

Comparison of portable instruments for screening and ID of Lab-Grown Diamonds

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Considering the occurrence of undisclosed lab-grown diamonds, vigilance combined with the use of standard and advanced gemmological tools are critical to ensure confidence in the supply line. While well-equipped labs can identify such non-natural origin and issue a report accordingly, diamond dealers, gemmologists, appraisers and retailers need instruments that help them to screen natural and some cases identify lab-grown diamonds. There are an increasing number of detection instruments and machines (see table 1 below) on the market that use different methods for screening/detection, notably:

- transparency to SW UV light
- characteristic fluorescent/phosphorescent reaction to LWUV, SWUV and other UV light
- Vis, PL, Raman, FTIR and fluorescence spectroscopy
- fluorescence imaging and other undisclosed techniques

Name of Instrument	Synthetic Diamond Kit (3 instruments)	Synthetic Diamond Screener II	Jewellery Inspector	Gempen	iD100	DiaTrue CS	EXA/J-Screen
Producer	GRI Inc	Presidium	Gemetrix	Gemometrics	GIA	OGI	MAGILABS/HRD
Country	Canada	Singapore	Australia	Sweden	USA	Israel	Finland, Italy / Belgium
Cost (US\$)	\$525+shipping	\$599+shipping	\$600+shipping	\$2,750+shipping	\$4,995+shipping	\$5,900+shipping	\$8,200+shipping
Weight	0.15 kg	0.17 kg	0.11 kg	0.40 kg	1.02kg	6.50 kg	3.40 kg
Instrument (image)							

Table 1:30 loose /mounted items (which included 55 diamonds and 7 imitations) were tested in March 2020 in Vancouver with 7 instruments: the suite comprised **17 natural diamonds with natural colour** (16 near colourless, 1 coloured), **4 natural diamonds with treated colour** (2 near-colourless, 2 coloured), **18 HPHT-grown diamonds** (16 near colourless, 2 coloured), **16 CVD-grown diamonds** (12 near colourless, 4 coloured) and **7 diamond imitations** (3 near colourless CZ, 3 near colourless moissanite, 1 coloured moissanite).

The samples were tested with 7 portable instruments under US\$9,000. Other instruments tested under the DPA (Diamond Producers Association) program were not provided for tests by manufacturers and are not included in this study.

Each member of the trade has specific needs on the type of item to be tested (loose or mounted, size and colours), the number of items needed to be tested per hour and the accepted tolerance on accuracy, as well as budget. Table 2 (*see below*) shows our results, compared to DPA report. **It is advised that a potential buyer spend at least 1 day at a trade workshop or online webinar seeing the use of standard and advanced portable instruments with samples of lab-grown diamonds before deciding which instrument to buy.**

Instrument	Sample Size	Loose or Mounted	Colour of samples	ID of imitation	Samples tested per hour	Method used	% properly detected by CGL	DPA /or 'manufacturer report on product performance'	CGL report on product
"Portable Polarioscope" + Loupe (Synthetic Diamond Kit)	+0.02 ct (under loupe)	Loose and opened back mounts	Near colourless and coloured	Screening (showing no pattern) from natural	10sec / sample 300 per hour	2 Polarized Filters at 90 degrees	ID as nat. or lab-grown Diamond: 90% Undecided (referred): 10%	Not tested at DPA /'The combination of 4 portable instruments with training will ID HPHT grown; screen CVD grown'	<i>Simple and inexpensive, good back-up on clean stones without fluorescence, not useful on closed backs and melee</i>
"PL Inspector Jewellery Inspector"	+0.01 ct	Loose (PL Inspector) and mounted (Jewellery Inspector)	Near colourless and coloured	CZ yes, loose moissanite	15 sec / sample 240 per hour	Relation of LW/SW fluorescence + phosphor.	ID as nat. or LGD:90% Undecided (referred): 10%	Not tested at DPA/ 'HPHT grown will be detected and CVD-grown will be screened'	<i>Good screening technique, saving images via phone app to compare LW/SW, create database</i>
"Synthetic Diamond Screener II"	+0.02ct	Loose and opened back mounts	D-J	No	15 sec / sample 240 per hour	UV transparency	Percentage of LGD diamonds wrongly classified as natural: 0% Screen as IIa (colorless): 90% Referred 10%	DPA: False Positive: 0% Nat diamond Accuracy 85% Referral 15%	<i>Well priced and easy to use, but is screening device, need further testing on low nitrogen natural diamonds and some CVD without fluorescence</i>
"Gempen"	+0.01 ct	Loose and mounted	D-M	No	4-5 sec per sample, 800 per hour	UV fluorescence at specific UV wavelengths.	ID as nat. or lab-grown Diamond: 90% Referred: 10%	DPA: Diamond False Positive: 5-15% Synthetic Diam Accuracy. 85-95%	<i>Nice design and portable, strong UV source, not always clear results, some colours overlap</i>
"DiaTrue CS"	+ 0.01	Loose and Mounted	Best for near-colorless range D-K	Not clear ID, overlap with natural	20 sec per tray of samples tray 18 trays/hr	UV multi luminescence	ID as nat. or LGD Diamond:77% Undecided (referred): 23%	Not tested at DPA /'Can detect color less CVD, HPHT and Moissanite in a large parcel'	<i>Save and archive data on the tablet quick to use, colours could overlap of natural and LGD</i>

"iD100"	+ 0.005ct	Loose and Mounted	D-J Some coloured (pink)	Yes	12 sec per sample, 240 per hour	Not disclosed (Visible/PL spectroscopy ?)	Percentage of LGD diamonds wrongly classified as natural: 0% ID as nat. Diamond 93% Referred: 7%	DPA: False Positive: 0% ID as nat. Diamond:96-97% Referred 3-4%	<i>GIA behind so builds trust with consumers, easy to use, but many referrals, not final ID option for referred ones, so need to go to lab for final tests</i>
"EXA/J-screen"	+ 0.005ct	Loose or mounted	D-N colour (also some coloured on second advanced level)	Yes	2 sec per sample (+ 2 sec advanced) 800 per hour	Hi-Power LED at 365nm (spectroscopy)	Percentage of LGD diamonds wrongly classified as natural: 0% ID as natural diamond:97% Referred: 3%	Not tested at DPA / 'ID nat. Diamonds 100%: Referred: ~4% can drop to ~1% when using advanced mode'	<i>Very effective and fast, even on melee in mounted diamonds, second final ID level with PL spectroscopy, could be used for gems ID too</i>

Table 2, results, Legend: **Diamond false-positives %:**(the percentage of synthetic diamonds or simulants wrongly classified as natural) **Diamond referrals %:** (the percentage of natural diamonds referred for further testing) **Diamond accuracy %:** (the percentage of natural diamonds correctly categorized as natural)

SUMMARY

We tested 3 instruments that were already tested at DPA but added 4 more instruments that have been tested for the first-time using education workshop diamond collection that has a larger variety of stones (not only colourless diamonds but also colored and simulants). This collection is fully documented with all standard and lab instruments and available to all trade members via "Gemmological Research Industries (GRI) Inc" / "CGL" workshops. Our results on ID of natural and LG diamonds using the **Synthetic Diamond Screener II**, **Gempen** and **iD100** are similar, but slightly different to those of DPA results. DPA focused on near-colorless diamonds, while we used a range of types and colours of synthetic and natural colourless and coloured diamonds, and natural diamonds with various degrees of fluorescence. The **iD100** and other instruments based on PL spectroscopy like **EXA/J-screen** would "refer" some natural diamonds with yellow to orange fluorescence, but the 'EXA/J-screen' has the advantage of displaying spectra on a second level of output to help ID.

We found **DiaTrue CS** very good for HPHT-grown but difficult to use, we had to compare colours of testing samples on the screen with a reference collection and some natural and LGD colours overlap that could explain the higher referred rate for CVD-grown of this instrument.

This study gives us conclusion that there is no single instrument under US\$9,000 that will separate natural and synthetic diamonds 100%. The limitation is partly that Type IIa diamonds may be either natural or synthetic and require more sophisticated analysis and that some natural diamonds do not fluoresce blue. As these low-nitrogen diamonds represents 2-3% of the natural population, it is reasonable that most instruments will have a >3% referral level. Samples in M colours and lower are problems for some automatic instruments (D-J range) so other instruments need to be used.

At CGL we like to combine the use of standard instruments to screen loose and mounted diamonds (like **portable polariscope** to see 'strain pattern' or **Synthetic Diamond Screener II** for jewellery and **PL/Jewelry inspector** to check fluorescence on loose or jewellery) with advanced portable instrument like **EXA/J-screen** and FTIR infrared spectrometer to arrive at a final conclusion of diamond origin - natural or lab grown.