Task Force on Lighting and Diamond Color Grading
Part 1: Lighting and Its Effect on Color Grading Colorless Diamonds
Findings, Conclusions, and Recommendations
February 2009

Executive Summary

Main Issue Overview

In response to allegations over the past number years from gemologists and appraisers that colorless diamonds exhibiting blue fluorescence were being over-graded by gem-testing laboratories, the Accredited Gemologists Association (AGA) formed a Task Force in June 2008 to research lighting and its impact on color-grading colorless diamonds. Various gemologists and laboratories from around the world were invited to participate on the Task Force; several important labs have made significant contributions to the AGA study (See Appendix A for list of participants working with the AGA Task Force on Lighting).

After extensive research, the findings, conclusions, and recommendations were prepared for presentation 2009 AGA Tucson Gemological Conference. Just prior to the AGA presentation, an article titled "Grading D-Z Diamonds at the GIA Laboratory" appeared in the Winter 2008 issue of *Gems & Gemology*. This article presented information in direct opposition to the findings of the AGA Task Force. Therefore, in order to avoid any confusion and misunderstanding, the Task Force presentation was modified to compare its findings directly to the information presented in *Gems & Gemology*.

This summary presents facts related to the historical findings that are readily available in the gemological archives, information from the recent G&G article, and the scientific findings of the AGA Task Force. It will become evident that the lighting environment for color grading diamonds used at current GIA laboratories is contrary to both the gemological trade's historical understanding and teachings of color grading D-Z diamonds for over a century, and the vast body of historical and recent scientific findings related to lighting and its impact on color-grading these diamonds.

The newly prescribed lighting environment in the G&G article promotes a new, conceptual and fundamental change that a diamond must be color graded and reported by a professional gemological laboratory at its "Perceived Color", and not at its "True Body Color". In addition to this new and historical change, the "Basic Technical Standards for Lighting and Color Grading D-Z diamonds at GIA Laboratories" promote the continuation of global color grading inconsistencies, and may cause laboratories to over color grade diamonds that exhibit medium (M), strong (ST), or very strong (VST) blue fluorescence. If these new lighting standards are not complied with for reasons of ethical objections, a gemological laboratory may risk loss of dealer customers and ultimately, remaining in business.

Science Overview

98% of colorless, sizeable, natural diamonds are Type 1a. 40% of these diamonds exhibit fluorescence. Of the diamonds exhibiting fluorescence, 98% fluoresce blue, while the remaining 2% fluoresce another color. Approximately 50% of blue fluorescent diamonds exhibit fluorescence strength of Medium, Strong, or Very Strong. Therefore, the focus of the Task Force was on blue fluorescent diamond.

A theoretical perfect diamond is formed completely of carbon. It has no particles of other matter. It is completely transparent. It has no color and it does not fluoresce. The cause of the varying concentrations of yellow "hue" in Type 1a Cape Series diamond is the presence of nitrogen particles (atoms) when the diamond is formed over millions of years.

In addition to the yellow hue caused by the presence of nitrogen, certain groupings of nitrogen in a diamond cause it to fluoresce blue. This particular grouping of nitrogen is called N3, because it represents the combination of 3 Nitrogen atoms with 3 Carbon atoms. The N3 center in diamond has been scientifically studied for over 100 years. It is well understood and documented how the N3 center absorbs certain wavelengths of energy in our day-to-day living environments, especially outdoors during daylight, and then subsequently emits energy in the "visible" energy spectrum in the form of blue fluorescence.

The N3 centers in Type 1a diamonds are "excited" primarily by ultra-violet (UV) energy. Being complementary colors, the excitation of blue fluorescence whitens a diamond's "true body color". In some cases, in natural outdoor daylight, blue fluorescence may cause a diamond with ST or VST blue fluorescence to be "perceived" as blue-white, not its "true body color". Also, artificial lighting environments can be created to include sufficient UV energy to excite the fluorescence reaction.

In these lighting environments, the diamond is observed at its "Perceived Color" (e.g. when its fluorescence is stimulated). But the diamond's "True Body Color" is observed when removed from these UV-emitting lighting conditions (e.g. when the diamond is in its "steady state").

(Other "optical centers" comprised of different types of chemical elements can be found in diamond, including the Cape Series. They can also absorb and emit different wavelengths of energy. These other elements are also well studied and understood. They are secondary in importance to the N3 center and its effect on color grading Type 1a Cape Series diamond).

True Body Color vs Perceived Body Color – Historical View

Going back over 100 years, there was concern in the diamond trade for this fluorescence-improved "perceived color", which was viewed as a "false color". Evidence of concern for this fluorescence-improved, "false color", is found in Frank B. Wade's book ***"Diamonds: A study of the factors that govern their value"***, published in 1916. Wade warned dealers to be "on their guard against them". "Some of these stones are inferior in beauty to pure white stones when viewed under a light which does not cause them to fluoresce." A small sampling of other noteworthy opinions on the topic includes:

- 1940's: Shipley and Liddicoat – "The Federal Trade Commission fair-trade-practice rules and rulings established by the American Gem Society in both the United States and Canada require that the color of the stone be graded entirely on the basis of its body color."

- 1950's: GIA Course Materials - "Fluorescent stones should be graded at their poorer color [as seen] in artificial light devoid of ultraviolet radiation, rather than at their daylight grade"

- 1970's: Peter Read – "A large portion of diamonds fluoresce under ultraviolet light, and because 'daylight' fluorescent lamps contain a proportion of ultra-violet rays, such stones can appear to be "whiter' than they actually are because of their blue fluorescence. For this reason, most lamps have a diffusing cover over their fluorescent tubes which absorbs ultra-violet rays…"

- 1980's: Dr. Eduard Gübelin – Regarding the design of his Koloriscope G+S Diamond Grading Cabinet, "A removable U-V filter is provided with a sharp cut-off below 400nm, and this

removes any residual ultra-violet light from the source, enabling accurate color comparisons to be made in non-fluorescing conditions."

- 1990's: AGS Way Course – "Use daylight-equivalent fluorescent lighting with minimal ultraviolet output. To eliminate all ultraviolet light, use a filter of Lexan plastic**"**

- 1990's: John King – "Certainly a lack of UV would allow a diamond to show its "true" body color without any additional blue fluorescence to enhance the color grade."

New Lighting Standards announced by GIA in Winter 2008 G&G Issue

- "We believe that a standard light source for diamond color grading should have key characteristics of daylight, **including a UV component**." p320

- The light source used in laboratory color grading D-Z diamonds must have "An emission for long-wave UV (between 315 and 400 nm, close to the reference spectrum of D55–D65)." p305

- "A color spectrum close to CIE D55–D65", (including its daylight long-wave UV emission) p305

- "An 8-to-10 in. distance between the lamps and the grading tray" p.305 (note that neither the GIA Diamondlite or DiamondDock comply with this "Basic Technical Standard").

AGA Task Force Findings

Justification for this historical change announced by current GIA in January 2009, which is clearly in conflict with teachings by the GIA and others for the past century, is summarized best by John King:

> **"Yes, you can create an environment devoid of UV, but it's a false situation. It may sound like the ideal, but it steps outside the practical world. It's not relevant because it doesn't really exist anywhere. We try to be sensitive to the practical gemological issues."**

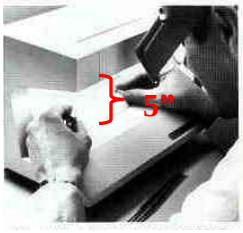
All reputable manufacturers (GE, Osram Sylvannia, Philips) design overhead light bulbs specifically to minimize UV content due to perceived health concerns and related potential product liability.

UV emitted from overhead fluorescent light sources properly mounted in a standard overhead fixture with a diffuser covering in a 10' ceiling is virtually undetectable from 6' off the ground.

Today's windows for commercial and residential buildings of all kinds are specifically designed to filter out UV wavelength to prevent color fading and UV damage to curtains, furniture, etc. Even a few inches away from common UV protected windows, UV is virtually undetectable.

All gemologists should consider UV energy at night when consumers are more likely to wear and show off their most important diamonds. **There is no "UV".**

Energy emitted from a source (sound from speakers, light from a bulb, etc.) diminishes in intensity with increasing distance from the source (Isaac Newton). In a diamond grading laboratory that uses fluorescent light bulbs that are not covered by a simple UV filter, such as a piece of Lexan (or other brand polycarbonate), changing the distance from the exposed fluorescent bulb which a diamond is color graded matters significantly – **up to 4 color grades for a VST fluorescent diamond, up to 2 color grades for a ST fluorescent diamond, and up to 0.5 color grade for a MED fluorescent diamond**. Here are some of the different distances from unfiltered fluorescent bulbs that GIA has prescribed for color grading diamonds.



1960's

1980's - 2000's

2006

NOTE: None of the above diamond grading environments comply with the GIA's newly prescribed grading distance of 8"– 10" from their unfiltered fluorescent light bulbs. Therefore, MED, ST and VST diamonds color graded in these grading environments may be over color graded.

In summary, in indoor artificial lighting environments whether during the day or at night, UV energy is virtually undetectable at normal distances away from fluorescent light sources (e.g. greater than 3'). Therefore, the "justification" by GIA to include unfiltered UV as an energy component in their lighting environment for color grading D-Z diamonds conflicts with scientific fact.

Master Stones as Basis for Color Comparison

Master Stones used as the primary basis for color comparison are **required** to have no fluoresce. Yet, they are used to color grade diamonds that fluoresce. If a MED, ST, or VST fluorescent diamond is color graded in an artificial lighting environment that contains UV, its color will improve as a result of exciting its fluorescence. Such a diamond is in its excited "Perceived Color" state, and not in its steady "True Body Color" state.

Like the variability of sunlight at different times during the day, influences from atmospheric conditions, and different locations on the earth, "Perceived Color" is a *variable* color that changes widely depending upon the intensity of the UV to which the diamond is exposed. The amount of UV energy emitted by a light bulb that reaches the point where the diamond is color graded, varies for many reasons: different bulb manufacturers, different phosphor mixes, the age of the bulb, where the diamond is graded in relation to the bulb (there can be a 50% variability in UV intensity from the middle of a linear fluorescent bulb to either of its ends), and the physical distance the diamond is graded from the bulb. Each of these factors adds variability to the "Perceived Color" of a fluorescent diamond and results in inconsistency in color grade reporting between labs.

The AGA Task Force scientific research confirms historical teachings of the fathers of gemology, and demonstrates that only by grading fluorescent diamonds against master stones in a controlled lighting environment in which UV energy has been removed will the diamond be reliably graded at its "True Body Color".

The new standards promulgated by current GIA require that a diamond's "Perceived Color" be graded against a reference Master Stone's "True Body Color". This is a fundamental change that is in conflict with gemological history, current and historical physical science, and the spirit of regulation requiring that the color of a diamond be reported at its "True Body Color".

Buying or Selling – Dealers, Retailers, and Public Consumer

When a diamond wholesaler or dealer purchases or sells diamond at a price based in part on its color grade, does the dealer want to pay for the diamond's "Perceived Color" or its "True Body Color"? (reference Frank Wade's warning to diamond dealers in 1916).

When a diamond dealer sells to a retailer or to the consuming public, should the diamond retailer or public consumer pay for the diamond's "Perceived Color" or for its "True Body Color"? Robert Shipley answered this question in 1941: Grade the diamond at its "True Body Color" in the exacting conditions of a gemological laboratory. Show the (uneducated) consumer this color. Then, take them over to the window and show them how the color improves in outdoor lighting. They will be pleasantly surprised.

Once again, history clearly documents that all of the original founders, authors, and their successors, understood that the intention of color grading fluorescent diamonds in a professional gemological laboratory meant grading its "True Body Color"; that is, its color when it is NOT stimulated by UV energy. The recent standards formally announced by current GIA management represent a most basic change to historical understanding and teachings of the global gemological community. These standards add confusion throughout the trade, promote the continuation of inconsistency in grading practices between global grading laboratories, and are in conflict with the basic intention and ethical mandate to protect the public consumer.

The Conclusion

An industry standard must be established that requires any professional gemological grading laboratory that issues a report on the color grade of a diamond, to grade that diamond in a lighting environment in which UV energy is removed. If a laboratory elects to use a fluorescent light bulb, or other light source that emits UV energy, then that light bulb must be filtered to remove the UV.

Basic systems must be implemented to ensure that the output from the light source complies with the established lighting standard. There are simple processes a professional lab can take to ensure industry compliance. In doing so, global consistency of grading results will improve among professional labs.

For purposes of reporting disclosure, a very simple, inexpensive, and readily available UV Meter should be used by the gemological laboratory to quantify the amount of UV present in its grading environment. For purposes of quantification and definition, UV energy should not exceed 2µ/cm² at the point of color grading diamond.

For fluorescent diamonds, we recommend reporting disclosure similar to the following:

1. For a lab using an unfiltered fluorescent light bulb or other unfiltered, UV emitting light source:

   XYZ Lab uses unfiltered fluorescent lighting when color grading diamonds. Fluorescent light bulbs emit a small amount of ultraviolet energy which may stimulate fluorescence in certain diamonds. As such, the diamond 's color reported is a perceived color.

2. For a lab using a light source that is devoid of UV energy or that is filtered to eliminate or sufficiently reduce UV energy (2µ/cm² at the point of color grading diamond):

   ABC Lab uses artificial lighting that has been filtered to remove ultraviolet energy when color grading diamonds. As such, the color reported is the diamond's true body color. When a blue fluorescent diamond is worn outdoors during daylight, or in other lighting conditions in which ultraviolet energy is present, its color may appear whiter.

For further background and in-depth information on this topic, including the technical and scientific findings of this task force, please visit the Accredited Gemological Association website at the follow internet address: http://www.accreditedgemologists.org/currevent.php

Appendix A

AGA Task Force on Lighting and Color-Grading Colorless Diamonds

Chairman: Stan Hogrebe, Dazor Lighting, CPA, CEO

Gary Smith – Forensic Gemologist™, GG, AGS-CGA, AGA-ASG, ASA - Master Gemologist Appraiser®
Michael Cowing – FGA, MSEE
Thomas Hainschwang – DUG, FGA, GG, Experte SGG
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Martin Haske – GG, Senior Member NAJA, JVC-ATF
Renata Jasinevicius, Candidate PhD Physics
Michael Allchin, Chief Executive and Assay Master
Branko Deljanin – DUG, FGA, GG
Nicholas Del Re – EGL/USA
Dan Gillen – GG
Manfred Eickhorst – PhD

Other international laboratories, such as the GIA, were invited to participate but where, regrettably, unable to do so. We look forward to more extensive participation as we move ahead.