DISCUSSION OF BRIGHTNESS PLOTS

In the September 1988 SF Design we considered brightness variations based on material (i.e.Refractive Index), identical plan view designs and identical view angles. Here, in Table I, we show brightness plots as a tool to study different but similar designs as they respond to viewing the stone at different angles. Arbritrarily each design is shown at 0, 5, and 10 degree view angle (positive view angle corresponds to tipping the stone about the y-axis as seen in the plan view).

We can only apply this technique to a design that is determinate, because brightness response is dependent on fixed (and known) relationships between the facets. The computer is attempting to trace the path of sample light rays striking the stone. To do this, the computer must know exactly where each facet surface is located so it can predict which facet will be hit, considering reflection, refraction, and penetration angles of the sample light ray that is being traced. Fresnel equations on which this computer simulation is based, assume that each time a ray hits a facet the ray is either totally reflected or some of light is reflected and some is refracted. The computer program takes all this into account, but it would not arrive at a reasonable effect if it did not know the extent and location of the facets on the stone.

In the real world, brightness is also greatly affected by the polish on the facet, but our model is not smart enough to account for polish. We have used 75 x 75 as the number of sample scan lines. This too is a compromise...between the amount of computation time needed and lack of precision if we use fewer than 75 scan lines (with our EGA monitor the greatest number we could use is about 260, but response time is so long it is hardly practicable and little additional information is gained)

For some time now we have known how to use the computer to accept input information (in faceting terms) and output a complete description of the design in cartesian coordinate form (X,Y,Z). From this three dimensional information we can have the computer draw pictures of the design. The drawings in the first column of Table I are produced in this way as are the orthographic projection drawings in the graphics on page 3 and 4. Use of Raytracing to produce brightness plots from this information is the new feature that permits us to go beyond just drawing a picture to predicting the brightness and/or reflectance performance of a design without necessarily actually cutting a stone. When enough trials have been made we expect to be able to give a more definite answer to the often asked question ...What angles should we use with a given material and design?...At this time we cannot use the computer techniques of Raytracing unless we can precisely define the design in terms the computer understands. To us that means we need a reproducible design to begin with. If the design is indeterminate, our conclusions will only apply precisely to the combinations we actually used. A step cut for example would have to have the location and size of each step facet defined separately. The good news is that there are a lot of good looking determinate designs that can be used, including all Meetpoint designs and those pseudo meetpoint designs that require something like a CAM preform to define the outline.

Tables I and II summarize the average brightness results for the two designs ...Design 13.022 and 13.022A...that were selected for this SF Design issue. All brightness plots are computed using a six-level brightness system. (Relative darkness of the symbol corresponds to light returning to the eye ...light = bright, dark = shadow)

Table II LONDON SHIELD VARIATIONS BRIGHTNESS RESPONSE TO VIEW ANGLE

DESIGN	VIEW ANGLE (degrees from vertical)		
	0 deg	5 deg	10 deg
13.022	83	77	66
13.022A	82	78	69

Both designs have the SAME PAVILION so any brightness differences must be due to the CROWN and the way it interacts with this particular pavilion. Overall average brightness differences are slight, but the pattern of bright and less bright areas is much different. Compared to the 49 average brightness of an SRB (in Quartz) , the 82-83 average brightness of these designs is a great improvement.

Cutting details are shown on page 3 and 4. Crown 13.022A is a No Table (Apex Facet) type whereas 13.022 is a normal Table design. Pavilion 13.022A is identical to 13.022 shown on page 3. Brightness plots for both designs (appropriate for RI 1.54 Quartz) are shown on page 1. Primary difference between the two designs is the lack of a table in 13.022A. Overall brightness is about the same, but without the table facet a dark area appears directly in the center. This is typical of the face-up performance of apex facets, When the stone is tipped the central shadow band broadens. Tip a normal Table design like 13.022 far enough and you get a shadow that works its way into the Table area usually beginning on the side toward which the stone is being tipped. The light distribution in the two designs, particularly in the Table area, is quite different. Whether one is more acceptable than the other is purely a matter of personal preference.