Gemstones In the Eyes of Gemology

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A gemstone is a mineral - an object which is formed spontaneously in nature without human intervention. Gemstones had always been considered to be the essence of beauty – they have served the advertizing and promotion fields, and have inspired scientists, painters, and poets.

Gemstones are defined by 5 properties, which differ from one stone to another:

Beauty: although beauty is a subjective factor, this property is being examined due to objective criteria amongst with some optical characteristics such as the color dispersive power color, transparency and high refractivity.

Durability: durability is defined by toughness, hardness and Chemical stability: Hardness relates to the stones resistance to external stresses in one direction (scratching), two (abrasion) or three (penetration). Hardness is a crucial property for a precious stone, since a scratch on the surface or an abrasion of the edges, can affect certain properties such as refraction, and thus its appearance. So does chemical resistance: if the stone's resistance to chemical treatments or influences – it could be easily damaged and deprived of its clarity or brilliance, and thus – its value.

Rarity: this criterion refers to the ratio of supply to demand, as well as natural origin as, explained in the introduction.

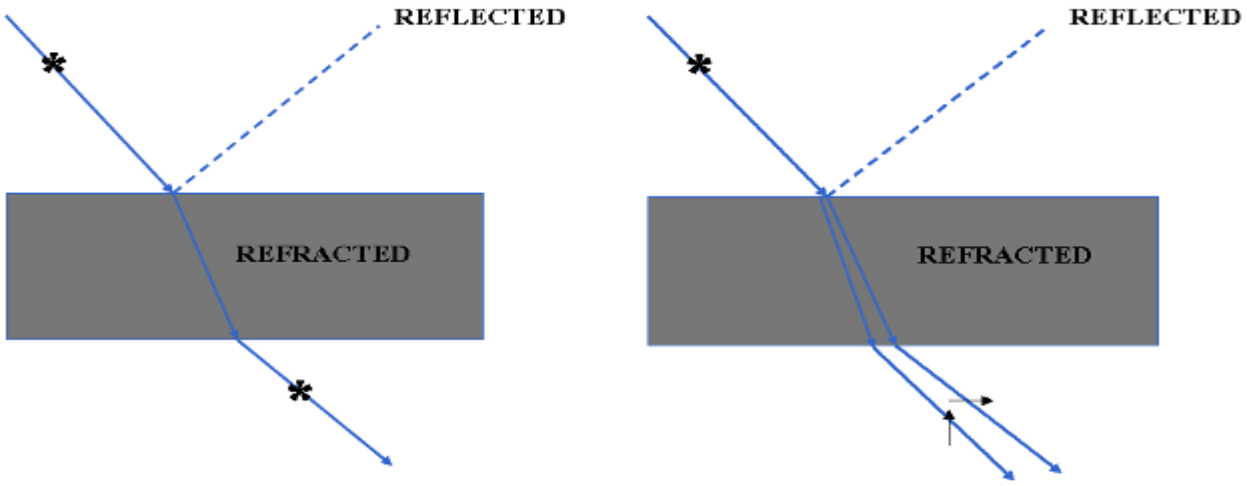
Tradition: in some cultures and throughout some periods stones have been acknowledged for their magical properties such as mood improvement and their medicinal merits as pain reliefs est.

Portability: this criterion refers to the possibility of transporting the stone from one place to another.

Each stone has its distinctive unique characteristics which are used to distinguish one from another, among which their color, transparency, chemical composition, physical properties and mode of formation. These properties are used to identify the stone, and are measurable by applying certain criteria:

Refractive Index

The RI refers to the "play of light" in the stone. The behavior of the light within the stone is defined as SR (single refraction) or DR (double refraction). Each stone has a different RI, which is derived from the chemical and physical properties which are unique to every substance. When a ray of light encounters a medium different than the one it's been going through (such as air and iron for instance) – part of it is reflected (goes back to the first medium), part is absorbed and part is refracted entering the second medium.

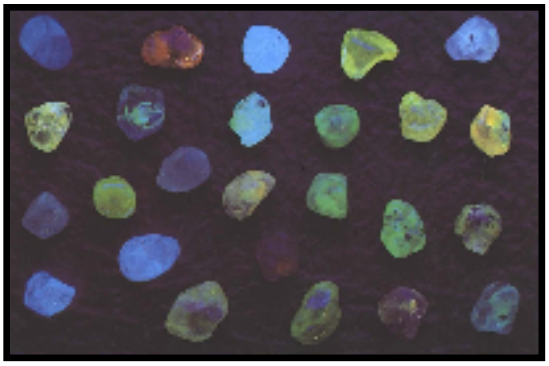


Light behaves differently when it meets different mediums. That's why in every stone we can see a different play of light.

Fluorescence

This criterion refers to the stone's reaction to exposure o an Ultra Violet radiation. There's no connection between the color of the fluorescence and the color of the stone.

Gemstones fluoresce in different color



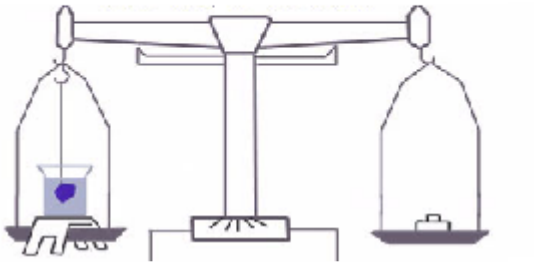
Specific Gravity

SG is the relative weight per unit volume known and unique for every material. The SG is calculated as the ratio of the weight of the stone to that of an equal volume of distilled water.

Specific gravity = Wa /(Wa-Ww)

Wa = weight in air

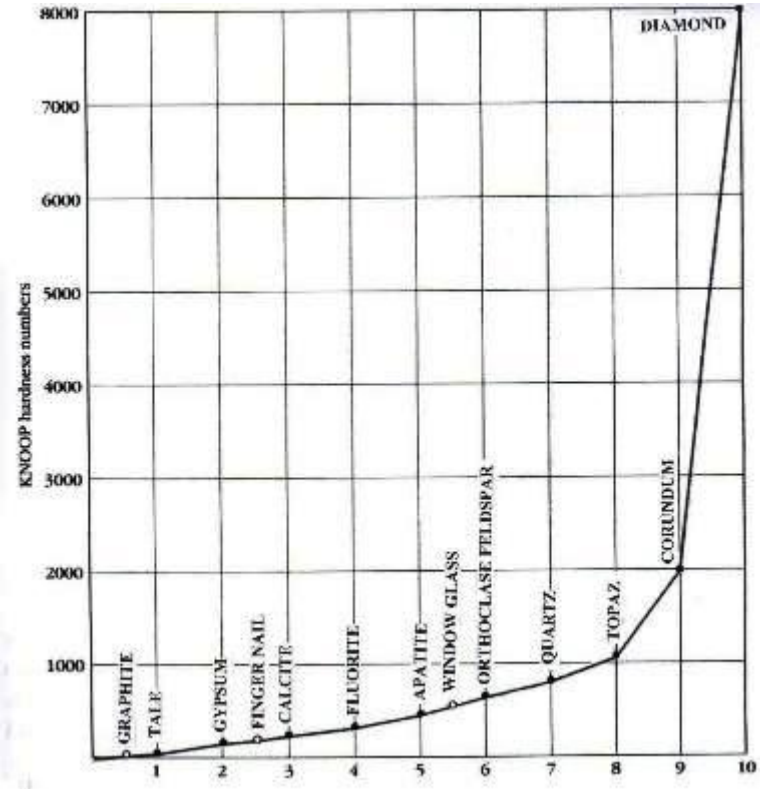
Ww = weight in water



Hardness

Hardness is defined by the minerals cohesion level or the strength of their chemical bonds in the stone. Since a precise measurement of hardness is very hard to perform, the stone is being examined against MOH'S scale - a scale of 10 sample minerals of increasing hardness, each of which is capable of scratching the preceding mineral.

Moh's Scale



There are about 2000 minerals in nature, only 200 of which are consistent with the definition of a precious stone. However, only 20 of them serve in the jewelry industry. This article does not review all 20, but provides a glance on four known gemstones among which: the Diamond, the Ruby, the Sapphire and the Emerald.

Diamond:

pure Carbon

Appearance:

Color: Diamonds usually range from perfectly colorless to yellow-tinged or sometimes brownish but they can also vary to green, pink, red, blue, grey and black. Diamonds with definite color are extremely rare though.
Luster: Its luster and dispersion are greater than of the other gemstones, due to a high refractive index and its hardness thanks to which it has a very good polish degree, with no surface scratches or damaged edges.
Clarity: ranges from clean to imperfect under X10 magnification. Described as: IF, VVS1, VVS2, VS1, VS2, SI1, SI2, I1, I2, I3.

Typical Inclusions:

Crystalline inclusions, big or small, isolated or in groups, or discontinuities (fractures or breaking in various directions).

Physical properties:

Hardness: A diamond is rated 10 on Mohs' scale and it's 10 to 150 times harder than corundum (A mineral rated 9). The **SG** – is c3.52 g/cm^3 and the **RI** is 2.417 (very high). It has a dispersion equal to 0.044 (which is the highest for colorless minerals.

Main sources:

South Africa, Namibia, Congo, Angola, Siera Leona, Russia, Australia, Canada.

Ruby:

Corundum family
aluminum oxide
Coloring agent: Chromium

Appearance:

Color: Red color - varies from fiery vermilion to violet red. A distinct brightening of color in strong light.
Luster: considerable luster.

Fluorasence: Red Fluorescence intensifies under artificial light and mostly direct UV light of the sun. Slightly weaker than synthetic, difference will be apparent when comparing the two.
Transparent to opaque.

Typical Inclusions: Flux-filled cavities-these look like a network of lace. The filling in the cavity is liquid. Silk-fine needle-like inclusions often intersecting at 60' angles. Crystalline inclusions. Pronounced twinning-sharp, color bands. Saturn-like inclusions- a core with fingerprints radiating out from it. Something that resembles cleavage-separations Along the growth plane. Perfectly clean rubies few and far between-any ruby which appears so should immediately send up a red warning

Physical properties: **hardness**: 9; **SG**: 4.00 g/cm^3; **RI** – 1.76-1.77 (DR).

Main sources:

Burma (Mogok, Mong hsu), Thailand, Sri-Lanka, East Africa.

Sapphire:

Corundum family
Aluminum oxide
Coloring agent: Iron/Titanium

Appearance:

Color: A blue variety of corundum, its color ranges from strong (but not too bright) blue to very dark, sometimes accompanied by blue to dull green pleochroism. However, sapphire can appear in varios other colors as green, orange, yellow sapphire est.
Luster: It's got Medium luster due to low refractive index. Small dispersion.
Fluorescence: Generally shows no fluorescence weak to strong orange or red, some treated natural stones exhibit splotchy green or blue fluorescence. Transparent to opaque.

Typical Inclusions:

Basically, sapphire has the same types of inclusions as natural ruby

Physical properties: Hardness: 9; **SG**: 4.00 g/cm^3; **RI**: 1.76-1.77 (SR).

Main sources:

Burma, Thailand, Phailin (Cambodia), Kashmir, Australia, Montana (USA).

Emerald:

Beryl family
Beryllium aluminum silicate
Coloring agent: Chromium

Appearance:

Color: A green variety of beryl. Other varieties of the beryl: Aquamarine (blue-green, coloring agent: iron), Morganite, Golden Beryl, Ghoshonite (colorless).
The typical color of Emerald is a distinctive beautiful emerald green, which is due to traces of chromium in the crystal. Can be found in different hues of green.

Luster: It's got small dispersion and low luster which is strongest in medium light stones with few inclusions.

Fluorescence: Although natural stones rarely show any fluorescence, Stones of the very finest color do sometimes show yellow or orange fluorescence.

Typical Inclutionds:

Three phase inclusions – a liquid filled cavity with both, a gas bubble and a crystal, oxides, angular inclusions, tube-like and needle-like inclusions

Physical properties:

Hardness of 7.5-8 but is pretty brittle and may show ill defined cleavage parallel to the basal plane. The density is normally 2.72 g/cm^3. RI: 1.577-1.583. .

Main sources:

Colombia (Chivor, Muzo), Zambia, India, Afghanistan, Brazil (Minas Geraes), Russia.