ESTIMATING WEIGHTS OF MOUNTED COLORED GEMSTONES

By Charles I. Carmona

Updated formulas are presented for estimating the weights of mounted colored gemstones. These formulas are derived from measurements and weights of thousands of German-cut calibrated amethysts and citrines, representing most commercially available shapes and sizes. As with the formulas taught by GIA, the dimensions of a stone are multiplied by its specific gravity and by a "shape factor" that is determined by the stone's face-up outline. This article also illustrates how the shape factor changes over a continuum of common face-up outlines. As in previous formulas, a separate weight correction factor is applied to stones that show proportion variations in profile view.

Estimating weights of mounted gemstones has become a common routine for many of today's jewelry tradespeople. Weight estimation is necessary when the stone cannot be removed from its mounting, either because the client will not allow it or because the piece might be damaged. This is typically the case with estate jewelry (i.e., jewelry that has been previously owned). Estimating weight might be done when performing an appraisal, calculating an offer to purchase jewelry with unknown gemstone weights, or negotiating the sale or pawn of jewelry.

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Please see acknowledgments at the end of the article.

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Over the past two decades, estate jewelry has become increasingly important in the market (figure 1). No longer is all second-hand jewelry simply melted down and the stones recut for remounting. In fact, more jewelers are entering this market, at both wholesale and retail levels, as witnessed by regular estate jewelry sections in the trade press (see, e.g., *Jewelers' Circular-Keystone* and *Professional Jeweler*), the growth of estate jewelry sections at trade shows (such as the Las Vegas *JCK* Show), and the prevalence of this jewelry in on-line bulletin boards (e.g., http://www.diamonds.net, http://www.polygon.net) and Web sites (e.g., http://www.antique-estate-jewelry.com, http://www.estatejeweler.com). For appraisers, estate jewelry dealers, and pawnbrokers in particular, the ability to accurately estimate the weight of mounted gemstones is critical to the success of their operations.

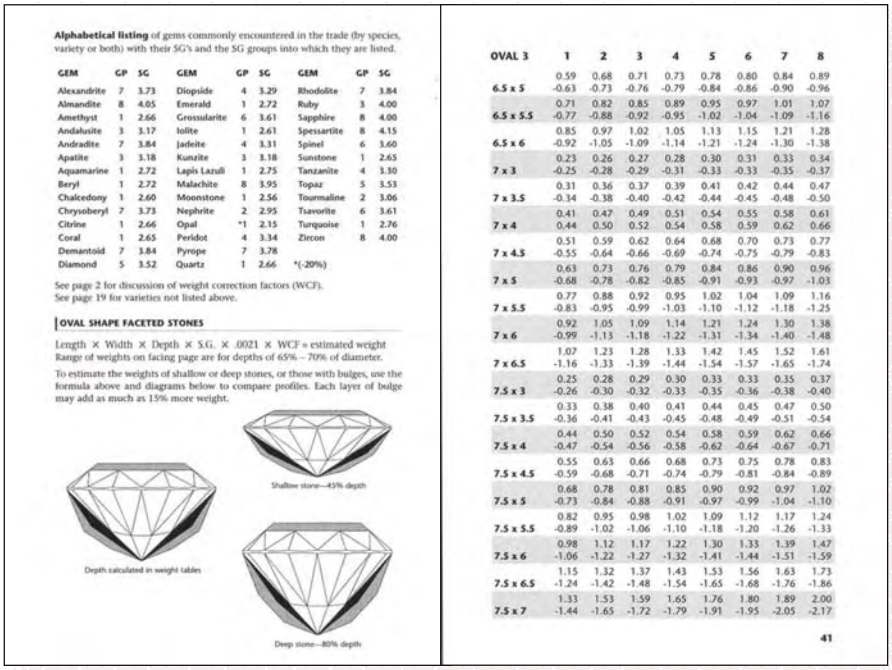
Tables of diamond weights according to mil-

Figure 1. Estate jewelry is gaining in popularity with today's customers. However, the valuation of such jewelry is not straightforward, as the gems cannot be removed from their mountings for weighing. As a result, weight estimation is very important for colored stones as well as diamonds. This suite of amethyst jewelry was created in France around 1824. The 65 amethysts are cut in oval, pear, and round shapes and set in two-color gold. The largest amethyst (set in the choker brooch) is estimated to weigh about 92 ct. Courtesy of David Humphrey; photo © Harold & Erica Van Pelt.

limeter measurements first appeared in the gemological literature in the mid-18th century (Jeffries, 1750). However, it was not until the mid-20th century that the first formulas for the estimation of diamond weights appeared (Leveridge, 1937), in a booklet that accompanied the Leveridge® gauge, a spring-return measuring device that was introduced that year. Also included in this booklet were the first specific gravity correction factors to convert diamond formulas for use in estimating the weights of colored stones.

The first weight estimation formula specifically for colored stones was developed for cabochons (Small, 1952); it was followed by formulas for common faceted stone shapes (i.e., round, oval, rectangle, square, emerald cut, cushion, marquise, and pear; Ellison, 1957). Also from the late 1950s to early 1960s, formulas developed by GIA were published as supplements to coursework (R. T. Liddicoat, pers. comm., 1998). Currently, the earliest version extant at GIA of these colored stone formulas is a notebook on the appraisal of jewelry (Gemological Institute of America, circa 1977). These formulas are the same as those listed in other references that have appeared since then, both published (Altobelli, 1986; Miller, 1988; Drucker, 1997) and on-line (http://www.geogem.com/weightestimate.html, http://www.teleport.com/~raylc/gems/estimate.html).

The formulas developed by GIA for colored stones have served the industry well since their introduction. Over time, however, there has been no published attempt to corroborate these formulas or adjust them to the modern cutting styles that have evolved with new cutting technologies, increased understanding of optics, and continued artistic expression in the lapidary arts. The present author developed his formulas by measuring and weighing thousands of calibrated citrines and



Alphabetical listing of gems commonly encountered in the trade (by species, variety or both) with their SG's and the SG groups into which they are listed.

GEM	GP	SG	GEM	GP	SG	GEM	GP	SG
Alexandrite	7	3.73	Diopside	4	3.29	Rhodolite	7	3.84
Almandite	8	4.05	Emerald	1	2.72	Ruby	3	4.00
Amethyst	1	2.66	Grossularite	6	3.61	Sapphire	8	4.00
Andalusite	3	3.17	Iolite	1	2.61	Spessartite	8	4.15
Andradite	7	3.84	Jadeite	4	3.31	Spinel	6	3.60
Apatite	3	3.18	Kunzite	3	3.18	Sunstone	1	2.65
Aquamarine	1	2.72	Lapis Lazuli	1	2.75	Tanzanite	4	3.30
Beryl	1	2.72	Malachite	8	3.95	Topaz	5	3.53
Chalcedony	1	2.60	Moonstone	1	2.56	Tourmaline	2	3.06
Chrysoberyl	7	3.73	Nephrite	2	2.95	Tsavorite	6	3.61
Citrine	1	2.66	Opal	*1	2.15	Turquoise	1	2.76
Coral	1	2.65	Peridot	4	3.34	Zircon	8	4.00
Demantoid	7	3.84	Pyrope	7	3.78			
Diamond	5	3.52	Quartz	1	2.66	*(-20%)		

See page 2 for discussion of weight correction factors (WCF).
See page 19 for varieties not listed above.

OVAL SHAPE FACETED STONES

Length × Width × Depth × S.G. × .0021 × WCF = estimated weight
Range of weights on facing page are for depths of 65% – 70% of diameter.

To estimate the weights of shallow or deep stones, or those with bulges, use the formula above and diagrams below to compare profiles. Each layer of bulge may add as much as 15% more weight.

OVAL 3	1	2	3	4	5	6	7	8
6.5 x 5	0.59 -0.63	0.68 -0.73	0.71 -0.76	0.73 -0.79	0.78 -0.84	0.80 -0.86	0.84 -0.90	0.89 -0.96
6.5 x 5.5	0.71 -0.77	0.82 -0.88	0.85 -0.92	0.89 -0.95	0.95 -1.02	0.97 -1.04	1.01 -1.09	1.07 -1.16
6.5 x 6	0.85 -0.92	0.97 -1.05	1.02 -1.09	1.05 -1.14	1.13 -1.21	1.15 -1.24	1.21 -1.30	1.28 -1.38
7 x 3	0.23 -0.25	0.26 -0.28	0.27 -0.29	0.28 -0.31	0.30 -0.33	0.31 -0.33	0.33 -0.35	0.34 -0.37
7 x 3.5	0.31 -0.34	0.36 -0.38	0.37 -0.40	0.39 -0.42	0.41 -0.44	0.42 -0.45	0.44 -0.48	0.47 -0.50
7 x 4	0.41 0.44	0.47 0.50	0.49 0.52	0.51 0.54	0.54 0.58	0.55 0.59	0.58 0.62	0.61 0.66
7 x 4.5	0.51 -0.55	0.59 -0.64	0.62 -0.66	0.64 -0.69	0.68 -0.74	0.70 -0.75	0.73 -0.79	0.77 -0.83
7 x 5	0.63 -0.68	0.73 -0.78	0.76 -0.82	0.79 -0.85	0.84 -0.91	0.86 -0.93	0.90 -0.97	0.96 -1.03
7 x 5.5	0.77 -0.83	0.88 -0.95	0.92 -0.99	0.95 -1.03	1.02 -1.10	1.04 -1.12	1.09 -1.18	1.16 -1.25
7 x 6	0.92 -0.99	1.05 -1.13	1.09 -1.18	1.14 -1.22	1.21 -1.31	1.24 -1.34	1.30 -1.40	1.38 -1.48
7 x 6.5	1.07 -1.16	1.23 -1.33	1.28 -1.39	1.33 -1.44	1.42 -1.54	1.45 -1.57	1.52 -1.65	1.61 -1.74
7.5 x 3	0.25 -0.26	0.28 -0.30	0.29 -0.32	0.30 -0.33	0.33 -0.35	0.33 -0.36	0.35 -0.38	0.37 -0.40
7.5 x 3.5	0.33 -0.36	0.38 -0.41	0.40 -0.43	0.41 -0.45	0.44 -0.48	0.45 -0.49	0.47 -0.51	0.50 -0.54
7.5 x 4	0.44 -0.47	0.50 -0.54	0.52 -0.56	0.54 -0.58	0.58 -0.62	0.59 -0.64	0.62 -0.67	0.66 -0.71
7.5 x 4.5	0.55 -0.59	0.63 -0.68	0.66 -0.71	0.68 -0.74	0.73 -0.79	0.75 -0.81	0.78 -0.84	0.83 -0.89
7.5 x 5	0.68 -0.73	0.78 -0.84	0.81 -0.88	0.85 -0.91	0.90 -0.97	0.92 -0.99	0.97 -1.04	1.02 -1.10
7.5 x 5.5	0.82 -0.89	0.95 -1.02	0.98 -1.06	1.02 -1.10	1.09 -1.18	1.12 -1.20	1.17 -1.26	1.24 -1.33
7.5 x 6	0.98 -1.06	1.12 -1.22	1.17 -1.27	1.22 -1.32	1.30 -1.41	1.33 -1.44	1.39 -1.51	1.47 -1.59
7.5 x 6.5	1.15 -1.24	1.32 -1.42	1.37 -1.48	1.43 -1.54	1.53 -1.65	1.56 -1.68	1.63 -1.76	1.73 -1.86
7.5 x 7	1.33 -1.44	1.53 -1.65	1.59 -1.72	1.65 -1.79	1.76 -1.91	1.80 -1.95	1.89 -2.05	2.00 -2.17

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Figure 2. Reproduced here are two representative pages from The Complete Handbook for Gemstone Weight Estimation *(Carmona, 1998). The upper left side alphabetically lists commonly encountered gemstone varieties or species and their specific gravities and S.G. groups. Profiles of stones with various depths and bulge patterns are illustrated below to aid in estimating weight correction factors. The right side has tables with eight columns of weight ranges by millimeter sizes, into which most colored stones can be grouped by their similar specific gravities.*

amethysts, as well as dozens of synthetic sapphires, in a broad variety of shapes and sizes. He then checked and confirmed the formulas on noncalibrated loose stones over the course of several years, through his work as a gemologist and appraiser. He has also developed formulas for a greater number of shapes than are currently covered in GIA's Colored Stone Grading course. In addition, he has explored in depth the process of using both "shape factors" and "weight correction factors" (WCFs) to estimate the weights of mounted colored gemstones.

The full results of the author's work in this area are being published in *The Complete Handbook for Gemstone Weight Estimation* (Carmona, 1998). This book contains formulas for estimating the weights of 24 common shapes of colored gemstones, and tables to look up weights already calculated for average well-cut stones (see, e.g., figure 2). It also contains another 48 formulas for stones with unusual shapes. The weight estimation tables cover all colored gemstones by grouping them into eight categories according to their similar specific gravities (again, see figure 2).

The Complete Handbook also contains separate sections with formulas and weight charts pertaining to diamonds and pearls. Since diamonds generally are cut differently from other gemstones, they have a separate set of weight estimation formulas. It is unusual for colored stones to be cut with the exact facet arrangements and angles as diamonds (so-called "diamond cut"); such stones are typically small (calibrated up to 3 mm round). Because of their different critical angles, colored stones are usually cut with steeper crowns, as well as with greater pavilion bulges and thicker girdles, adding weight. Formulas for diamond weight estimation are not addressed in this article, and the use of colored stone formulas to estimate diamond weights may lead to inaccurate results.

The present article reviews both the key considerations for weight estimation and the procedure used by the author to provide more accurate estimates for the weights of colored gemstones. Several examples of shape factors and WCFs from *The Complete Handbook* are provided. These factors are used to compensate for variations from basic shapes that are commonly seen in the present jewelry market.

KEY CONSIDERATIONS FOR GEMSTONE WEIGHT ESTIMATION

A gemstone is a three-dimensional object with a specific volume that can be calculated by measuring its *length*, *width*, and *depth* (figure 3). (*Height* substitutes for length or width for some shapes.) The weight estimation process involves measuring the maximum values for these three dimensions, which are incorporated into the appropriate volumetric formula. (*Volumetric* refers to the capacity, size, or extent of a three-dimensional object or region of space.)

Besides the Leveridge gauge, various other devices are used to measure gemstones, including screw micrometers and calipers. All measure in millimeter units, since the metric system is standard in the international gemstone business. Generally, micrometers are the most accurate, but they are not as versatile as the Leveridge gauge (which can also estimate to hundredths of a millimeter) for gemstones that are partially enclosed by mountings. The disadvantage of calipers is that they are accurate only to tenths of a millimeter, which will reduce the accuracy of the results obtained from the formulas.

Careful measurements are necessary to obtain accurate weight estimations. Each dimension should be measured several times to find the maximum value. A table gauge can be helpful for determining face-up measurements of smaller stones. When a bezel setting or prong hides the edge of a stone, examination with a loupe or microscope can help determine the extent to which the stone continues into the mounting. When gallery work obscures direct measurement of the depth, an offset measurement is necessary: Hold the measuring instrument to the side of the stone and line up the measuring device by eye with the top and bottom points of measurement.

There are many possible sources of error in the weight estimation process. Besides measurement and mathematical errors, specific gravity variations can affect the estimated weight. For example, air pockets trapped within a heavily included stone will lower its S.G. Conversely, inclusions with a higher S.G. than the host gem (such as rutile needles in quartz and tourmaline) will raise the S.G. Since samples of flawless quartz were used as the standard for the formulas and tables presented here, included stones may require slight corrections. Potential margins of error also increase proportionate to the size and S.G. of a stone: The larger and heavier the stone, the greater the care needed to estimate its weight accurately.

However, the greatest challenge in estimating weights of mounted gemstones is correcting for proportion variations. This requires judgment and experience. By thinking of gemstone outlines as a continuum of traditional shapes from one to the next, it is easier to correct for such variations. Examples of such continuums are: round to square, round to oval to cushion to rectangle, and pear to heart. The following discussion first explains the development of the new formulas, and then illustrates these shape sequences and provides the corresponding shape factors. Next, it examines profile variations (e.g., pavilion bulge), and how weight correction factors are applied to stones with nonstandard profiles.

DEVELOPING THE FORMULAS

The proposed formulas are based on numerous weights and measurements of actual stones, not on mathematical constructs or computer models. To develop accurate formulas, the author weighed and measured several dozen parcels—totaling over 5,000 stones—of calibrated German-cut amethyst and citrine in common shapes and sizes. The availability of such a large number of precision-cut stones, along with the fact that amethyst and citrine are

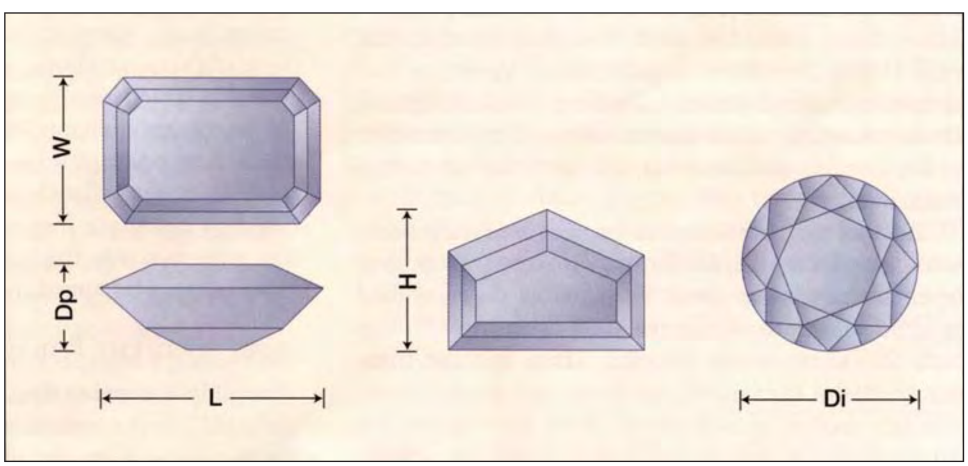


Figure 3. Weight estimation requires that the following dimensions be measured: length (L), width (W) [or height (H) for stones with nonparallel sides], and depth (Dp). Round shapes are defined by their diameter (Di) and depth.

Figure 4. Cabochons are featured by many contemporary jewelry designers. This Bulgari parure consists of a necklace, bracelet, and earrings set with oval sapphire and round ruby cabochons, and accented with diamonds. The sapphire cabochons in the necklace range from 11 × 90 mm to 17 × 24 mm. Jewelry courtesy of Suzanne Tennenbaum. Photo © GIA and Tino Hammid.

two of the most common gem varieties on the market, made them logical standards for this purpose. Since these formulas were first developed in the mid-1990s, hundreds of additional varieties and shapes of colored stones have been checked against them to verify their universality. The formulas proved to be accurate for all the colored stones examined.

Lots of 10 to 50 stones in standard calibrated sizes (e.g., 5 × 3 mm, 6 × 4 mm, 7 × 5 mm, 8 × 6 mm) of each shape were used. Each parcel was weighed to the hundredth of a carat (0.01 ct) using a Scientech SE300 electronic balance. Then, specific measurements of the largest, smallest, and several intermediate stones in each parcel were recorded to the hundredth of a millimeter using a Leveridge gauge. The average weight of a stone in each parcel was calculated by dividing the total weight of the parcel by the number of stones it contained. The actual weights of the stones in each lot showed minor variations from the average weight, due to slight cutting variations. The average weight, size measurements, and S.G. were used to calculate a shape factor for each calibrated size and shape, as follows:

$$\text{Shape Factor} = \frac{\text{Weight}}{\text{Length} \times \text{Width} \times \text{Depth} \times \text{S.G.}}$$

All of the shape factors (calculated for each size within a given shape) were then averaged to arrive at a single factor for that shape. This process was repeated for each shape, for both faceted stones and cabochon cuts. The shape factor is a critical part of the weight estimation formulas, because it compensates for the fact that *length* × *width* × *depth* is the volume of a rectangular solid, rather than the shape of a faceted gemstone.

Once the shape factor was established, the formula was inverted to solve for weight (and a weight correction added where appropriate), as follows:

$$\text{Weight} = \text{Length} \times \text{Width} \times \text{Depth} \times \text{S.G.} \times \text{Shape Factor} \ (\times \text{WCF})$$

Tables in the *Complete Handbook* present ranges of gemstone weights for many shapes and sizes (up to 20 mm, in half-millimeter increments), in a common range of depths. Weights for intermediate sizes that are not normally calibrated were interpolated by formula. The weights are grouped into eight narrow S.G. ranges (again, see figure 2). The first column, calculated using quartz, also includes other stones with S.G.'s in the 2.55 to 2.75 range (e.g., beryl, chalcedony, and feldspar). A spreadsheet analysis was used to calculate the weights given in the other columns. Formulas for 48 uncommon shapes are also presented, calculated from fewer samples (3–12 for each shape). In addition to quartz, flawless synthetic corundum was used to calculate formulas for uncommon shapes, because this was the only material found in which these shapes occurred.

APPLYING THE FORMULAS

Face-Up Examination. The face-up outline (or "shape") of the gemstone determines which shape factor is used in the weight estimation formula.

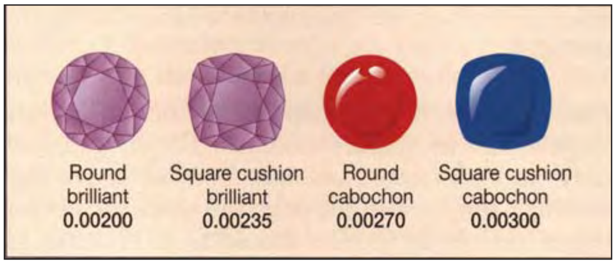


Figure 5. The shape factors (the numbers in boldface type) increase from round to square cushion cuts, for both faceted stones and cabochons.

Many colored stones have mixed cutting styles on the crown and pavilion, but these shape factors can still be applied regardless of minor differences in facet arrangements within similar shapes. These shapes are described by commonly used names, several of which are registered trademarks. (A glossary of names for over 200 gemstone shapes is included in *The Complete Handbook*.)

Following are examples of how the shape factors change according to face-up variations between common shapes. Remember: It will take some practice to learn how to interpolate the shape factors for actual gemstones. In any case, the calculated weight should always be stated as an estimate. Because cabochon cuts (see, e.g., figure 4) are rounded versions of faceted stones, their volumes are greater and their shape factors are always higher than those for the corresponding faceted shapes.

Round to Square. For both faceted and cabochon-cut stones, there is a continuum in the face-up outline from round to square cushion shapes (figure 5). The shape factors for faceted stones increase 17 1/2% from the round shape (0.00200) to the average square cushion shape (0.00235). For cabochon cuts, the increase is 11% (from 0.00270 to 0.00300). Shape factors must be interpolated for stones that are intermediate between these two shapes.

In a related continuum, the faceted square cushion shape may show variations toward the cut-corner square (emerald or Radiant*) cut or toward the square step cut or square Princess cut (figure 6). The shape factors for the average square cushion cut and the average square emerald or square Radiant cut show a decrease of only 2% (from 0.00235 to 0.00230, a difference of approximately 0.10 ct for every 5.00 ct). Therefore, the formulas here and the tables and formulas in the *Handbook* can be used interchangeably for both of these shapes, at least for smaller stones. For larger stones (over 3 ct), the difference between these shapes could become significant, so the shape factor should be adjusted appropriately.

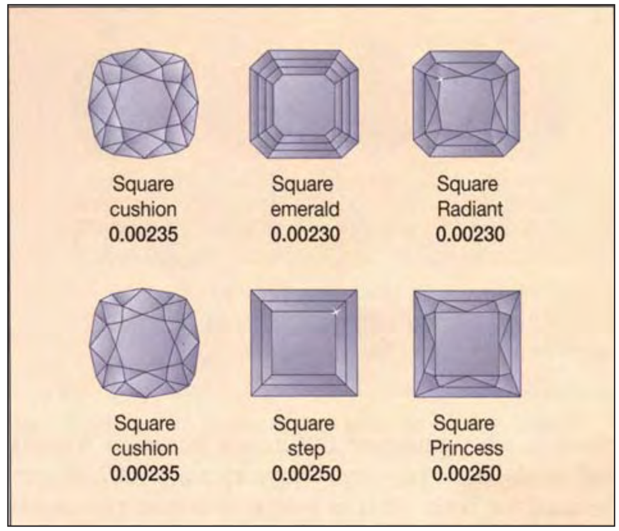


Figure 6. The difference in shape factor between a square cushion and a square emerald (or Radiant) cut is not significant, except in the weight estimation of larger stones. The change in shape factor is more significant (6 1/2%) between square cushion and square step cut or square Princess cut stones

The shape factors increase 6 1/2% (0.00235 to 0.00250) from the average square cushion cut to the average faceted square step cut or square Princess cut (again, see figure 6). Because this difference is significant, it will be necessary to interpolate the shape factor for all stones that are transitional between these cuts.

Round to Oval to Rectangular Cushion. Another continuum for both faceted and cabochon-cut stones is from round to oval, and also from oval to rectangular cushion shapes. The factors for faceted stones increase 5% from the round shape (0.00200) to the average oval shape (0.00210), as illustrated in figure 7. For cabochon-cut stones, measuring and averaging of hundreds of cabochons revealed that

**Radiant Cut Diamond is a registered trademark of the Radiant Cut Diamond Corp. and is commonly used to describe similarly cut colored stones.*

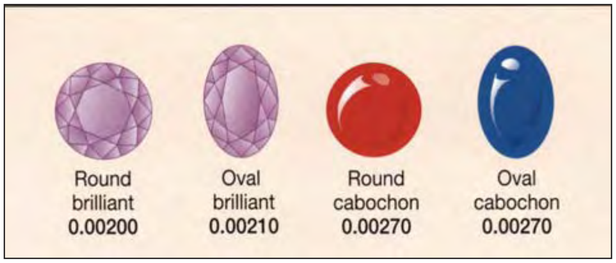


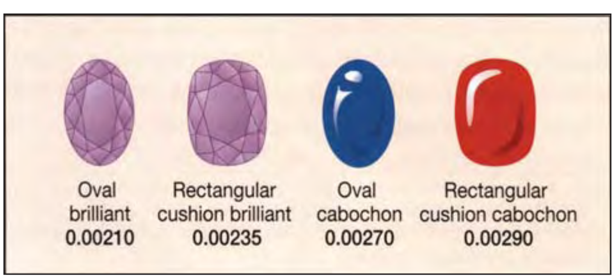
Figure 7. Although the shape factor increases from round to oval shapes in faceted stones, there is no increase for cabochons.

there is no significant difference between rounds and ovals, and the same shape factor (0.00270) can be used for both. This is probably due to the tapering down of the dome along both axes of symmetry as it changes to an oval shape.

As the shoulders of an oval shape bulge, there is a transition toward a rectangular cushion cut (figure 8). The shape factors increase 12% from the average oval cut (0.00210) to the average rectangular cushion cut (0.00235). The increase for cabochons is $7\frac{11}{42}$% (from 0.00270 to 0.00290). Again, use shape factors somewhere between these numbers for transitional shapes.

Rectangular Cushion to Rectangular Step Cut. Another continuum exists for faceted rectangular gemstone shapes. These range from a rectangular cushion to a rectangular Radiant, through an emerald cut, to a Princess cut (with culet) or a rectangular step cut (with keel; figure 9). Both of these latter cuts have pointed corners. The shape factor increases about 10% from the average rectangular cushion cut (0.00235) to the average rectangular Radiant cut (0.00260). In the shape sequence from the Radiant cut to the emerald, Princess, and step cuts, the shape factor increases another 15% (from 0.00260 to 0.00300).

Figure 8. With its bulging shoulders, the rectangular cushion has a larger shape factor than an oval cut, for both faceted stones and cabochons.

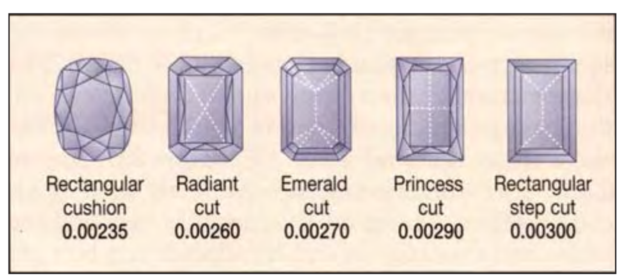


Pear to Heart. A pear shape transitions to a heart shape—with its broader shoulders, flatter head, and cleft—in both faceted and cabochon-cut stones (figure 10). Compared to the pear, the shape factors for hearts increase for broader shoulders, or decrease as the cleft deepens.

Profile Examination. Proportion variations seen in the profile view of a gemstone are accommodated by applying a weight correction factor (WCF) to the weight estimation formula. This factor must be selected with utmost care, because profile variations may have a large impact on a stone's weight. Stones that are equidimensional face-up, such as rounds to squares and triangle shapes, will generally show consistent proportion variations in profile, regardless of the viewing direction. Therefore, it is easier to estimate a WCF for these cuts. However, the proportion variations may be greater for oval to rectangular stones, or for pear and marquise shapes. For example, the crown heights and pavilion bulges seen from end views may be different when examined from the side. Also, tables and/or culets in such shapes are commonly off-center, which complicates the weight estimation process. Whereas face-up proportion variations are readily visible from one direction, the profile examination requires a complete rotation of the stone. Therefore, more skill is needed to apply an appropriate WCF to cuts that are not equidimensional face-up.

Brilliant-Cut Stones. The pavilion facets of brilliant-cut stones converge to a point (or culet). Since the weight estimation formulas for brilliant-cut stones were derived from the average weights of

Figure 9. Among rectangular stones, there is a continuous increase in shape factor from a cushion to a rectangular Radiant cut, an emerald cut, a Princess cut, and, ultimately, a step cut.



well-proportioned samples, we use a representative profile of the proportions of an average-cut stone, such as that shown at the far left in figure 11. This profile (viewed from the end) represents a stone with a 30% crown/70% pavilion ratio, a thin to medium girdle, and no culet.

The profiles of the brilliant-cut stones in figure 11 are representative of the profiles for round, square, oval, cushion, pear, marquise, heart, Radiant, and Princess cut stones. Stones with identical length, width, and depth measurements within a given cut style may have significantly different weights, due to variations in girdle thickness, crown height, and pavilion depth, as well as bulges. Using the stone profile at the far left in figure 11 as an example of an average well-cut stone, and assigning it a weight of 1.00 ct, we can see how weights are affected by variations in profile. The other stone profiles in figure 11 represent what a stone with that profile might weigh relative to the profile of the 1.00 ct round brilliant cut. Although the basic measurements are the same, the first of the comparison profiles—with very shallow crown angles—might require a 10% deduction as a WCF. The next profile, with a very steep crown, might require a 10% premium as a WCF; a heavy pavilion could have a 30% WCF; the combination of steep crown angles with a heavy pavilion could have a 40% WCF; a very thick girdle might have a 10% WCF. When a weight correction factor is required, the percentage deduction or premium is then subtracted from or added to the formula at the end of the calculation.

Step-Cut Stones. The pavilion facets of step-cut stones converge to a keel (i.e., an elongated culet). The length of the keel averages about one third the overall length of the stone. Stones with shorter keels will weigh less, and those with longer keels will weigh more (figure 12). Stones that vary in keel length from this average may require a WCF of up to ±10%.

Cabochons. The weight of a cabochon is greatly affected by the curvature of its dome. A highly peaked dome with relatively flat sides may require a WCF deduction of as much as 25%, while a dome with a nearly flat top and full shoulders might require a WCF premium of as much as 35% (figure 13).

Examples. For a better understanding of this weight estimation process, the reader is referred to the exercises in Box A.

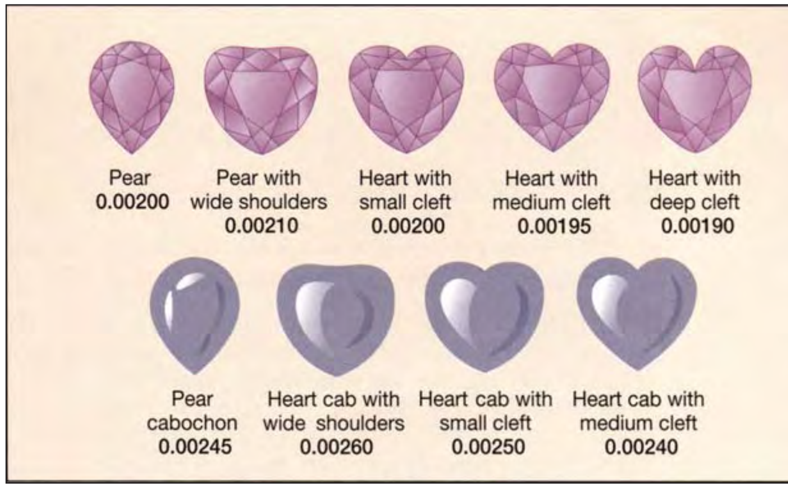


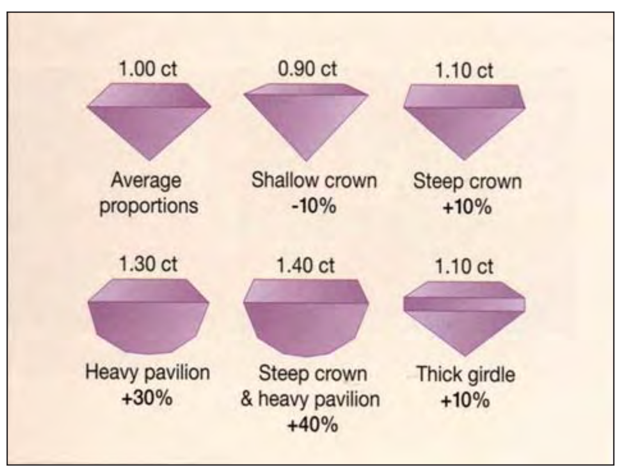
Figure 10. In this sequence of pear- to heart-shaped outlines for faceted stones (top), the shape factors decrease as the clefts become deeper. The same trend is seen in cabochons (bottom).

SUMMARY AND CONCLUSIONS

As the face-up outlines of faceted stones vary from one classic shape to another, the shape factors in their weight-estimation formulas change accordingly. Both precise face-up measurements and profile observations are critical to the accurate estimation of the weight of a mounted colored gemstone.

This task also requires a combination of good references and precise judgments. The formulas and tables developed for this purpose are the basic refer-

Figure 11. Seen in profile view, proportion variations can have a significant impact on a stone's weight, and must be considered carefully in the estimation process. These drawings show how the crown and pavilion proportions, as well as the girdle thickness, can affect the weight correction factors (given as percentages).



BOX A:
EXERCISES IN WEIGHT ESTIMATION

The following examples illustrate the weight estimation process for three actual gemstones (figure A-1).

Example 1. This emerald-cut emerald has a slightly asymmetrical face-up outline and a deep pavilion, with an extra bulge on one side. It measures 10.25 × 8.85 × 6.88 mm.

FORMULA FOR EMERALD CUTS:

$$L \times W \times Dp \times S.G. \times 0.00270 = \text{est. wt.} \times WCF = \text{final estimate}$$

$$(10.25) \times (8.85) \times (6.88) \times (2.72) \times 0.00270 = 4.58 \text{ ct } (+10\%) = 5.04 \text{ ct}$$

Deeper stones tend to have more of a bulge, and this emerald cut is no exception. A WCF of +10% might be appropriate for this stone. Incorporating this factor into the formula results in an estimated weight of 5.04 ct. Although this varies from the actual weight of 4.97 ct by only 1.4%, it is critical to value, as the difference pushes the weight estimate to over 5.00 ct. After more experience, the estimator would apply a WCF between +5% and +10%.

Here is a case where the difference of a percentage point or two in the weight of a gemstone could make a significant difference in its value. It is important at this point to reassess whether the stone can or should be removed from its mounting for actual weighing.

Example 2. This pear-shaped faceted sapphire has a symmetrical face-up outline, a very shallow depth, and a culet closer to the tip (the erratic culet has not created an inordinate bulge in this stone, but such a bulge is often seen and should be considered, if appropriate). It measures 10.63 × 8.22 × 4.30 mm.

FORMULA FOR PEAR SHAPES:

$$L \times W \times Dp \times S.G. \times 0.00200 = \text{est. wt.} \times WCF = \text{final estimate}$$

$$10.63 \times 8.22 \times 4.30 \times 4.00 \times 0.00200 = 3.00 \text{ ct } (-10\%) = 2.70 \text{ ct}$$

Because the stone is so shallow, there is not enough pavilion to create a normal bulge. A weight correction factor (WCF) of –10% might be appropriate for this stone. Incorporating this factor into the formula results in an estimated weight of 2.70 ct. This varies from the stone's actual weight of 2.63 ct by 2.7%. After more experience, the estimator would apply a WCF between –10% and –15% to obtain a more accurate weight estimate.

Example 3. This oval cabochon ruby has a symmetrical face-up outline, a medium-height dome, and slightly flattened sides. It measures 10.02 × 7.59 × 5.65 mm.

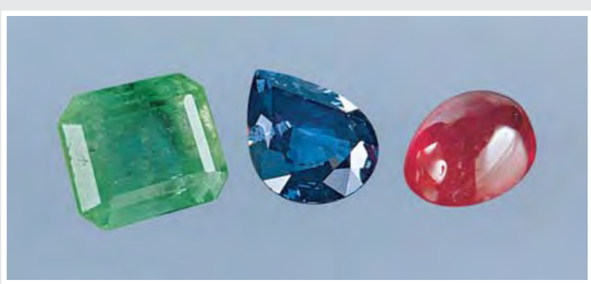
FORMULA FOR OVAL CABOCHONS:

$$L \times W \times Dp \times S.G. \times 0.00270 = \text{est. wt.} \times WCF = \text{final estimate}$$

$$(10.02) \times (7.59) \times (5.65) \times (4.00) \times 0.00270 = 4.64 \text{ ct } (-10\%) = 4.18 \text{ ct}$$

Because the sides are a little flat, a WCF of –10% might be appropriate for this stone. Incorporating this factor into the formula results in an estimated weight of 4.18 ct, which is 1.9% lower than the stone's actual weight of 4.26 ct. After more experience, the estimator would apply a WCF between –5% and –10%.

Figure A-1. These stones are typical of those that a tradesperson might encounter in jewelry. Left = table up; right = profile view. The weight estimation exercises in this box were developed using these samples. Stones courtesy of Pravin Davé, Los Angeles, (ruby and sapphire) and Ivan Rozo, Los Angeles, (emerald). Photos by Maha DeMaggio.



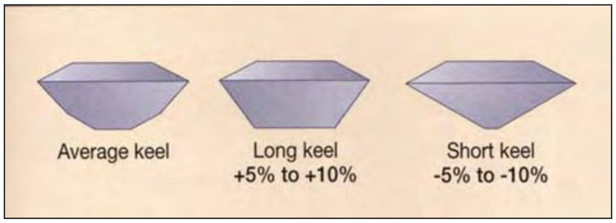


Figure 12. The stone on the left shows an average keel line length. The WCF values vary considerably for short or long keels.

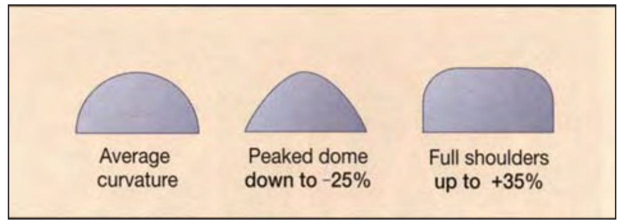


Figure 13. The curvature of a cabochon, as seen in profile, profoundly affects the weight of the stone. As a result, the weight correction formulas may require WCF values that vary from –25% to +35%.

ence tools needed. The formulas described in this article were derived primarily from the average weights of parcels of well-proportioned German-cut calibrated amethysts and citrines. The person responsible for weight estimations must then learn to make the necessary adjustments to the standard formulas. This process requires extensive experience and practice. In fact, the tables and formulas developed by the author were adjusted and refined on the basis of several years of experience with actual colored stones examined in the course of his business.

Most tradespeople who have been estimating weights of colored stones for any length of time are probably using 40-year-old formulas and techniques that carry the disclaimer that "Even for the experienced grader, they are accurate only to within 10 to 15%" (Gemological Institute of America, 1994). With the formulas and estimation procedures developed by the present author, not only is it easier to address contemporary cutting styles, but it is also possible to reduce that potential margin of error to 5% or less.

At all times, however, the person who is using these (or any other) formulas and techniques must always use qualifying terms such as *approximately*, *estimated*, or *about* in conjunction with the weight estimate. Such disclosure is important, since the value of a piece of jewelry is often greatly affected by the weights of the gemstones it contains.

The updated formulas presented here are meant to set a new standard for weight estimation and to give a fresh look at this important task for many who make their living in the jewelry trade. The weight estimation process may also provide an opportunity for jewelers to improve the accuracy of their gemological skills, while enhancing the profitability of their businesses.

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