Why a Two-Dimensional Cut Grading System is Passé

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Traditionally, cut grading systems would specify ranges of proportions and percentages and then assign a cut grade based on those proportions and percentages. Typically, these two-dimensional systems only considered the main angles and culet, which account for 18 of the 58 facets on a standard round brilliant cut. The optical effects of the 40 'brilliandeered', sometimes spelled 'brilllianteered', facets – stars, upper halves and lower halves – were unaccounted.

One of the best known of these systems was the legacy Cut Grading System of the American Gem Society. To get a top grade of AGS Ideal 0 for a round brilliant cut diamond, a cutter would have to cut the pavilion main angles between 40.2 and 41.2 degrees, create a table between 52.4 and 57.5%, cut crown main angles between 33.7 and 35.8 degrees, keep the girdle thickness below 2.95% at the 'valleys' (usually the thinnest points) and cut a culet no larger than 'medium'. In addition, averages have to be used in order to grade this way.

The introduction of the American Gem Society's current cut grading system made all two-dimensional cut grading systems obsolete. The AGS Cut Grading System scans a diamond to create a three-dimensional file and then uses optical physics ray-tracing software to evaluate the three-dimensional model. This approach calculates the ability of that diamond to reflect, refract and return light to the observer. In so doing, the interaction of all of the diamond's facets are measured and accounted.

The following examples serve to exemplify why a two-dimensional approach to diamond cut grading is woefully inadequate.

All of the following models share these exact dimensions:

Diameter	6 mm
Table size	55%
Pavilion main angles	40.8 degrees
Crown main angles	34.5 degrees
Girdle thickness	3% at the mains
Culet size	pointed

This data chart gives performance and proportion results as compiled using the American Gem Society's Performance Grading Software (PGS):

Polish and Symmetry were assumed to be 0.

Filename	Final Grade	Cumulative	Light Performance	Brightness	Dispersion	Contrast	Leakage	Weight Ratio	Durability	Girdle	Culet	Tilt
D6.0G3.0I11.250T55P40.80C34.50LG70.0ST60.0	4	3.6352	3.6352	1.6199	0.4615	1.5538	0	0	0	0	0	0
D6.0G3.0I11.250T55P40.80C34.50LG80.0ST40.0	0	0	0	0	0	0	0	0	0	0	0	0
D6.0G3.0I11.250T55P40.80C34.50LG80.0ST50.0	0	0	0	0	0	0	0	0	0	0	0	0
D6.0G3.0I11.250T55P40.80C34.50LG80.0ST60.0	0	0.1613	0.1613	0.0996	0	0.0617	0	0	0	0	0	0
D6.0G3.0I11.250T55P40.80C34.50LG90.0ST60.0	1	0.5327	0.5327	0.1878	0	0.3449	0	0	0	0	0	0
D6.0G3.0I14.000T55P40.80C34.50LG85.0ST65.0	2	2.1473	2.1473	1.8482	0	0.2991	0	0	0	0	0	0
D6.0G3.0I14.000T55P40.80C34.50LG90.0ST65.0	3	2.5405	2.5405	1.9966	0	0.5439	0	0	0	0	0	0
D6.0G3.0I16.000T55P40.80C34.50LG80.0ST55.0	1	1.4498	1.4498	1.4498	0	0	0	0	0	1	0	0
D6.0G3.0I3.000T55P40.80C34.50LG80.0ST60.0	3	0.5891	0.5891	0	0.5285	0.0606	0	0	0	3	0	0
D6.0G3.0I4.000T55P40.80C34.50LG80.0ST60.0	0	0.471	0.471	0	0.4085	0.0625	0	0	0	0	0	0
D6.0G3.0I5.000T55P40.80C34.50LG75.0ST50.0	0	0.2162	0.2162	0	0.132	0.0842	0	0	0	0	0	0
D6.0G3.0I5.000T55P40.80C34.50LG75.0ST60.0	1	0.5135	0.5135	0	0.1375	0.376	0	0	0	0	0	0
D6.0G3.0I5.000T55P40.80C34.50LG80.0ST40.0	0	0.248	0.248	0	0.248	0	0	0	0	0	0	0

What this data set illustrates is that the 'brilliandeering' can have significant optical effects on the light performance of the diamond. The number and combinations of 'brilliandeering' effects are nearly infinite, which precludes the creation of two-dimensional charts to accommodate every conceivable combination. Moreover, when such charts are used to determine the cut grade of an actual stone, averages of key angles and azimuths must be used, which, perforce, introduces inaccuracies.

The filenames in the data set tell us how the stone was cut, so an explanation of the file names is required.

D6.0 means that the diameter of the stone is 6 mm
G3.0 is the girdle thickness percentage at the main facets – crown and pavilion mains
I xx.xxx is the index (azimuth) on which the upper half facets were cut
T55 is the table diameter percentage
P40.80 is the pavilion main angle
C34.50 is the crown main angle
LG xx.x is the lower girdle facets height
ST xx.x is the star facets length

To be clear, the first example in the data set tells us that the upper girdle facets were cut on an index or azimuth of 11.25 degrees. It is exactly halfway between 0 and 22.5 degrees. This happens to be the normal or usual index – 360 degrees divided by 16 upper girdle facets = 22.5 – for cutting the upper half facets. Girdle thickness is then equal at the mains and half junctions.
LG70.0 tells us that the lower half facets were cut at 70% height.
ST60.0 tells us that the star facets were cut at 60% length.

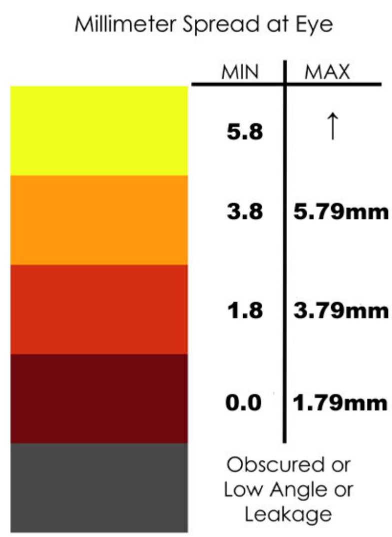
Finally, we have arrived at the examples which are presented in no particular order. These images are from virtual diamonds with every facet exactly on angle and index. They graphically demonstrate the diamond's performance. Real-world cut diamonds can have substantial variations within each tier of facets thereby adding to the complexity of the 'brilliandeering' effects.

Each image set contains 14 individual images – 7 face up and 7 tilted 15 degrees.
Top row from left to right:

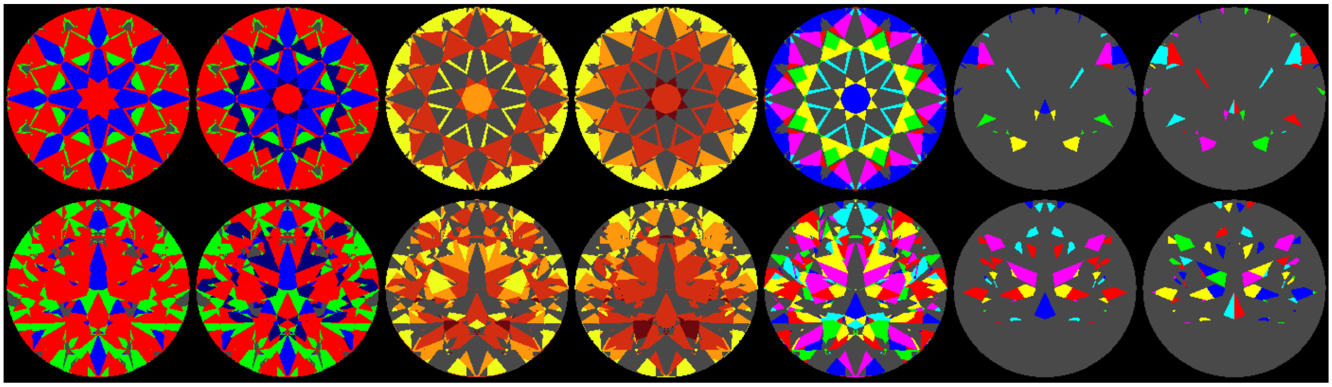
1) The American Gem Society's Angular Spectrum Evaluation Tool (ASET) with a blue cone of 30 degrees.
2) The American Gem Society's Angular Spectrum Evaluation Tool (ASET) with a blue cone of 40 degrees.
3) Reverse ray-traced 'fire map'.
4) Forward ray-traced 'fire map'.
5) 360 degree scintillation map.
6) Sector 1 scintillation map.
7) Sector 2 scintillation map.

Bottom row from left to right is the same as above but the stone is tilted 15 degrees.

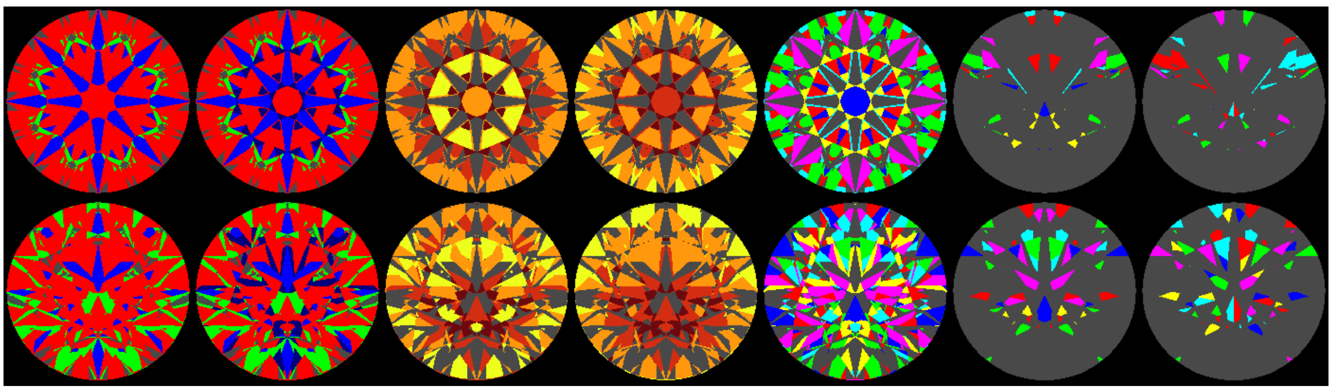
This translation key will help you to decipher the 'fire maps'. Higher dispersion increases the potential for you to actually see fire. Yellow is the highest, with average dispersion in these areas greater than 5.8 mm at the close observation point of 250 mm or 9.84 inches.



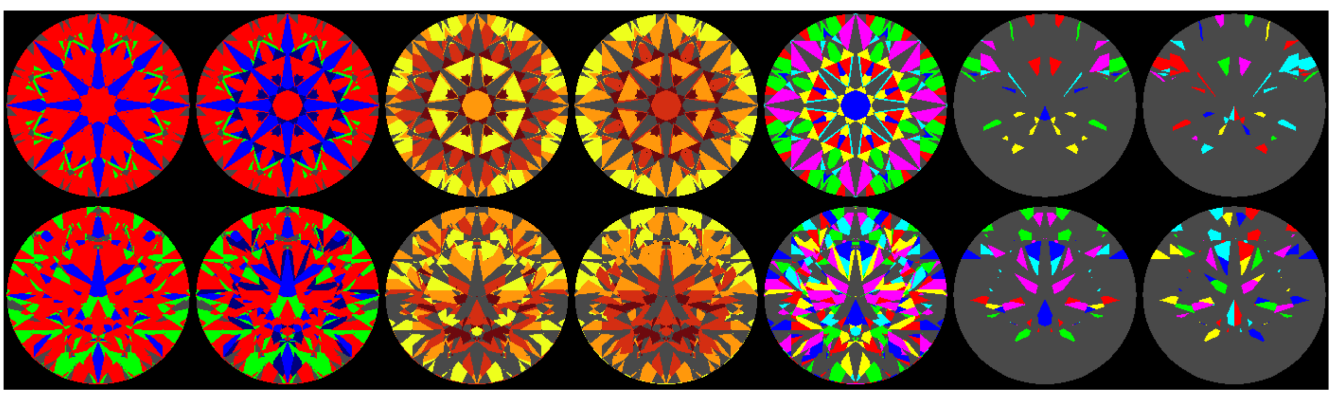
We continue to research scintillation and have not yet published on this topic. However, the scintillation maps are somewhat intuitive.



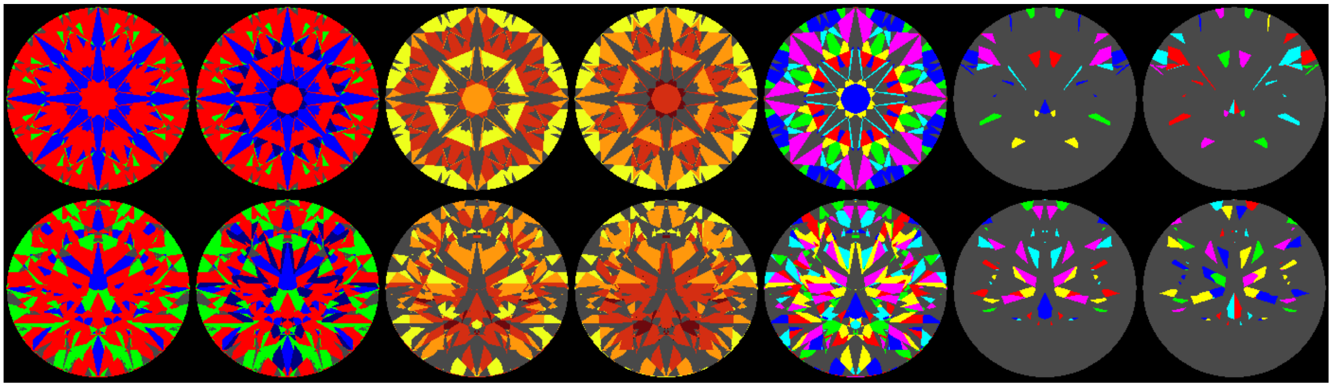
D6.0G3.0I11.250T55P40.80C34.50LG70.0ST60.0
Cut Grade: AGS Good 4
Majority of stone center can appear dark



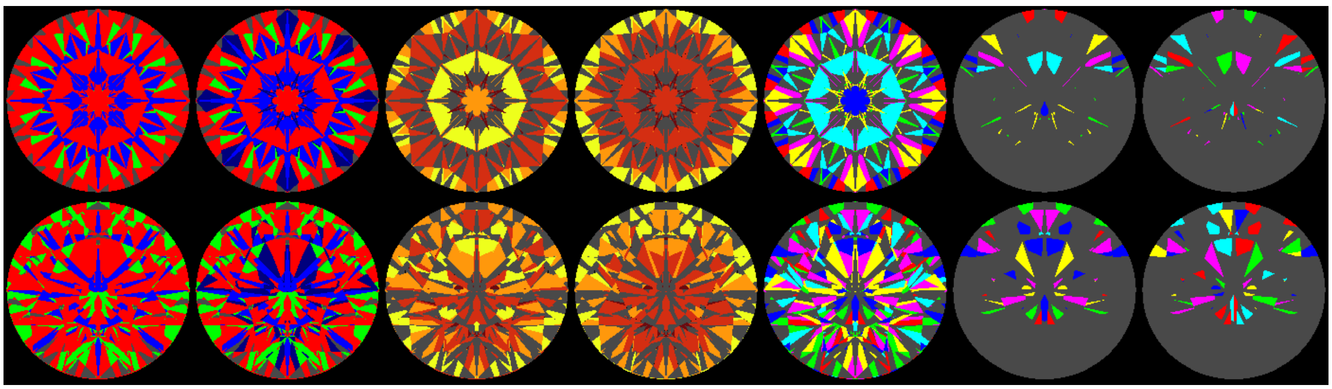
D6.0G3.0I11.250T55P40.80C34.50LG80.0ST40.0
Cut Grade: AGS Ideal 0



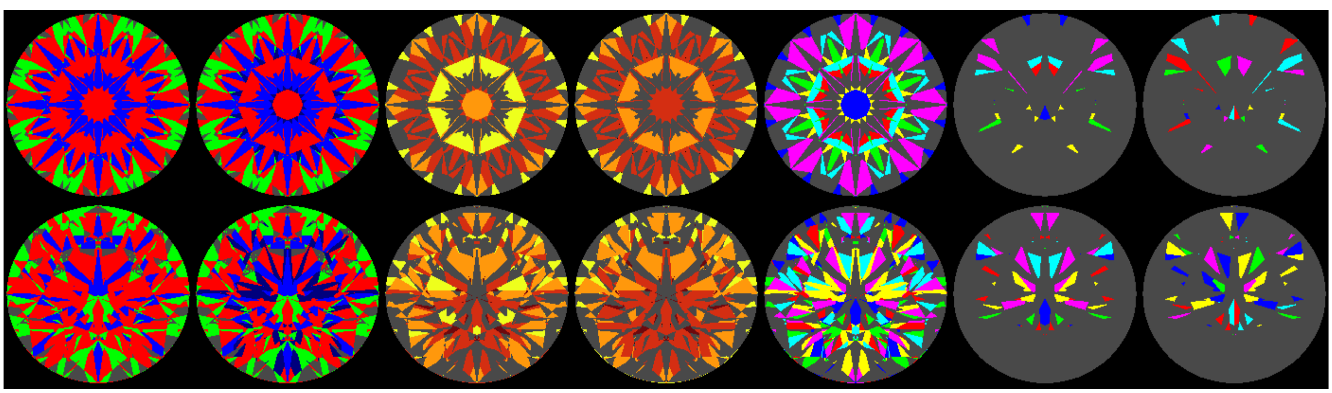
D6.0G3.0I11.250T55P40.80C34.50LG80.0ST50.0
Cut Grade: AGS Ideal 0



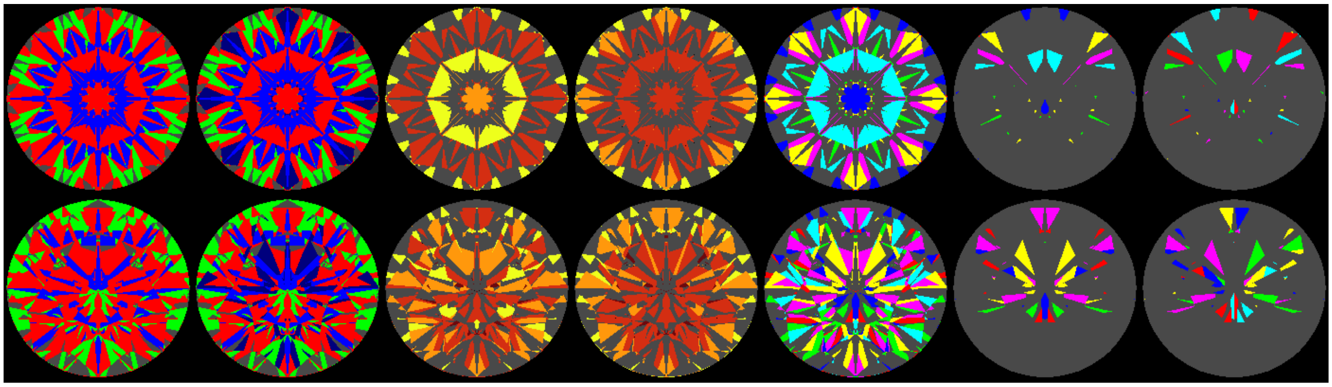
D6.0G3.0I11.250T55P40.80C34.50LG80.0ST60.0
Cut Grade: AGS Ideal 0



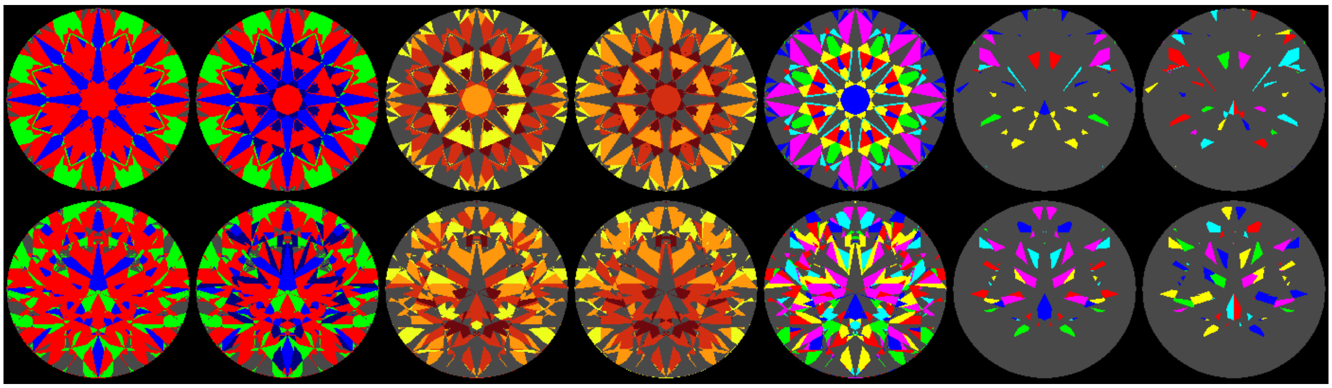
D6.0G3.0I11.250T55P40.80C34.50LG90.0ST60.0
Cut Grade: AGS Excellent 1



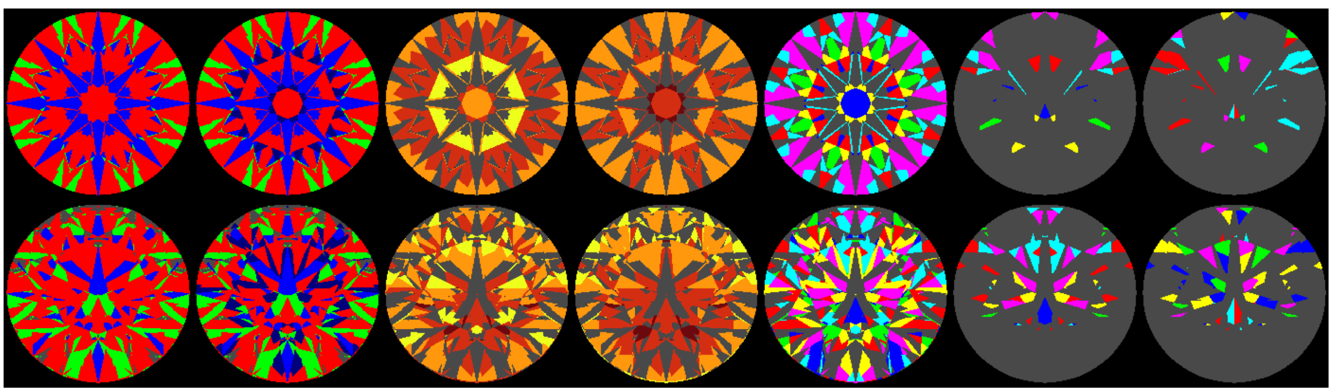
D6.0G3.0I14.000T55P40.80C34.50LG85.0ST65.0
Cut Grade: AGS Very Good 2



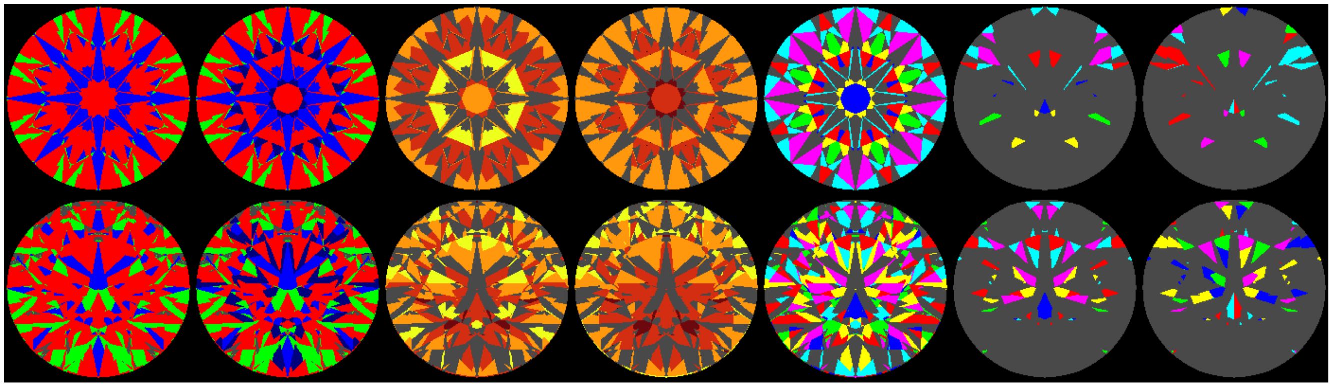
D6.0G3.0I14.000T55P40.80C34.50LG90.0ST65.0
Cut Grade: AGS Good 3



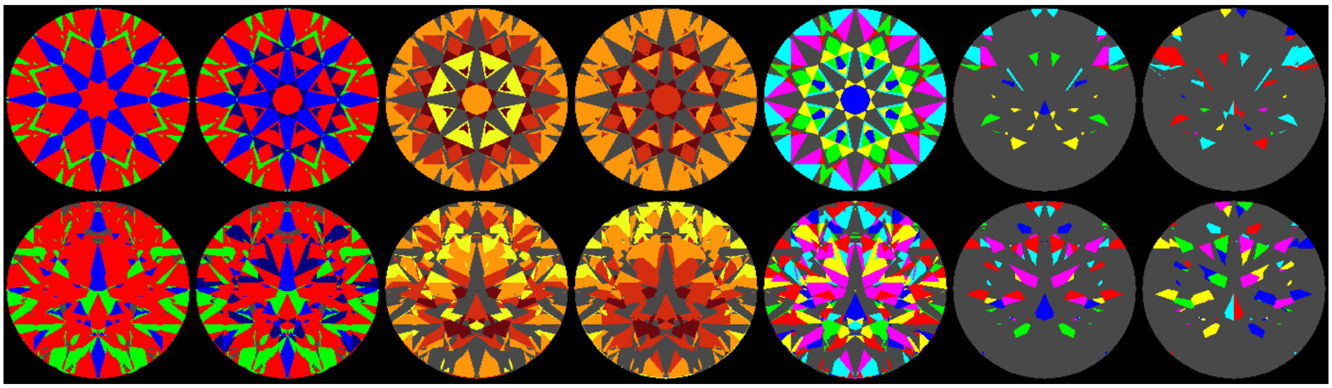
D6.0G3.0I16.000T55P40.80C34.50LG80.0ST55.0
Cut Grade: AGS Excellent 1
Girdle goes to Very Thin



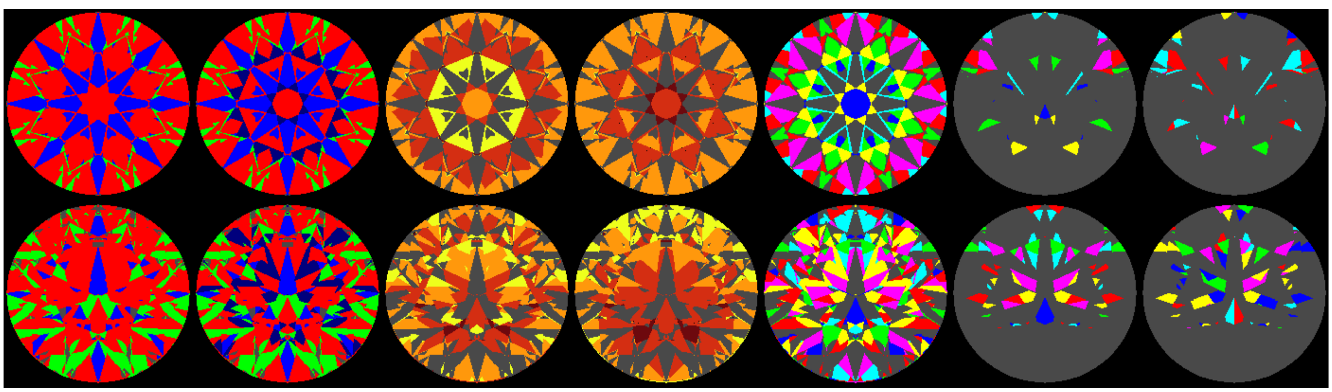
D6.0G3.0I3.000T55P40.80C34.50LG80.0ST60.0
Cut Grade: AGS Good 3
Girdle goes to Thick at half junctions



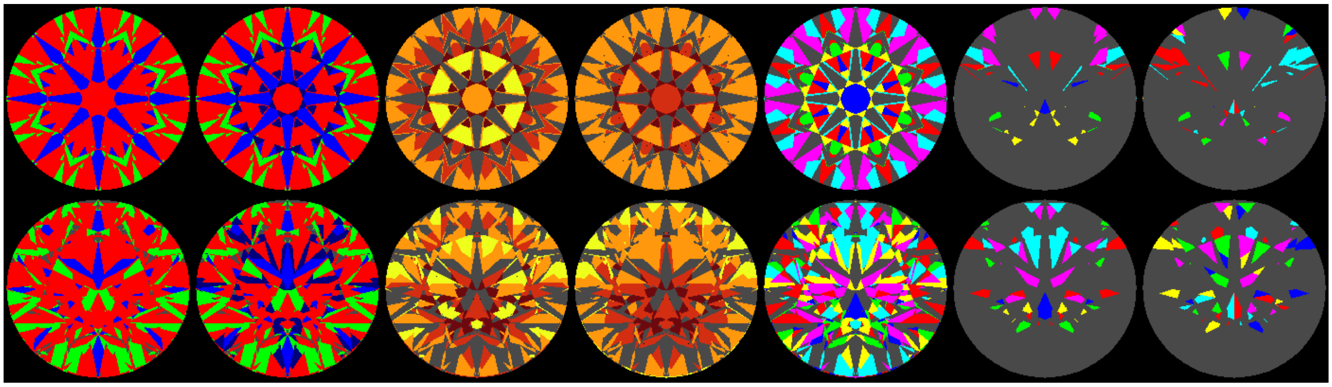
D6.0G3.0I4.000T55P40.80C34.50LG80.0ST60.0
Cut Grade: AGS Ideal 0



D6.0G3.0I5.000T55P40.80C34.50LG75.0ST50.0
Cut Grade: AGS Ideal 0



D6.0G3.0I5.000T55P40.80C34.50LG75.0ST60.0
Cut Grade: AGS Excellent 1



D6.0G3.0I5.000T55P40.80C34.50LG80.0ST40.0
Cut Grade: AGS Ideal 0

The above examples are only a miniscule sampling of the myriad possibilities. Nevertheless, we believe that they are a convincing argument for the benefits of a three-dimensional grading system while simultaneously making the point that a two-dimensional system is passé.

Diamond cutters like to work from charts. We have provided the cutting industry with Guideline Charts with specific 'brilliandeering' parameters. These types of charts are very helpful to the cutting trade. But, when presented to the consuming public they can be used to purposefully misrepresent and deceive.

Another interesting insight derived from our research is that some proportion sets can perform over a wide range of 'brilliandeering' effects, while other proportion sets are very sensitive to slight changes in the 'brilliandeering' effects and their performance drops off rapidly.

In conclusion, we have shown that 'brilliandeering' effects can cause a diamond to have a cut grade from AGS Ideal 0 to AGS Good 4 even though its traditional proportions fall within the old Ideal two-dimensional proportion range.