Calculation of the weight with the aid of the weight constant for a given cut.

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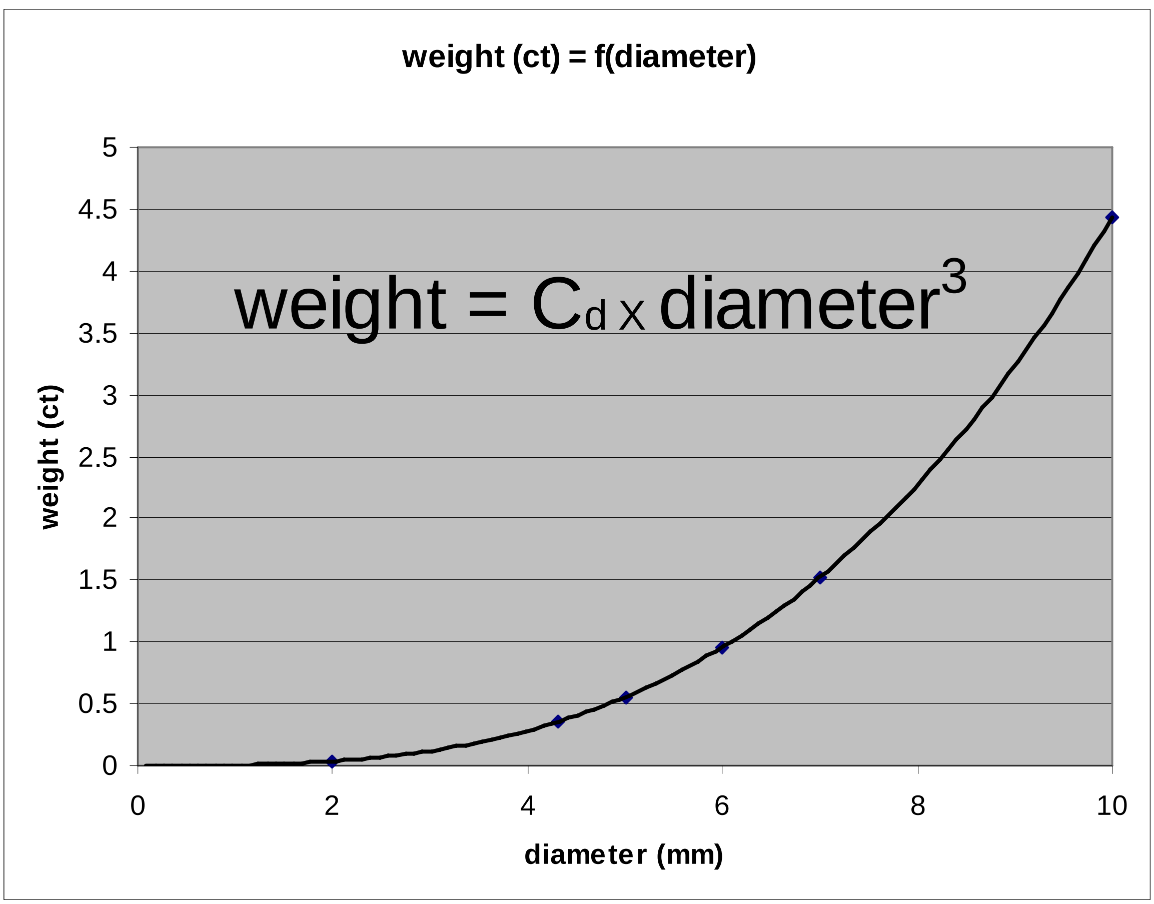
How do we predict the weight of a polished diamond when only the diameter or another dimension is known? This question rises especially when we want to produce a new cut. In the case of a known cut we predict the weight of the polished stone with optimisation software after scanning the rough or out of the cut/bruted diameter. When the new cut is not available in the software, the software is not able to predict the weight of the finished stone.

If we plot the weight of a certain cut with certain proportions according to the diameter, for example, we get the following chart.



We notice that there is a simple relationship between the diameter and the weight: the weight is directly proportional to the third power of the diameter.

C_d is called the “weight constant according to the diameter” of a certain model with certain proportions. C_d equals the carat weight of a stone with diameter 1mm.

It is enough to know the weight and diameter of one stone to determine the weight of all other diameters. For that purpose we need to calculate the weight constant C_d.

$$C_d = \frac{\text{weight}}{\text{diameter}^3} \qquad [\text{ct/mm}^3]$$

wherein:

- C_d: the weight constant of the cut with certain fixed proportions
- the weight in ct
- the diameter in mm

Now that the weight constant of the cut is determined we can calculate the weight for each diameter.

$$\text{weight} = C_d \times \text{diameter}^3 \qquad [\text{ct}]$$

Or we can calculate the required diameter for a desired target weight.

$$\text{diameter} = \sqrt[3]{\frac{\text{weight}}{C_d}} \qquad [\text{mm}]$$

Remarks:

- The model is only being scaled. The calculation is only valid if the cut (model + length-width ratio), angles and proportions are fixed.
- The weight constant can be determined according to the diameter (C_d) but also according to any other measure like the total height (C_h) or the diameter of the table (C_t) as we can see in following formulas.

$$C_h = \frac{\text{weight}}{\text{height}^3} \qquad [\text{ct/mm}^3]$$

$$C_t = \frac{\text{weight}}{\text{table}^3} \qquad [\text{ct/mm}^3]$$

$$\text{weight} = C_h \times \text{height}^3 \qquad [\text{ct}]$$

$$\text{weight} = C_t \times \text{table}^3 \qquad [\text{ct}]$$

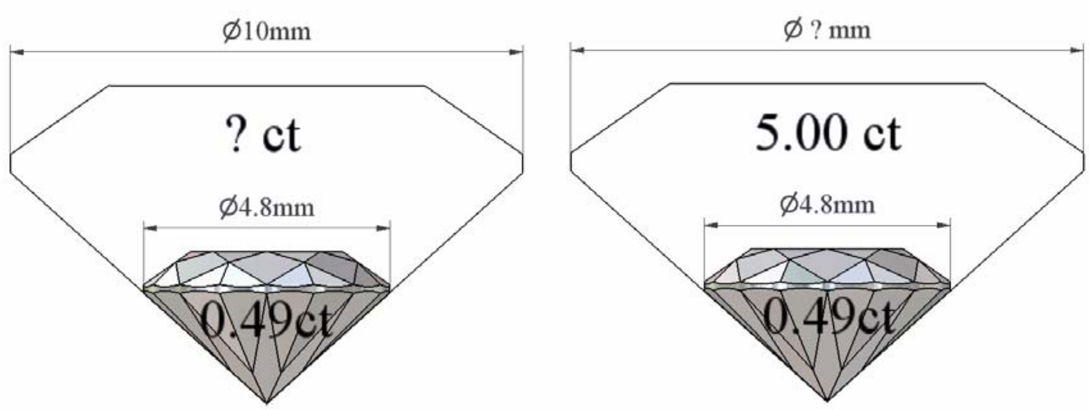
$$\text{height} = \sqrt[3]{\frac{\text{weight}}{\text{Ch}}} \qquad [\text{mm}]$$

$$\text{table} = \sqrt[3]{\frac{\text{weight}}{C_t}} \qquad [\text{mm}]$$

The following table shows the weight constants for a number of cuts with certain fixed proportions and length-width ratios:

cut	length width ratio	Weight constant (ct/mm^3)		
		according prim. diameter (C_d) or width (C_b)	according sec. diameter (C_{d2}) or length (C_l)	according total height (C_h)
brilliant	1	0.003641		0.016475
radiant	1	0.005634		0.015743
flanders	1	0.005315		0.014724
princess	1	0.005428		0.015982
heart	0.95	0.002966	0.003463	0.017799
oval	1.4	0.005315	0.001939	0.023125
marquise	2	0.006832	0.000856	0.029675
pear	1.5	0.005315	0.001578	0.023125
emerald	1.4	0.007719	0.002806	0.027327

Example 1:



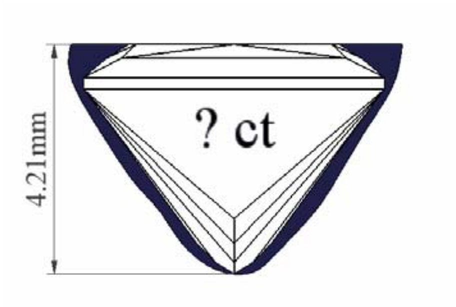
We have a 0.49ct polished stone with a diameter of 4.8mm. If we want to produce a stone with the same cut and proportions with a diameter of 10mm, what will be the weight of that stone?
First we calculate the weight constant according to the diameter.
C_d = weight / diameter^3 = $0.49 / 4.8^3 = 0.49 / 110.592 = 0.00443\ ct/mm^3$

For a 10mm stone we have:
weight = C_d x diameter^3 = $0.00443 \times 10^3 = 0.00443 \times 1000 =$ **4.43ct**

If we want to produce a 5.00ct stone we need the following diameter:

$$\textbf{diameter} = \sqrt[3]{\frac{5}{0.00443}} = \textbf{10.41mm}$$

Example 2:



We have a rough stone out of which we want to produce a princess cut. The table is already cut and the total height is 4.21mm. What is the maximum weight of the polished stone that we can produce?

$C_{h} =$ 0.015982 (see table)
weight = C_h x height³ = 0.015982 x 4.21³ = 0.015982 x 74.618 = **1.19ct**

The maximum weight of the polished stone produced out of the rough is 1.19ct when the total height is considered as the restricting factor.