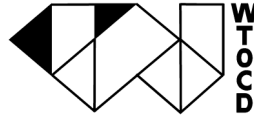


## Hearts and Arrows: Relationship with the cut parameters

By Erik Wanten & Tim Gevers, WTOCD



Creating Hearts and Arrows (H&A) is not a trivial task. It is very important that polishers know the relationship between the proportions and the H&A patterns. The nomenclature for the different brilliant proportions, which is used in this and other articles, is illustrated in figure 1.

- The crown half length (p)
- The pavilion main facet angle
- The pavilion half length (q)

To make a H&A by HRD Antwerp brilliant, only certain combinations of parameters are allowed. Besides the right cut parameters a highly symmetrical cut is necessary for an H&A by HRD Antwerp.

To avoid misunderstanding, the assumption is made that every brilliant in this article has a perfect symmetry. Let's take a look at the relation between these parameters and H&A. The pavilion angle is the most important parameter in the processing of H&A brilliants. If the pavilion main facet angle is out of range then creating H&A by HRD Antwerp is impossible. The lower-half facets determine the pavilion half length (q). This parameter is crucial in the process of creating the heart shapes. The only parameter left affecting the heart shapes is the

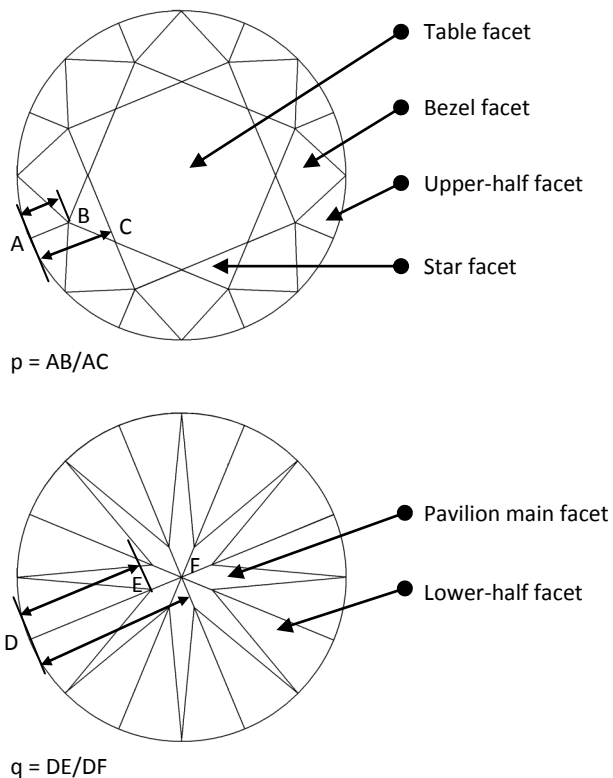


Figure 1: Proportion definitions of a round brilliant

From all brilliant parameters the following are crucial in the process of creating H&A:

- The table facet
- The star facet
- The crown angle (bezel)

table. If the hearts are formed, only a small range of crown angles will lead to clearly visible arrows. To facilitate the making of H&A by HRD Antwerp, the right crown angle ranges for each combination of pavilion angle and table size should be used. In the next section, the

effect of variation on each cut parameter is discussed.

### *The pavilion angle and half length*

To get H&A, a pavilion angle between 40.0° and 41.8° is necessary. For producing H&A by HRD Antwerp the range of 40.5° to 41.0° is more realistic. All other angles give heavy side effects on the arrow shapes. At the border the arrows appear coloured or completely disappear. In figure 2 the images show the evolution of the H&A patterns for pavilion angles between 40.50° and 41.10°.

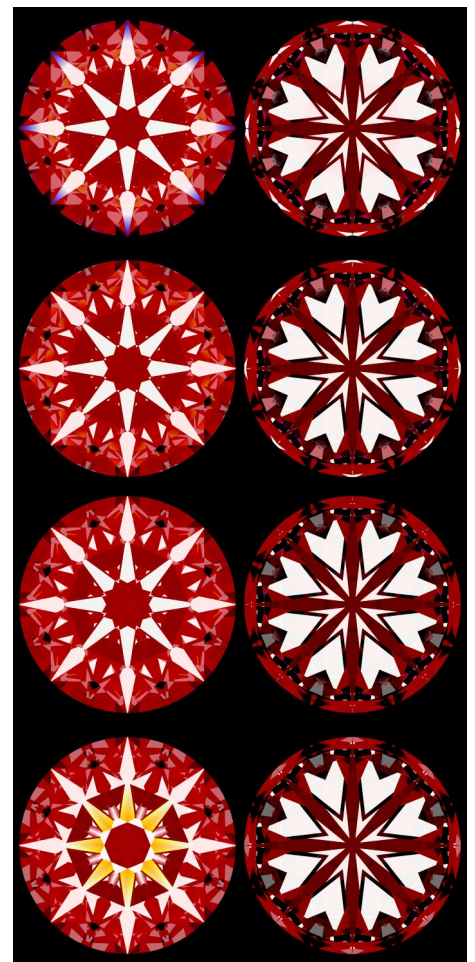


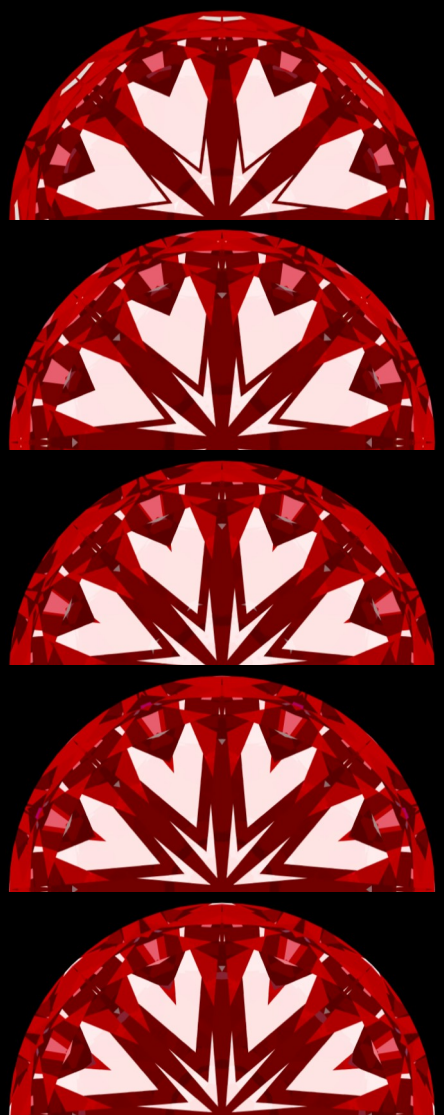
Figure 2: Pavilion angle ranging from 40.50° to 41.10° in steps of 0.2° (arranged from top to bottom)

The common parameters are:

Crown angle	35.00 °
Table size	57.00 %
Crown half length	50.00 %
Pavilion half length	77.00 %
Girdle height	2.70 %

Variation in the pavilion half length influences the gap between the v-shaped arrow head and the heart shape. Lowering the pavilion half length (<74%) gradually removes the gap between the heart and the V. On the arrow side the arrows get wider. Increasing the half length (>79%) makes the gap between the V's and the hearts wider and creates incisions in the heart shapes. The arrows become thinner. It should be noticed that the range of acceptable half lengths is very narrow. In figure 3 the variation is illustrated with pavilion half lengths ranging from 75% to 83%.

Figure 3: Pavilion half length ranging from 75% to 83% in steps of 2% (arranged from top to bottom)

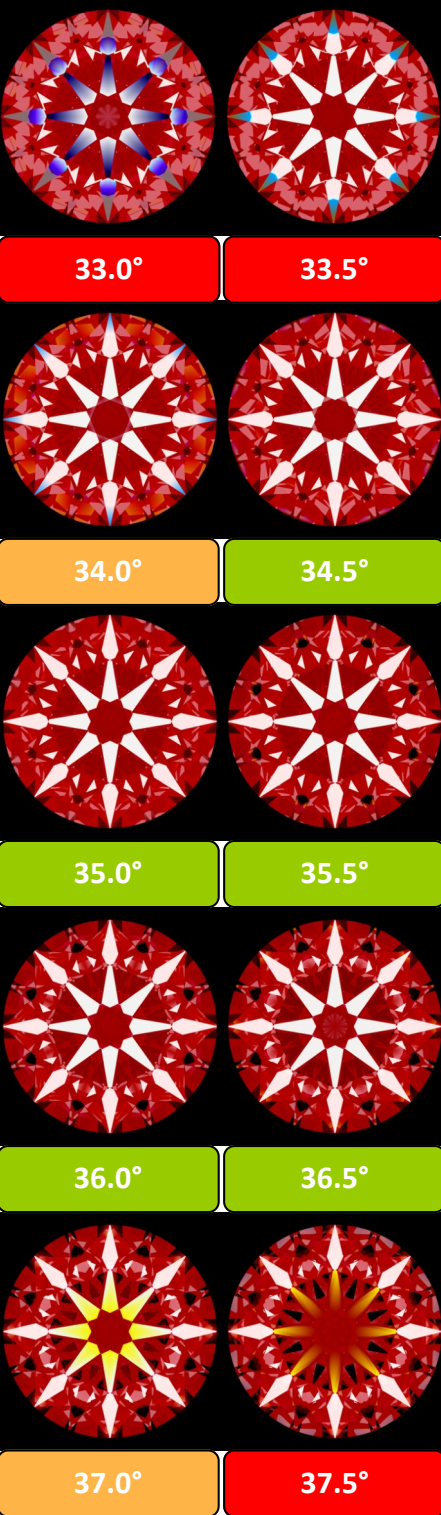


### The table size and the crown angle

The table size effects the shoulder width of the hearts. The line formed at

the crossing of the table and the star facets results in a flattened heart shape if the table is smaller than or equal to 60%. Tables bigger then 60% give pointed shoulders and are rejected as H&A by HRD Antwerp. The crown angle is very important for the creation of the arrows. In figure 4 we see the evolution of the arrows as a function of the crown angle and a fixed pavilion (main pavilion facets and lower-half facets). The common parameters are:

Figure 4: Crown angle variation from 33.00° to 37.50° in steps of 0.5°



Pavilion angle	40.70 °
Table size	57.00 %
Crown half length	55.00 %
Pavilion half length	76.00 %
Girdle height	2.70 %

The background colour illustrates the H&A by HRD Antwerp grading. If the background colour is red, the arrows are rejected. An orange background points to a border case. A green background gets an arrow grade with zero penalty (in case of perfect symmetry).

### The crown half length

The crown half length has an impact on “clustering”. Clustering means that the arrow shafts are surrounded with white areas. Only a limited amount of clustering is allowed. The clustering is accompanied by another effect around the arrowheads. This effect is an exaggeration of the small triangular facets aside the arrowheads. It is caused by a combination of pavilion angle, pavilion half length and crown half length. When the pavilion main facet angle increases above 41° the chances on clustering are higher. In combination with half lengths below 45% (star length of 55%) and pavilion half length above 77% clustering is unavoidable. Figure 5 gives an example of excessive clustering. Small non disturbing clusters result in a pen-

Figure 5: Excessive clustering and side effects

Pavilion half length	79.0%
Pavilion angle	41.3°
Crown half length	40.0%



**Table 1: Proportion sets for perfect H&A**

Table size (%)	Crown Angle : min-max										
59	39.8-41.5	39.2-41.1	38.6-40.5	38.1-41.1	37.5-39.4	36.9-38.8	36.3-38.1	35.8-37.8	35.1-37.1	34.6-37.0	34.0-36.3
58	39.8-41.5	39.2-41.1	38.6-40.4	38.1-39.9	37.5-39.3	36.9-38.7	36.3-38.1	35.8-37.8	35.1-37.0	34.6-36.9	34.0-36.2
57	39.8-41.5	39.2-41.1	38.6-40.4	38.1-39.9	37.5-39.3	36.9-38.7	36.3-38.1	35.8-37.7	35.1-37.0	34.6-36.8	34.0-36.1
56	39.8-41.5	39.2-40.9	38.6-40.4	38.1-39.9	37.5-39.3	36.9-38.7	36.3-38.1	35.8-37.7	35.1-37.0	34.6-36.8	34.2-36.1
55	39.8-41.5	39.2-40.9	38.6-40.4	38.1-39.9	37.5-39.3	36.9-38.7	36.3-38.1	35.8-37.7	35.1-37.0	34.6-36.8	34.2-36.1
54	39.8-41.6	39.2-40.9	38.6-40.4	38.1-39.9	37.5-39.3	36.9-38.7	36.3-38.1	35.8-37.7	35.1-37.0	34.6-36.8	34.2-36.1
53	39.8-41.8	39.2-40.9	38.6-40.4	38.1-39.9	37.5-39.3	36.9-38.7	36.3-38.1	35.8-37.7	35.1-37.0	35.2-36.8	34.9-36.1
52	-----	39.2-40.9	38.6-40.4	38.1-39.9	37.5-39.3	37.1-38.7	36.3-38.1	35.8-37.7	35.1-37.0	35.8-36.8	35.5-36.1
Pavilion angle(°)	39.8	39.9	40.0	40.1	40.2	40.3	40.4	40.5	40.6	40.7	40.8

Table size (%)	Crown Angle : min-max										
59	33.8-35.6	32.9-35.1	32.1-34.7	32.2-34.1	31.1-33.6	30.7-33.0	31.0-32.7	30.1-32.1	29.9-31.6	29.5-31.0	-----
58	33.8-35.6	32.9-35.1	32.1-34.7	32.0-34.1	31.4-33.5	31.0-33.0	31.3-32.7	30.8-32.1	30.3-31.6	29.8-31.0	-----
57	33.8-35.6	33.3-35.0	32.4-34.7	32.4-34.1	31.8-33.5	31.3-33.0	31.3-32.7	30.9-32.1	30.6-31.6	30.2-31.0	-----
56	33.8-35.6	33.4-35.0	32.9-34.7	32.7-34.1	32.1-33.5	31.7-33.0	31.6-32.7	31.2-32.1	30.8-31.6	30.4-31.0	-----
55	34.0-35.6	33.7-35.0	33.3-34.7	33.1-34.1	32.3-33.5	32.0-33.0	32.1-32.7	31.5-32.1	31.0-31.6	-----	-----
54	34.2-35.6	34.0-35.0	33.6-34.7	33.4-34.1	32.3-33.5	32.2-32.9	32.2-32.7	-----	-----	-----	-----
53	34.6-35.6	34.4-35.0	33.6-34.6	33.6-34.2	-----	-----	-----	-----	-----	-----	-----
52	34.7-35.6	34.3-35.0	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pavilion angle(°)	40.9	41.0	41.1	41.2	41.3	41.4	41.5	41.6	41.7	41.8	-----
Potential H&A by HRD				Disturbed arrow pattern				Heavy side effects on arrow pattern			

alty but excessive clustering and side effects leads to rejection.

### Choosing the proportions for H&A by HRD Antwerp

After polishing the pavilion main facets, the pavilion lower-half facets and the crown main facets (bezels) need to be polished. The bezel angle range in combination with the desired table width can be chosen from table 1. The following assumptions were made :

- For a pavilion angle smaller than 40.6°, the crown half length is between 45 and 50%
- For a pavilion angle between 40.6° and 41.0°, the crown half length is 50 to 55%
- For a pavilion angle greater than 41.0°, the crown half length is between 55 and 60%
- Girdle thickness is 2.5 to 4%
- Culet is pointed
- Weight is between 0.5 and 3 ct
- Perfect symmetry

**Table 2: Relation between Pavilion angle, Pavilion half length and Pavilion lower-half facet angle (°). The culet diameter is pointed.**

Pav. Half length(%)	Pavilion angle (°)								
	40.4	40.5	40.6	40.7	40.8	40.9	41	41.1	41.2
74	41.70	41.80	41.90	42.00	42.10	42.20	42.30	42.40	42.50
75	41.66	41.76	41.86	41.96	42.06	42.16	42.26	42.37	42.47
76	41.62	41.72	41.83	41.93	42.03	42.13	42.23	42.33	42.43
77	41.59	41.69	41.79	41.89	41.99	42.09	42.19	42.29	42.39
78	41.55	41.65	41.75	41.85	41.95	42.06	42.16	42.26	42.36
79	41.52	41.62	41.72	41.82	41.92	42.02	42.12	42.22	42.32
80	41.48	41.59	41.69	41.79	41.89	41.99	42.09	42.19	42.29
81	41.45	41.55	41.65	41.75	41.85	41.95	42.05	42.16	42.26
82	41.42	41.52	41.62	41.72	41.82	41.92	42.02	42.12	42.22
83	41.39	41.49	41.59	41.69	41.79	41.89	41.99	42.09	42.19
84	41.36	41.46	41.56	41.66	41.76	41.86	41.96	42.06	42.16

The correct angle for the lower-half facets in relation with the required half length can be found in table 2. Notice the very sharp change in half length for a small variation in angle. The half length varies 1% for a 0.04° difference in the lower-half facet angle. It is obvious that this is the most critical point in polishing H&A by HRD Antwerp. The crown half length is adjusted to avoid the clustering-effect as described in the previous section.

### Conclusion

This article provides the necessary information needed to produce an H&A by HRD Antwerp. The availability of the right parameters makes the polishing process for H&A easier than before. Still, only ultimately skilled polishers can deliver the perfect symmetry with the right proportions.