



The Journal of The Gemmological Association of Hong Kong

香港寶石學協會

2005 · Volume XXVI



P.O. Box 97711, T.S.T. Kowloon, Hong Kong.

Tel/Fax: (852) 2366 6006

Technology Reaches Ever Deeper Into the Diamond Business

A presentation of a new automated diamond grading system

David S. Atlas GG(GIA)

Senior Member & Assoc. Director NAJA

Over the past 8 years I have had an opportunity to do some things that few in our industry ever get a chance to do. From out of the blue, a local Philadelphia inventor asked me to consult with him on a secret project that has recently been unveiled, and has opened its first commercial installations both in Surat and Philadelphia. The company is called ImaGem, Inc. and it is offering a nearly automated diamond grading system combined with a very powerful laboratory information business system. The promise is to take a great deal of the subjectivity and human error out of diamond grading, add a repeatable and meaningful Light Behavior analysis of each diamond, provide a set of physical measurements that is far more accurate than those we now accept, and also to identify - or re-identify - a diamond, rapidly and permanently, without marking it.

When I first met Dr. Lalit Aggarwal, the inventor, he was working on a small wooden and cardboard model of the prototype. We moved the diamond manually and used a paper clip to position one of the parts. It was crude, but the concept was very appealing. How can the diamond business move into the 21st Century without entering the technological age? Diamond grading inconsistencies from lab to lab or grader to

grader are a stumbling block to a better and wider trading environment. In an age when people make long distance decisions about buying, they need the best in communication tools and consumers want jewelers to represent diamonds with accuracy. Human, subjective grading is gradually going to be replaced by a much higher degree of objective grading. It won't happen overnight, but those now studying gemology will have to confront this change in the status quo head-on if they are to be a part of the new world of the diamond trade.

Diamond Grading and Reporting:

The ImaGem process begins with weighing a diamond and measuring its depth with a digital micrometer. Then the diamond is placed on the Verigen device™ for about 20 seconds. This device takes digital images of the diamond and records several crucial measurements so that the diamond can be digitally memorized and a bar code label produced which serves to identify this particular stone throughout the balance of the lab processes.

After this comes the GL3100™, the digital gemologist of the system which measures the diamond fully, grades it for color, tests for fluorescence, grades the stone for symmetry, and verifies that the stone matches the bar code produced by the Verigen device.

The stone is next examined with the GL5000™ clarity device. Using immersion techniques, the stone is digitally scanned in segments and at various focal depths to distinguish between inclusions and surface features. The GL5000 can be set to reveal found inclusions and an expert operator makes choices about what to plot. While this may seem more complex than just drawing a clarity plot, the actual operation is not more time consuming and is actually more rapid for SI1 and lower stones. For finer diamonds, it still takes experience and good eyes. The GL5000 allows a manual drawing operation to be added in whenever appropriate.

The last station is called “Chief Gemologist”. This is where the trained decision-maker for the lab operates. Nearly all the mundane work has been done by the ImaGem system, but one must always have a review situation for that small percentage of diamonds which, for some reason, have not been graded properly via automation and technology. It is anticipated that about 1 to 2 percent of diamonds tested may need this review. Diamonds with two colors, diamonds with very patchy UV fluorescence, diamonds with odd shapes, or color bearing inclusions may all create technical issues which would raise the cost of processing beyond reason. However, it is my opinion that it is better to test 98% of all stones through an affordable process than to try to create a device that would prove successful for 99.5% or 99.99% at a cost that made the whole use of technology prohibitive.

The Chief Gemologist enters a grade for polish, verifies proper girdle thickness designations, verifies clarity and color as necessary and with the power of the Lab Information System immediately produces a report configured to the specific client's needs as well as an invoice - all in one step. The system recognizes batches

of diamonds or single stones from one vendor and adjusts billing output accordingly.

In the end, this system still produces GIA color and clarity grading and this remains subjective. But, with this system, the line at which one grade crosses into the next is more accurately defined. With classifications, one never eliminates borderline situations entirely; one can only strive to make them narrower and to bring clarification to the system. There is no need to remake the GIA system, but there is a definite need for repeatability and less doubt. With ImaGem a diligent effort has been made to find the centroids of each GIA color. Dr. Aggarwal has an expertise in statistics along with research experience in human perception. He has solved the mystery of color grading and matches it to GIA results via the use of sufficient samples of GIA graded diamonds and his knowledge of statistics. Rather than simply relying on colorimeters or spectrophotometers, neither having proved perfect at grading the color of diamonds, ImaGem uses a spectrophotometer along with other programming which matches up to GIA results on the sample database. This gives ImaGem repeatable accuracy to 1/3 of a GIA color grade.

The automatic clarity grading continues to be improved upon and to give better and better results. Clarity grading not only has many written “rules”, but many unwritten rules which are less apparent and are not applied with consistency. A device can be “taught” up to a point and then an expert user needs to interact with it. For the most part, the GL5000 calls clarity correctly according to GIA grading. Without doubt, there will be incremental improvements as time goes on. Every diamond teaches something about clarity grading rules, if one chooses to look for the message.

What do we get in the end? We get a diamond with a known identity that has been graded with only a very small dose of subjectivity. We get consistency sufficient that a diamond may be traded over great distances; sight unseen. We also have a system where the individual diamond has been measured for Light Behavior. The AGA lab in Philadelphia and the ImaGem lab in Surat make use of the data from ImaGem technology to produce similar grading reports, particularly full grading and "Light Behavior" reports. Unlike current methods, symmetry and fluorescence are objectively measured. The underlying technology contains proprietary and patented methods for capturing, processing and storing vast details of data. The rapid processing speed is considered an important feature of the technology.

Light Behavior grading

ImaGem uses the scientific term "Normal Lighting" for the lighting that is used in their devices. This is a scientific term to describe a repeatable, suitable light environment in which readings may be taken that give proper results upon interpretation. It should not be confused with everyday, regular room lighting.

Three primary ImaGem definitions are:

1. Brilliancy: a measure of a stone's overall strength of light return that represents its average light return in the face-up position. This measure is arrived at by computing the mean gray-scale value of all pixels within the girdle portion of a diamond.

2. Sparkle: a measure of those spangle-like flashes of reflected and refracted light that give diamonds what might be called "kick". The greater the number of these flashes, the higher a stone's sparkle. This measure is arrived at by measuring the standard deviation in the gray-scale value of the light return within the girdle image.

(Note: "Sparkle" is observed when the diamond is held stationary, and should not be confused with "scintillation", which is observed when a diamond is moved about.)

3. Intensity: a measure of the number and strength of contrasting light-dark areas within the diamond's girdle perimeter. This is what gives a stone vitality and character. The greater the "intensity", the greater a stone's "life" will be. This measure is arrived at by calculating a ratio of bright pixels to the total number of pixels within the girdle.

Overall Light Behavior Grading:

The top score is "0".....The lowest score is "5". Therefore 6 grades are possible.

Brilliancy, Sparkle and Intensity are measured and reported individually, and then combined under the formula below to create a single 0 to 5 AGA-LBI Grade.

ImaGem terminology Brilliancy Sparkle Intensity	"Excellent"	"Very Good"	"Good"	"Good to Fair"	"Fair"	"Commercial"
AGA rules to convert to LBI score.	1 V. Good allowed 2 Ex required	1 Good allowed 2 Ex or Very Good required	1 Fair allowed 1 Good allowed 1 Ex or V. Good required	2 Fairs allowed 1 Ex to Good required	3 Fairs	1 or more graded as Commercial
AGA-LBI Overall Grade	0 EX+ or EX	1 VG+ or VG	2 G	3 GF	4 F	5 C

"Overall" grades will be reported as letter abbreviations AND as numbers from 0 through 5.

EX+ is reserved for diamonds that score all three ImaGem measures in the "Excellent" range.

VG+ is reserved for diamonds that score all three ImaGem measures in the "Very Good" range.

The human eye can distinguish about 6 grades of Light Behavior. Diamonds are traditionally graded beyond what the eye can perceive, so EX+ has been added for stones that grade exceptionally high and VG+ to separate the upper ranges of the 'Very Good' range. While there is no real visual need for these grades, this clarification conforms to the fine separations typical of the diamond market.

Below is a chart of the numbers which create the individual grades: ImaGem provides the numbers. AGA has created the subjective classification words such as Excellent, Very Good, etc. The numbers will remain constant. AGA reserves the right to change the descriptive grading as more is learned.

These numbers relate only to round diamonds. Fancy shapes will be graded in comparison only to fancy shapes of similar configuration. Their number groupings may be somewhat different than those for round diamonds.

Brilliancy:

**Excellent ≥ 150 , Very Good $120 < 150$,
Good $110 < 120$, Good to Fair $100 < 110$,
Fair $80 < 100$, Commercial $0 < 80$**

Sparkle:

**Excellent ≥ 70 , Very Good $40 < 70$,
Good $20 < 40$, Good to Fair $10 < 20$,
Fair $5 < 10$, Commercial $0 < 5$**

Intensity:

**Excellent ≥ 160 , Very Good $125 < 160$,
Good $115 < 125$, Good to Fair $110 < 115$,
Fair $105 < 110$, Commercial $100 < 105$**

Further information is available on the following websites:

Grading, about the author, his family business and history: www.gemappraisers.com

datlas@datlas.com

ImaGem technology: www.ImaGemInc.com.

info@imageminc.com



GL5000 Clarity Instrument



GL3100 Grading Instrument



Inbound Station with VeriGem™