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

The Dyop gap/segment visual stimulus area of 0.54 arc min squared is the Minimum AREA of Resolution (MAR) and is smaller than the presumed Snellen/Sloan/Landolt visual stimulus area of 1.0 arc min squared. As a result, the increase in the Dyop angular arc width diameter has an almost linear relationship to an increase in the diopeters of blur, versus the typical Snellen logarithmic increase. That linear relationship is valid for both for myopia (minus sphere) and hyperopia (plus sphere). That Minimum AREA of Resolution (MAR) Dyop arc width where spinning is detected also creates an “optimum” value for sphere, cylinder, and axis.

The initial Dyop Unaided Acuity (DUA) is smallest unaided Dyop arc width diameter in arc minutes (am) where spinning can be detected. That DUA value determines an Emmetropie Comparison Value (ECV) in arc minutes and the Initial Refraction Sphere (IRS) in diopeters. An DUA value of 8 arc minutes will be equivalent to Snellen 20/20 or Metric 6/6. Because of the Dyop arc minute value has a linear increase with blur, subtract 8 from the DUA arc minute to find the ECV arc minute equivalent. That ECV arc minute value is then 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, a DUA of 14 arc minutes corresponds to either a plus (+) or minus (-) one diopeter of sphere (DUA of 14 am minus 8 = ECV of 6 am; 6/6 = IRS 1 diopeter). A DUA of 20 am will be two diopeters (DUA of 20 am minus 8 = ECV of 12 am; 12/6 = IRS 2 diopeters), a DUA of 26 am will be three diopeters (DUA 26 an minus 8 = ECV of 18 am; 18/6 = IRS 3 diopeters), and a DUA of 32 am will be four diopeters (DUA 32 an minus 8 = ECV of 24 am; 24/6 = IRS 4 diopeters). Reducing the Dyop diameter to where spinning is NOT detected is equivalent to adding blur to a 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, 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 test.

1. With unaided acuity determine the smallest Dyop arc width detected Unaided Acuity as spinning (DUA). That DUA arc minute value, minus 8 arc minutes, determines the Emmetropie Comparison Value (ECV). That ECV divided by six determines the Initial Refraction Sphere (IRS).

2. With the appropriate selected IRS diopeter lens (-) 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 Axis determined, incrementally 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 Cylinder determined, reduce the Dyop diameter to the smallest arc width where spinning can be detected, then incrementally add 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. Use additional (+/-) 0.25 diopter cylinder increments and (+/-) 0.25 diopter sphere increments to validate the Dyop optimum values. Reducing the Dyop diameter will also enable 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. Check for false positives by alternating the Dyop rotation location and direction. 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.