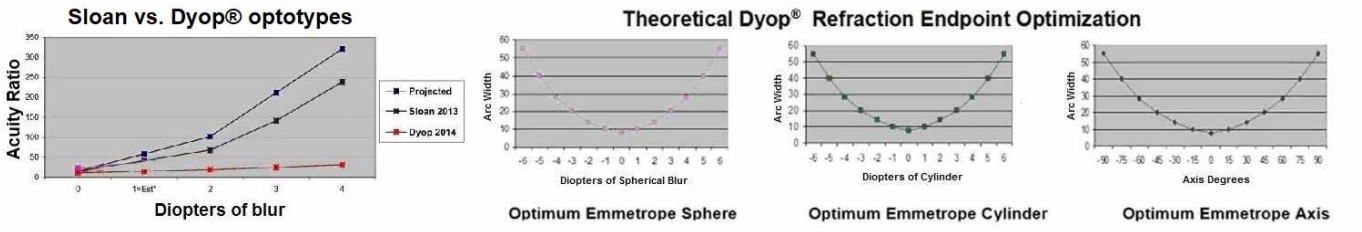
Dyop® Refraction Procedure

2018-02-02

A Dyop® is a rotating/spinning segmented optotype ring whose contrasting gap/segment motion provides a strobic stimulus of the photoreceptors to determine visual acuity and refractions. The Dyop® **Visual Acuity Endpoint** is the smallest diameter segmented ring where the entire Dyop® is clearly detected as spinning. A Dyop® whose gap/segments only "**twinkle**" rather than definitively spin is **NOT** "**spinning**."

The smaller Dyop® visual stimulus area (0.54 arc min squared), versus the Snellen/Sloan/Landolt optotypes (1.0 arc min squared), results in the Dyop® angular arc width having an almost linear relationship to diopters of blur versus the logarithmic Snellen increase. That linear relationship is for both for myopia (minus sphere) and hyperopia (plus sphere). That minimum Dyop® arc width where spinning/rotation is detected creates an "optimum" value for sphere, cylinder, and axis, and is the Minimum AREA of Resolution (**MAR**).



The initial **Dyop® Unaided Acuity (DUA)** is smallest **unaided** Dyop® arc width diameter in arc minutes (**am**) where spinning can be detected**.** That Dyop® (**DUA)** angular width arc minute value determines the **Emmetrope Comparison Value (ECV)** in arc minutes and the **Initial Refraction Sphere (IRS)** in diopters. An 8 **DUA arc minute** value will be an emmetrope 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**. Divide that **ECV arc minute** value by **6** to get the initial +/- **IRS** diopter setting, which will be plus (+) for a hyperope and minus (-) for a myope. An incorrect be plus (+) or minus (-) **IRS** lens will make the spinning Dyop blurrier. For example, a **DUA** of 14 **am** corresponds to either a plus (+) or minus (-) **one** diopter of sphere (**DUA** of 14 **am** minus 8 = **ECV** of 6 **am**; **6/6 = IRS 1** diopter)**.** A **DUA** of 20 **am** will be to **two** diopters (**DUA** of 20 **am** minus 8 = **ECV** of 12 **am**; **12/6 = IRS 2** diopters), a **DUA** of 26 **am** will be **three** diopters (**DUA** 26 an minus 8 = **ECV** of 18 am; 18/6 = **IRS** 3 diopters), and a **DUA** of 32 **am** will be **four** diopters (**DUA** 32 an minus 8 = **ECV** of 24 am; 24/6 = **IRS** 4 diopters).

Snellen/Sloan	6	10	15	18	20	25	30	40	45	50	60	65	70	75	80	90	100
Metric	2	4	4.5	5.5	6	7.5	10	12	14	15	18	20	21	23	25	27	30
Dyop Unaided arc min = **DUA**	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Emmetrope arc min = **ECV (-8.0)**	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
Initial Sphere (+/-) = **IRS - ROUNDED**	-0.75	-0.5	-0.25	-0.25	0	0.25	0.5	0.5	0.75	1	1	1.25	1.25	1.5	1.625	1.75	2

Snellen/Sloan	110	130	150	170	200	220	250	300	350	400	475	550	650	800	1000	1300	2000
Metric	34	40	45	50	60	67	75	90	100	120	145	170	200	240	300	400	600
Dyop Unaided arc min = **DUA**	21	22	24	25	28	30	32	35	39	41	47	52	57	61	70	73	90
Emmetrope arc min = **ECV (-8.0)**	13	14	16	17	20	22	24	27	31	33	39	44	49	53	62	65	82
Initial Sphere (+/-) = **IRS - ROUNDED**	2.25	2.25	2.5	2.75	3.25	3.5	4	4.5	5.25	5.5	6.5	7.25	8.25	9	10.25	11.5	13.75

DUA = Dyop® Unaided Acuity **ECV = Emmetrope Comparison Value** **IRS = Initial Refraction Sphere**
DUA arc minutes minus 8 **arc minutes** ==> **ECV arc minutes** **ECV arc minutes** divided by 6 ==> **IRS** diopters

Before using the Dyop® test, use the Setup menu to insure proper monitor size calibration and patient viewing distance. In the **lower left corner** of the test screen is the **Dyop® arc minute diameter (am)** and in the **upper left corner** is the corresponding **Sloan**, **logMar**, **Decimal**, or **Metric** ratio options. Use the Mouse Scroll Wheel, the Dyop® IR controller, or the Keyboard Up/Down Arrows to adjust the Dyop® diameter sizes.

There are five "simple" steps to determine a refraction using a Dyop test.

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

2. With the appropriate diopter (-) or (+) **IRS** lens in place, to **determine the axis** add a - 0.50 diopter cylinder lens and rotate that cylinder lens to determine the maximum Dyop® clarity (reduced blur) which will be the optimum **Axis setting**.

3. With that Axis setting, i**ncrementally add cylinder** in 0.25 diopter increments of to determine if the spinning Dyop® becomes clearer. If the spinning Dyop® becomes blurrier, incrementally reverse the selection to remove 0.25 diopters of cylinder to find the optimum Cylinder setting.

4. **Reduce the Dyop® diameter to the smallest arc width where spinning can be detected** and i**ncrementally add** either (-) 0.25 diopters (myope) or (+) 0.25 diopters (hyperope) of sphere to determine if the spinning Dyop® becomes clearer. If the spinning Dyop® becomes blurrier, reverse the selection of either (-) 0.25 diopters (myope) or (+) 0.25 diopters (hyperope) to make the spinning Dyop clearer. Use additional (+/-) 0.25 diopters cylinder increments and (+/-) 0.25 diopters 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® arc minute diameter** to where the smallest spinning Dyop® can still be detected to determine the refraction endpoint and the optimum setting for sphere, cylinder, and axis. Alternate the Dyop® rotation location and direction to check for false positives. 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 120 seconds or less per eye.