraction completed in 180 seconds or less per eye.