The Effects of Indexed Upper Half Facets

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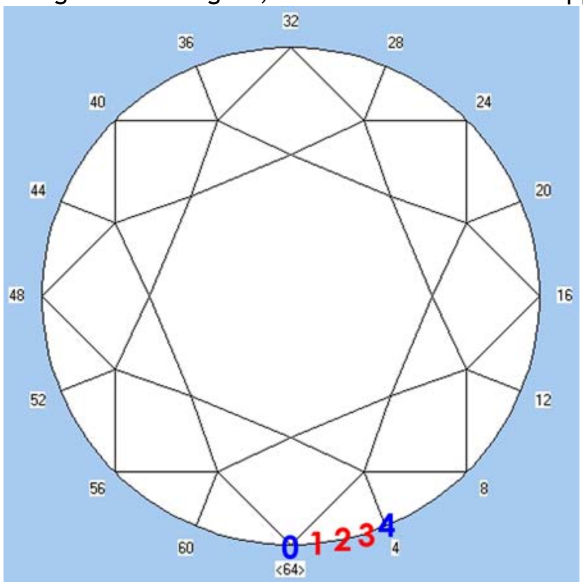
Gemstone cutters can tilt or 'index' the upper half (or upper girdle) facets. This indexing produces different amounts of weight retention from a given piece of rough and produces different optical performance effects. Indexing can also affect crown height and spread (millimeter footprint versus weight, also called 'weight ratio').

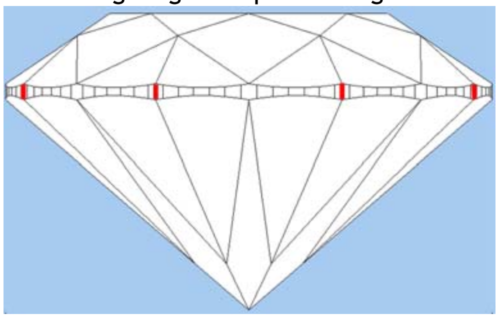
Indexing and Optical Performance

Using a 64-tooth gear, a cutter can index the upper halves at 1, 2, or 3.

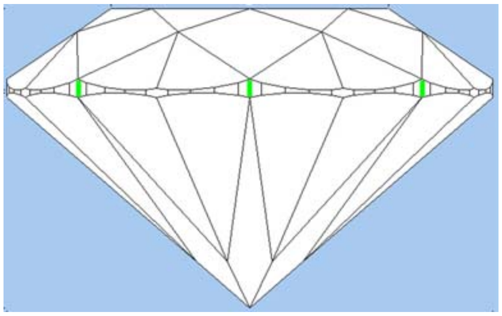


All of the stones in this article have a 57 % table, 33.80 degree crown angle, 21.27 degree star angle, 40.80 degree pavilion angle, and 42.02 degree lower half angle. The only difference is the index of the upper halves and the resultant change in angle of the upper halves.

We'll be giving examples with girdle thickness remaining constant at the halves. This is an example:

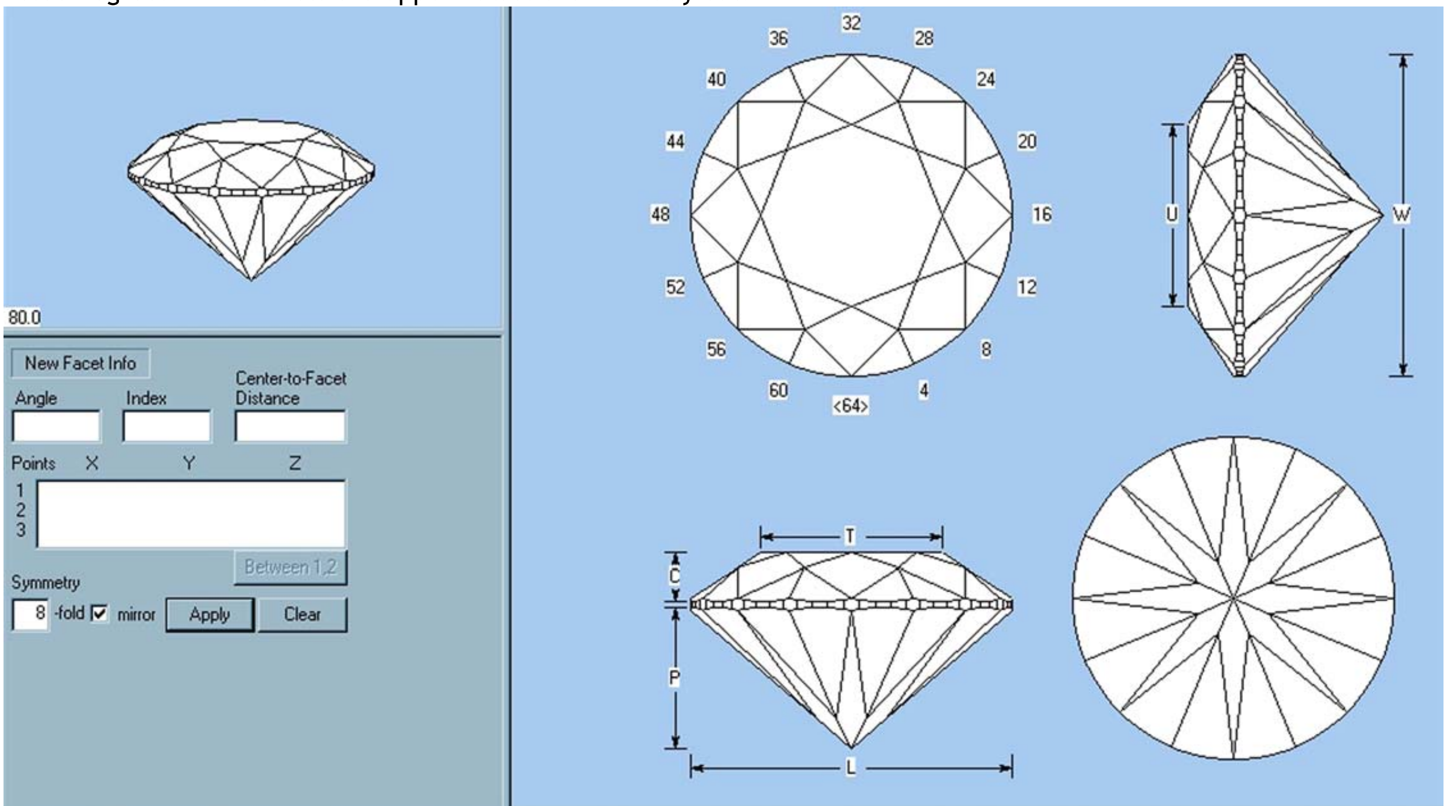


There will also be examples where the girdle thickness remains constant at the mains. This is an example:

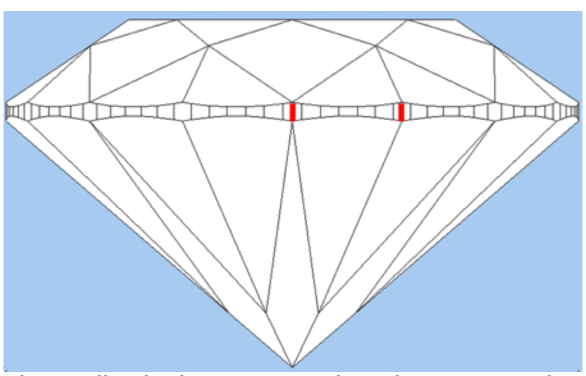


Diamond #1 - Normal Cutting

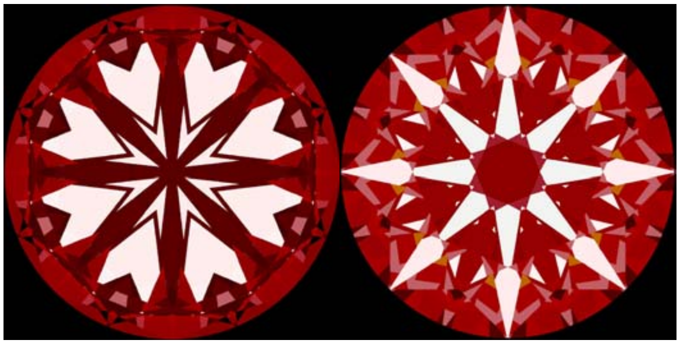
The upper halves are cut on an index of 2, or half way between 64 (or 0) and 4. The angle of the upper halves is 40.58 degrees. This is how the upper halves are normally cut.



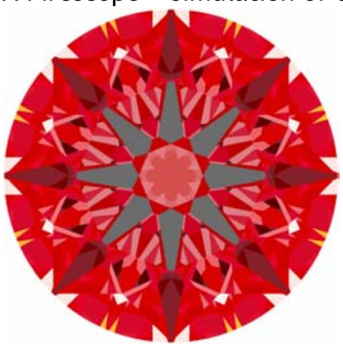
Name	Angle	Indexes	Cutting Instructions
CROWN			
	90.00°	(64 total)	
	40.58°	02-06-10-14-18-22-26-30-34-38-42-46-50-54-58-62	
	33.80°	64-08-16-24-32-40-48-56	
	21.27°	04-12-20-28-36-44-52-60	
	0.00°	Table	
PAVILION			
	40.80°	64-08-16-24-32-40-48-56	
	42.02°	02-06-10-14-18-22-26-30-34-38-42-46-50-54-58-62	


The girdle thickness is equal at the mains and upper half junctions.

A ‘hearts and arrows’ simulation of the above stone:



A Firescope™ simulation of the above stone:

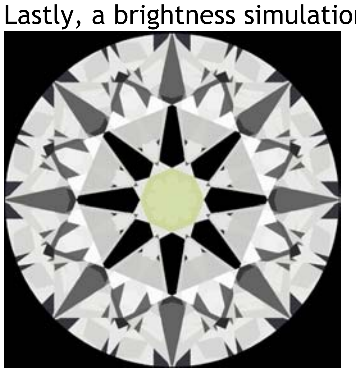


Simulating the American Gem Society’s ASET (Angular Spectrum Evaluation Tool), here’s a color-coded map of how the diamond utilizes light:

White is leakage (defined as an area that does not return light), green is from 0 to 45 degrees from the horizon, red is from 45 to 75 degrees, and blue is 75 to 90 degrees.

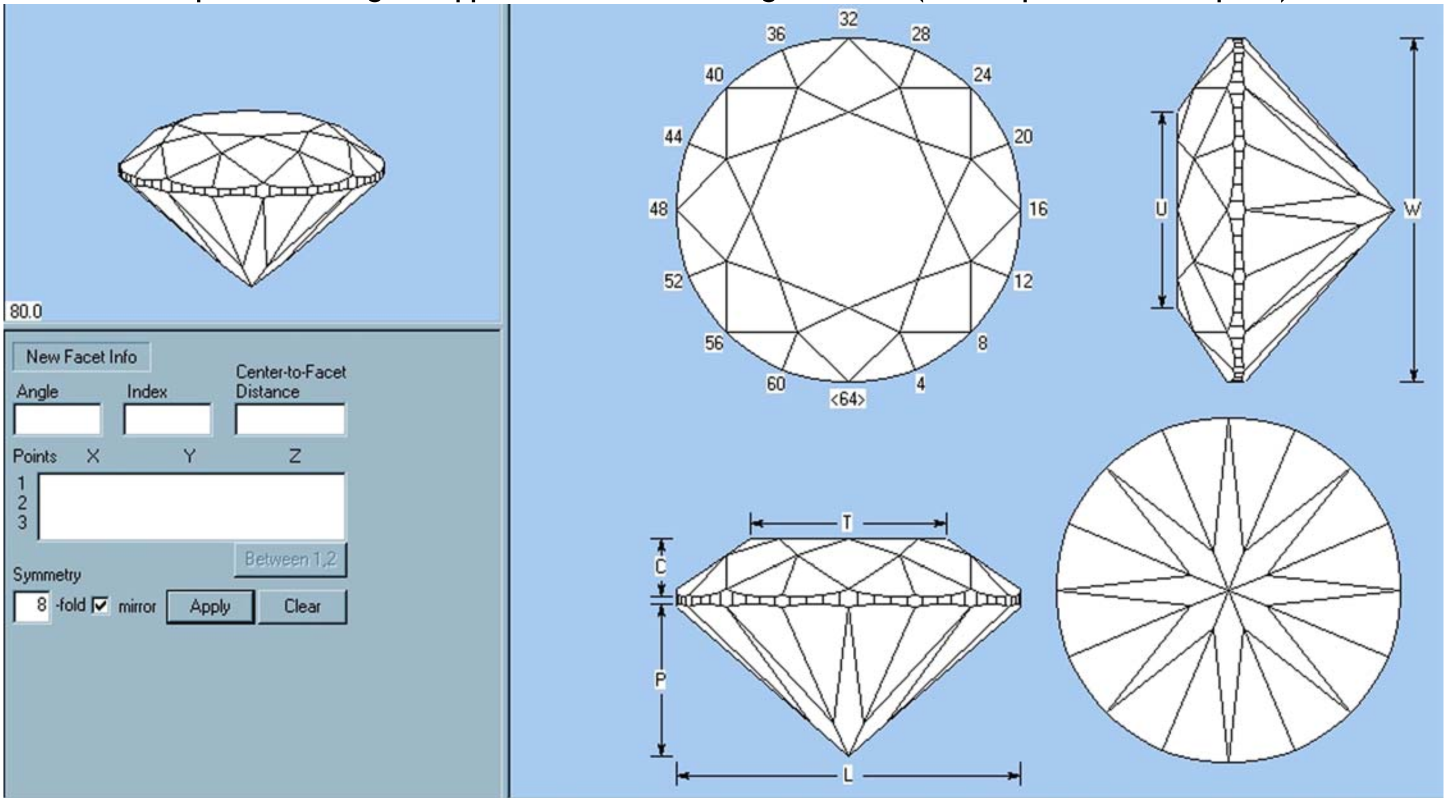
The upper girdle facets draw light from the red area (45 to 75 degrees).

Lastly, a brightness simulation:



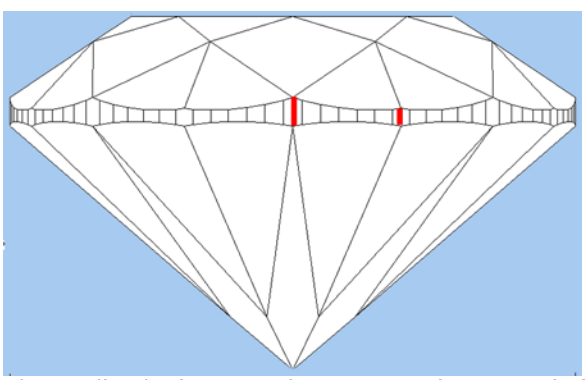
Diamond #2 - Indexed Cutting

This is an example of indexing the upper halves in the 'wrong' direction (from a performance aspect):



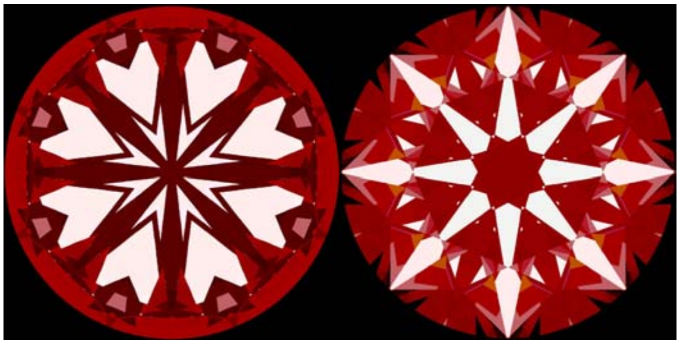
Name	Angle	Indexes	Cutting Instructions
CROWN			
	45.38°	03-05-11-13-19-21-27-29-35-37-43-45-51-53-59-61	
	33.80°	64-08-16-24-32-40-48-56	
	21.27°	04-12-20-28-36-44-52-60	
	0.00°	Table	
	90.00°	(64 total)	
PAVILION			
	42.02°	02-06-10-14-18-22-26-30-34-38-42-46-50-54-58-62	
	40.80°	64-08-16-24-32-40-48-56	

The upper halves are cut on an index of 3, or just over halfway between 64 (or 0) and 4. The angle of the upper halves is 45.38 degrees.

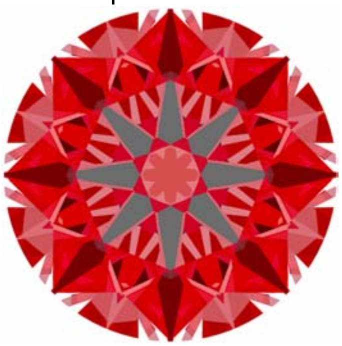


The girdle thickness is the same at the upper half junction as Diamond #1 but thicker at the mains because of the indexing.

A ‘hearts and arrows’ simulation of the above stone:



A Firescope™ simulation of the above stone:

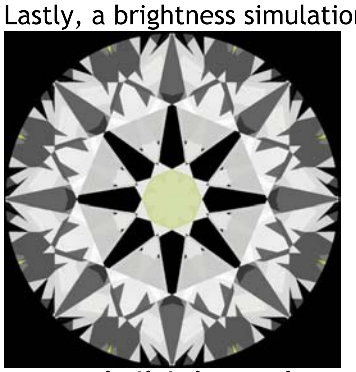


Simulating the American Gem Society’s ASET (Angular Spectrum Evaluation Tool), here’s a color-coded map of how the diamond utilizes light:

White is leakage, green is from 0 to 45 degrees from the horizon, red is from 45 to 75 degrees, and blue is 75 to 90 degrees.

The upper girdle facets draw a large percentage of light from the green area (0 to 45 degrees). Because of the indexed upper halves, their angle is too steep and optical performance suffers.

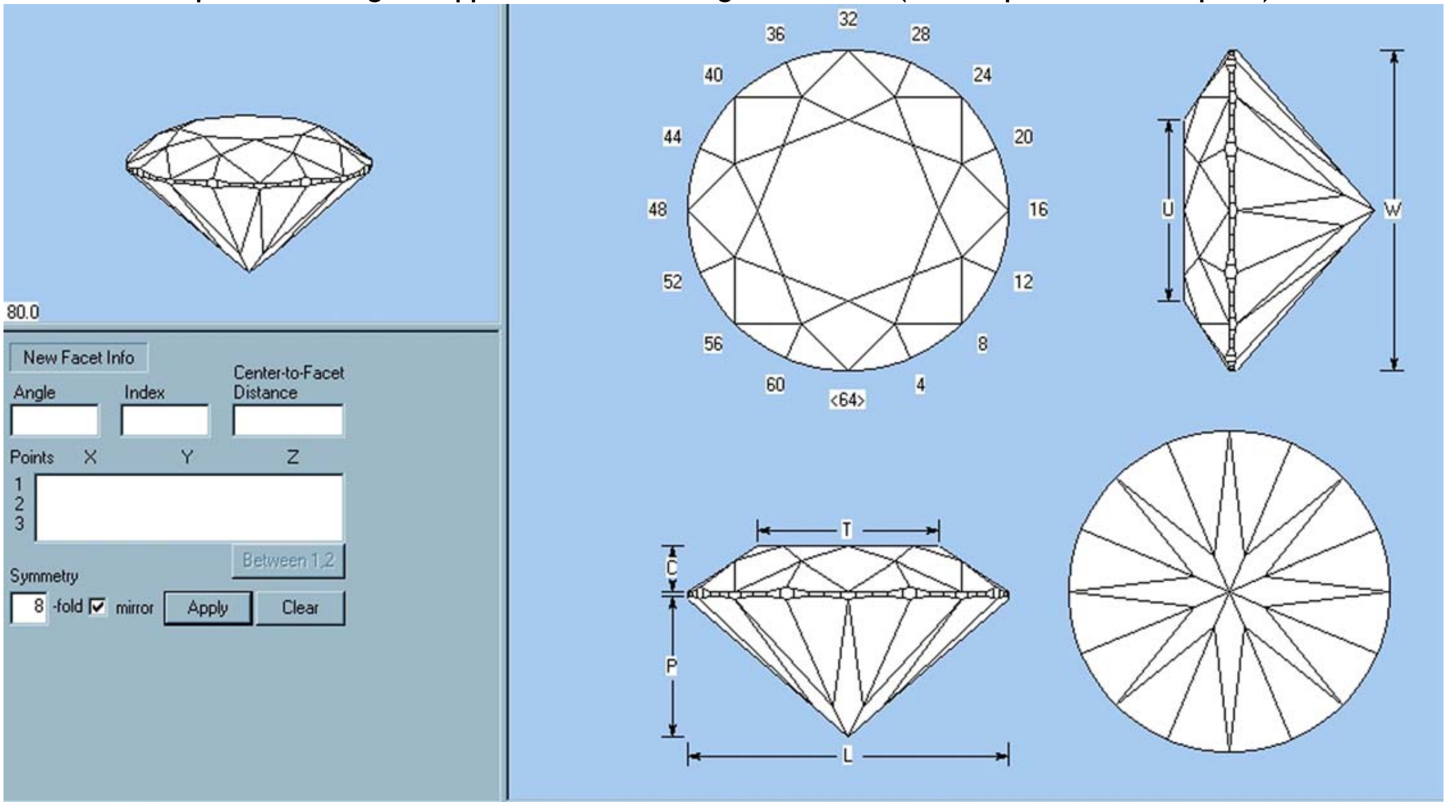
Lastly, a brightness simulation:



In certain lighting environments, this diamond will optically look smaller because the upper halves will darken. This stone will not earn a ‘0’ cut grade in the new AGS Grading System.

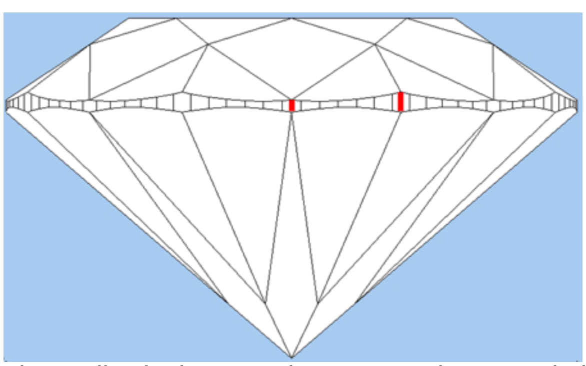
Diamond #3 – Indexed Cutting

This is an example of indexing the upper halves in the 'right' direction (from a performance aspect):



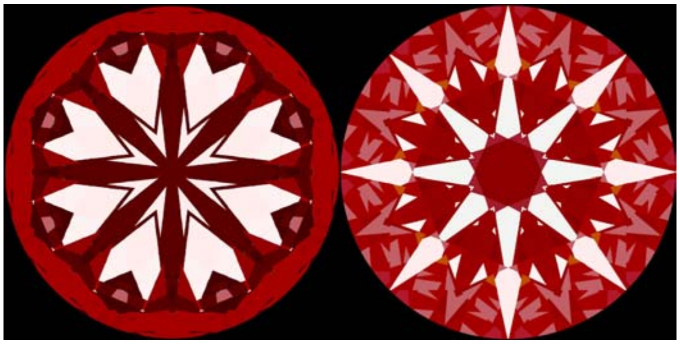
Name	Angle	Indexes	Cutting Instructions
CROWN			
	36.79°	01-07-09-15-17-23-25-31-33-39-41-47-49-55-57-63	
	33.80°	64-08-16-24-32-40-48-56	
	21.27°	04-12-20-28-36-44-52-60	
	0.00°	Table	
	90.00°	(64 total)	
PAVILION			
	42.02°	02-06-10-14-18-22-26-30-34-38-42-46-50-54-58-62	
	40.80°	64-08-16-24-32-40-48-56	

The upper halves are cut on an index of 1, or just less than halfway between 64 (or 0) and 4. The angle of the upper halves is 36.79 degrees.

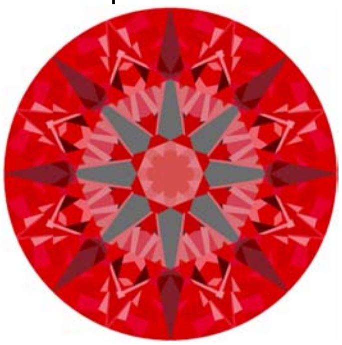


The girdle thickness is the same at the upper half junction as Diamond #1 and Diamond #2 but thinner at the mains because of the indexing.

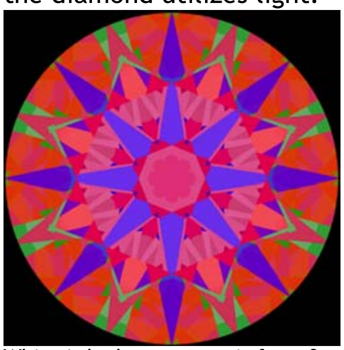
A 'hearts and arrows' simulation of the above stone:



A Firescope™ simulation of the above stone:



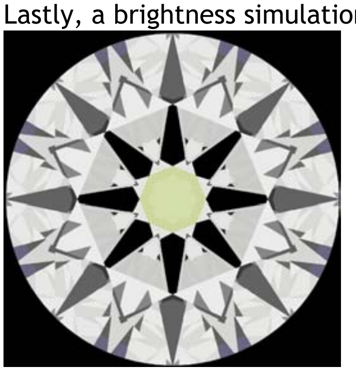
Simulating the American Gem Society's ASET (Angular Spectrum Evaluation Tool), here's a color-coded map of how the diamond utilizes light:



White is leakage, green is from 0 to 45 degrees from the horizon, red is from 45 to 75 degrees, and blue is 75 to 90 degrees.

Face-up leakage is eliminated.

Lastly, a brightness simulation:

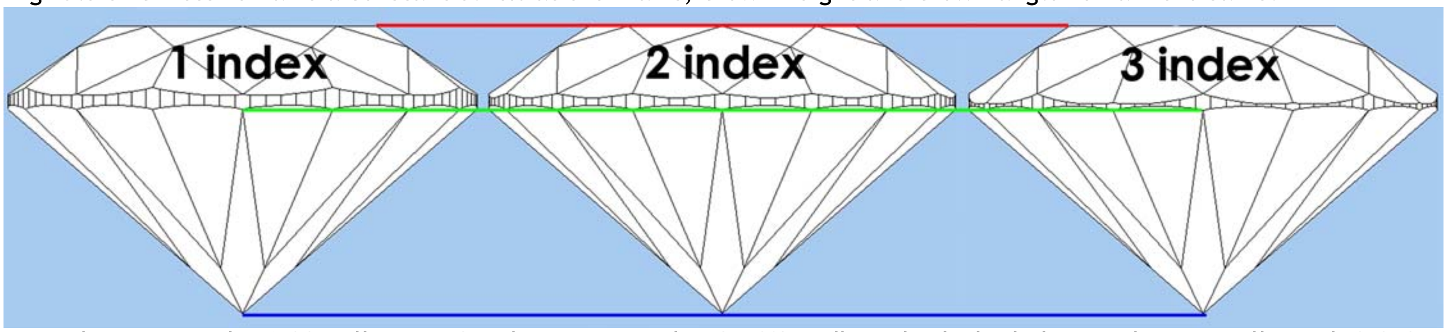


Setting a Constant Girdle Thickness at the Mains

Indexing and Weight Retention

To reiterate, all of the stones in this article have a 57 % table, 33.80 degree crown angle, 21.27 degree star angle, 40.80 degree pavilion angle, and 42.02 degree lower half angle. The only difference is the index of the upper halves and the resultant change in angle of the upper halves.

If girdle thickness remains a constant 3.78% at the mains, crown height and crown angle remain the same.



As we have seen, the 6.00 millimeter 2 index stone, with a 3.78% girdle at both the halves and mains will weigh 0.8137 carats.

The 6.00 millimeter 3 index stone, with a 3.78% girdle at the mains and a 1.85% girdle at the halves will weigh 0.8085 carats. This results in a weight loss of 0.64% compared to the 'normally' cut stone.

The 6.00 millimeter 1 index stone, with a 3.78% girdle at the mains and a 5.22% girdle at the halves, will weigh 0.8174 carats. This results in a weight gain of 0.45% compared to the 'normally' cut stone.

Indexing and Millimeter Spread at the Same Weight

Normalizing all three stones to 0.8174 carats (the heaviest weight at 6.00 mm from the section directly above), this is the approximate millimeter spread for each stone:

The stone cut with an index of 1 will have a diameter of 6.00 mm.

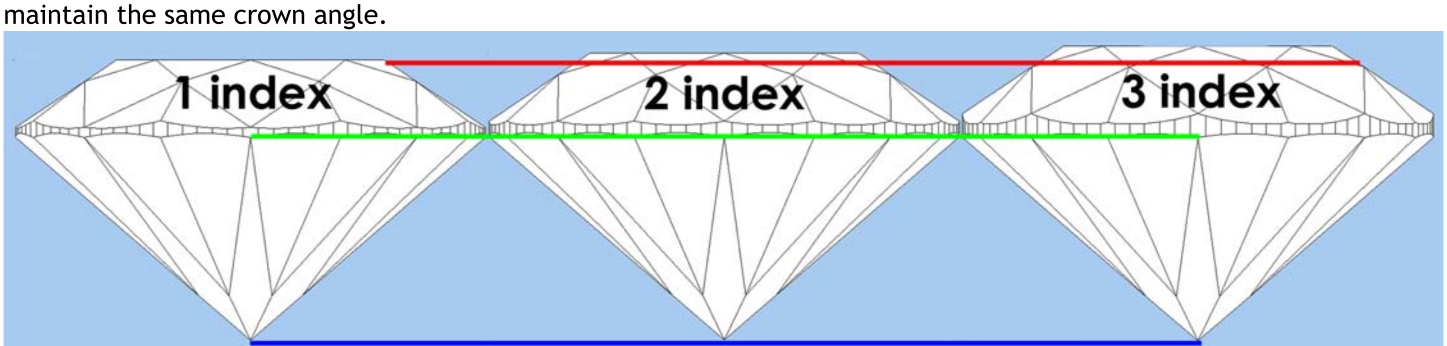
The 'normally' cut stone with an index of 2 will have a diameter of 6.01 mm.

The stone cut on an index of 3 will have a diameter of 6.02 mm.

Setting a Constant Girdle Thickness at the Halves

Indexing and Weight Retention

If girdle thickness remains a constant 3.78% at the upper half junctions, crown height changes with indexing to maintain the same crown angle.



The 6 millimeter round brilliant cut diamond in this article with normal (2) indexing on the upper halves, with a 3.78% girdle at both the halves and mains, will weigh 0.8137 carats or 81 points.

The 6 millimeter round brilliant cut diamond in this article with a 3 index on the upper halves, with a 3.78% girdle at the halves and a 5.05% girdle at the mains, will weigh 0.8578 carats. This results in a weight gain of 5.41% compared to the 'normally' cut stone.

The 6 millimeter round brilliant cut diamond in this article with a 1 index on the upper halves, with a 3.78% girdle at the halves and a 2.36% girdle at the mains will weigh 0.7748 carats. This results in a weight loss of 4.78 % compared to the 'normally' cut stone.

Indexing and Millimeter Spread at the Same Weight

Normalizing all three stones to 0.8578 carats (the heaviest weight at 6.00 mm from the section directly above) this is the approximate millimeter spread for each stone:
The stone cut with an index of 1 will have a diameter of 6.21 mm.
The 'normally' cut stone with an index of 2 will have a diameter of 6.11 mm.
The stone cut on an index of 3 will have a diameter of 6.00 mm.
Naturally, a larger diameter for any given weight is highly desirable.

Conclusions

- The American Gem Society's Angular Spectrum Evaluation Tool visually provides much more information than can be garnered using a 'hearts and arrows' viewer or a Firescope™.
- There is a fairly large range of weight retention and millimeter spread possibilities when setting the girdle at the halves and indexing the upper halves. This is really important when trying to make a 'size', i.e. 1.00 carat, from a given piece of rough.
- When setting the girdle at the halves and indexing the upper halves to 1, you can improve the optical performance of the stone and its millimeter spread, but at the expense of weight retention.
- When setting the girdle at the halves and indexing the upper halves to 3, you can improve weight retention, but at the expense of optical performance and millimeter spread.
- The new AGS Grading System will lower the cut grade of standard round brilliants whose upper girdle facets cause optical performance to suffer.