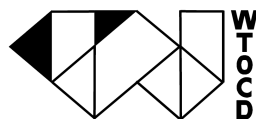


Hearts and Arrows: Objectively measured and certified

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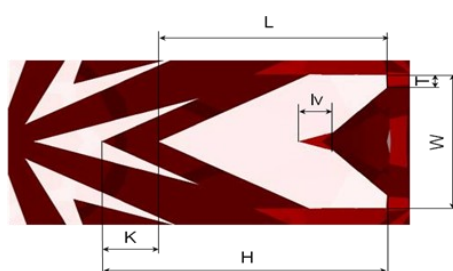


Hearts and Arrows diamonds (H&A) are round brilliants with special patterns visible under specific lighting conditions. They consist of eight hearts when viewed from the pavilion side and eight arrows when viewed from the crown side. Kinsaku Yamashita designed in 1988 an appropriate viewer which creates the typical images illustrated in figure 1. HRD Antwerp ordered a research project to solve several problems linked with grading the H&A pattern. The H&A pattern is very sensitive to symmetrical imperfections. Because of the high degree of symmetry and the limited proportion sets for which the patterns are visible a premium on the price for H&A brilliants is often applied. The appearance of the pattern is a strong indicator of a top quality cut but there are many top quality cuts without the H&A patterns. Therefore the grad-

ing must focus on the parameters and the symmetry of the pattern without making any other conclusions on the optical performance.

The hearts

The heart side must show eight nearly equally shaped hearts. The heart shape repeats itself, ideally, in a multiple of 22.5°. When grading the heart shapes, the parameters must confirm to some basic guidelines. The parameters of the heart are illustrated in figure 2.



L	Length of the heart shape
W	Width of the heart shape
lv	Length of the cleft
K	Length of the split
H	Distance from the shoulders to the arrow head
T	Shoulder of the heart shape

Figure 2:
parameters of the heart pattern

The arrows

The arrow side must reveal eight arrow heads and shafts (see figure 1). The arrow head, formed by the pavilion seen through the bezel facet, must reach the girdle and line up with the shaft. The shafts and the arrow heads must be

symmetrical and equally shaped. All the arrows must be clearly visible at the same time when seen from a direction perpendicular to the table. The shafts must touch or nearly touch each other at the base near the center of the brilliant. As with the heart shape the arrow repeats itself in a multiple of 22.5°. The appearance of the arrow shape is influenced by the pavilion angle, the main crown angle, the length of the crown halves and the table size of the brilliant.

HRD Antwerp grading H&A

H&A viewers available on the market show several disadvantages. Using them in a lab environment makes objective grading very difficult. There are several limitations: the diamond has to be centered manually, the alignment of the table perpendicular to the viewing axis is tedious and inaccurate, head movements make different viewing angles possible and, last but not least, the fixed magnification makes viewing of smaller stones very difficult. The importance of the viewing angles is explained in a separate article. The custom made H&A by HRD Antwerp viewer, developed for HRD Antwerp by



H&A by HRD Antwerp Viewer

WTOCD, solves all these problems. The tool can be used for visualizing both hearts and arrows patterns in one setup without turning the diamond. Based on measurements of the H&A patterns, an expert system makes an evaluation of the guidelines. The system delivers consistent, objectively measured, H&A grades.




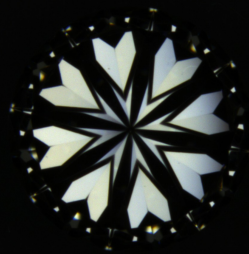


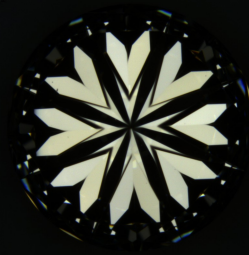
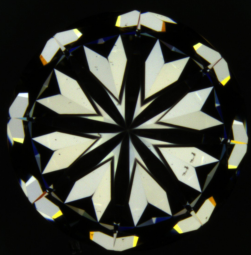

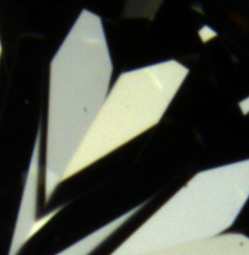
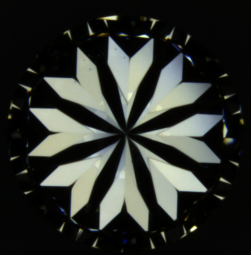

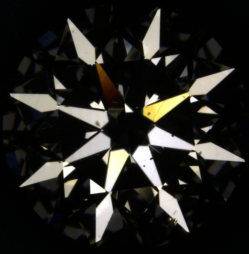
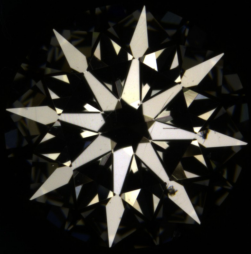
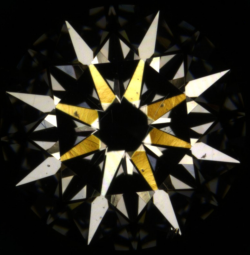
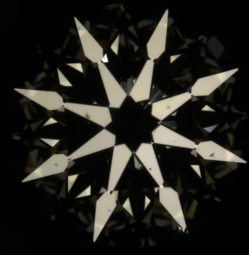
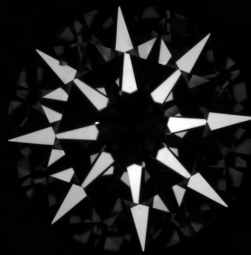
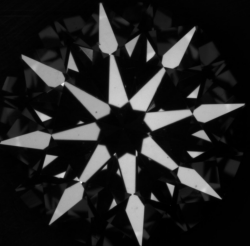
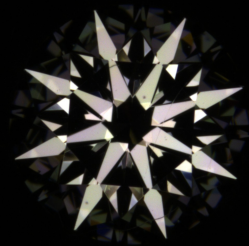
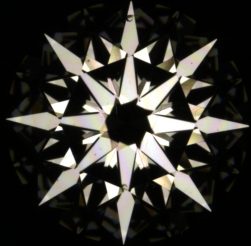
Figure 1:
typical H&A pattern

Each defect in the patterns is described in a guideline and each guideline is evaluated by the expert system. The result of the evaluation is a penalty. This penalty is multiplied by a weight factor depending on the impact of the guideline on the observation of the patterns. Approval or rejection of the patterns

depends on the way the guidelines are violated. To simulate the human behavior a system with soft limits is introduced. Each guideline has a **safe zone**, **border zone** and **reject zone**. A guideline evaluation in the safe zone has zero penalty. In the border zone the guideline evaluation leads to a penalty.

A guideline evaluation in the reject zone leads to immediate rejection of the H&A grade. Both the sums of the penalty's, for hearts and for arrows, must be smaller than 1 to receive the H&A by HRD Antwerp grade.

Hearts & Arrows by HRD Antwerp Guidelines

Reject Example	Guideline	Reject Example	Guideline	Reject Example	Guideline
	H1 8 hearts		H2 Uniform intensity		H3 No colour
	H4 No variation in size		H5 No or small incision (size and variation)		H6 No pointed shoulders
	H7 No or small variation of the shoulder width		H8 Symmetrical hearts		H9 Small but clear gap between V and heart
	H10 8 balanced V's		A1 8 arrows		A2 Uniform intensity
	A3 No Colour		A4 No variation in size		A5 Size center pattern
	A6 Concentric center pattern		A7 Regular shaped center pattern		A8 No Clustering