

More about Visual Gemmology

by Donald G. Coughlin

In my essay published in Gemmology Canada – Special Issue #5 entitled "Visual Gemmology – A Basic Approach" I described a simple method for observing double refraction in set or unset faceted gemstones. Here I will submit further findings as applied to natural vs synthetic gemstones, as well as a few comments on VG in general.

Below is an amended index table of DR for most common (and a few rare) gemstones. You can delete any stones you feel are not necessary, however I would point out that memorizing all the listed stones gives you far more confidence when viewing unknown stones. In particular I refer to stones with RI's too high for reading on a standard refractometer. I mention the rare stones such as taaffeite, fibrolite, sinhalite, etc. because I have them as study specimens. Sooner or later you will encounter one or more of them, and just knowing their existence is helpful. On the other hand, you could delete the stones you do not require, and substitute your own specimens which are not listed.

To make VG easy to memorize, the DR's have been multiplied by 1,000 to give a simple numerical value. When referring to a DR in notes or studies, divide by 1,000, e.g. 3 – Apatite becomes 0.003, and Taaffeite 0.004. A table of helpful DR stones, in ascending order, for use in VG follows (stars indicate important notes which follow the table):

3–4	Apatite*, Taaffeite
4–10	Beryl, including Aquamarine* and Emerald**.
8–10	Andalusite, Chrysoberyl, Corundum (ruby and sapphire)***, Enstatite, Iolite, Quartz, Tanzanite, Topaz. (Memory aid: A–C–C–E–I–Q–T–T)
13–15–18	Kornerupine, Spodumene (Kunzite, Hiddenite), Tourmaline
20	Scapolite, Fibrolite (Sillimanite)
25	Diopside
36–38	Peridot, Sinhalite
47	Benitoite
59	Zircon (watch for Sri Lanka metamict green and some brown where DR dwindles right down to zero (isotropic))
90	Lithium Niobate****
130	Sphene (Titanite)****
287	Rutile****

SYNTHETIC EMERALD **: (Ref Gem Testing, by Anderson/Jobbins)

Flux melt

3–5 Chatham, Gilson, Inamori, Lennix, Russian, Seiko, and
Zerfass.

6 Gilson "N" (believe no longer being manufactured but will
still be in circulation)

Hydrothermal

4–5 Biron/Pool

5–6 Lechleitner, Linde/Regency

6–7 Russian

NOTES:

*Blue Apatite and Aquamarine: VG is difficult to utilize for both these gemstones. The good colour is derived from the extraordinary ray, and these stones are therefore cut with the table facet parallel to the optic axis rather than perpendicular as for other uniaxial stones (see Webster/Anderson Gems Their Sources, Descriptions and Identification, Fourth Edition, p.746).

It is necessary to view these stones through the girdle to detect double refraction, however the fact that they appear isotropic through the table is an indication of the stone's identity. Even when using the refractometer it is often necessary to view a stone on different facets, so likewise, it is a good habit to rotate a stone when performing VG.

**Natural emerald vs synthetics: Visual Gemmology is useful in identifying the FLUX MELT synthetic emeralds (and possibly the Biron/Pool hydrothermal) only. Briefly, if you find the emerald under test appears to be "isotropic" after viewing through both the girdle and table, then the DR is possibly too small to identify. The stone is probably synthetic and conventional testing is required. The DR (0.006) of a reasonably clean natural emerald is easily determined using VG, but gets progressively more difficult with synthetics where the DR is as low as 0.003/0.004. In conclusion, I would use my microscope on any flawless or near-flawless emerald I encounter. However, VG does serve as an indicator in those situations where standard gem testing equipment is not available.

It is important to note that if the DR is above 6, the emerald is either a natural stone or synthetic hydrothermal. The flux melt emeralds are more plentiful and inexpensive than hydrothermal synthetics and are therefore more likely to be encountered. If the DR is very small (e.g. below 6) using VG, the stone is probably synthetic and further conventional testing is recommended.

***Ruby/Sapphire: VG is a useful aid in identifying synthetic corundums. These synthetics are usually cut in the same way as apatite and aquamarine, with the table facet parallel to the optic axis, to get maximize yield from the boule rather than attain optimum colour. If VG shows the stone to be isotropic through the table facet, and anisotropic through the girdle, then it is probably a synthetic and must be checked with conventional testing equipment. Just the fact the stone appears anisotropic viewing through the table facet is enough to arouse one's suspicions.

****Lithium Niobate, Sphegne and Rutile: When faceted, these stones make a dramatic contribution to observation of DR using VG. I would strongly recommend the use of the home made VAD (Visual Analyser Device) described in my original essay, when viewing such highly birefringent gemstones. The reason for this is that the double light source images are so far apart that it is extremely difficult to observe the doubling without rotating a polarizing lens. It is too easy to quickly identify such stones as isotropic!

HINTS

A good knowledge of colours in differing species of gemstones is a tremendous advantage when practising VG. The bold, harsh colours of glass (paste) stones can often trigger an alarm bell in your mind's eye, and this alone makes such identifications that much easier.

Visual Gemmology requires intensive practise. It should take the observer only a few seconds (using the VAD) to make a tentative identification or estimate of DR at the very least.

A student of VG (evening time or night is best) should select a variety of birefringent gemstones with widely varying DR's. Memorize the names of the selected stones in the order placed on the table, and preferably using the VAD, view the stones and make mental note of each variety with its DR.

When confident, the student should then mix up the stones and perform the same exercise, but this time turn off the room light and attempt to identify each stone. Note: Initially I switched on the light to confirm my identification, then off again to select another stone. In a very short time the student becomes more and more confident, and VG really comes into its own.

I strongly recommend you construct a Visual Analyser Device (VAD). It is a very valuable instrument, and the more you use it -- the more you will wonder how you managed without it!

IMPORTANT: Keep BOTH eyes open when using the VAD! One eye keeps you focussed on the pinpoint light source, while the other concentrates on determining DR. Even without the VAD the use of both

eyes prevents unnecessary strain.

REMEMBER: (With stone as close to the eye as possible)

*The wider your viewing angle from the light source is -- the HIGHER the R.I.

*The less you see of the "spider's web" (e.g. without "searching" for more) -- the HIGHER the R.I.

*The closer your images are to aligning up with the light source, the more you will see of the total image, and -- the LOWER the R.I.

Many students of VG give up prematurely, possibly because VG may be too intimidating. In the jewellery shop where I work, customers see me practising VG (using one of the incandescent ceiling lights as my light source) on their rings and brooches, and invariably they want to know what I am looking for. I explain it to them and they voice amazement when they first see the beautiful "spider's web". Though few can learn VG in a few minutes, they are at least initiated into one of gemmology's many mysteries. Persevere, and you will appreciate the value of VG, and more importantly -- you may contribute your own discoveries to this fascinating science.

All tests that led to the above article were performed using my own gemstones, therefore it would be useful to VG if users test their own specimens and make notes accordingly. I would be most interested in differing results -- as would the CIG. The study of natural and synthetic emeralds require much more research due to my having very few specimens.

(Editor: At this point a word of caution for users of "emerald" filter: these filters are said to separate natural and synthetic emeralds successfully. Tests conducted with filters of this type under various light conditions and using different viewing distances resulted in unreliable identification. The use of these filters for serious gem identification is not recommended! The only means of proper identification of any synthetic gem material is the gemmological microscope operated by an experienced gemmologist. If this approach does not produce satisfactory results other more sophisticated instruments must be used. Most of them are beyond the financial means of a gemmological laboratory.)

My next article will be on the application of Visual Gemmology to identify diamonds and their imitations.

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