Determining Gem Hardness

The tendency to resist scratching in a gem is known as its hardness. Of the three factors comprising durability, it is the most familiar. Even those folks with just a passing interest in gems know that they can be ranked on a scale of hardness. Hardness is primarily the result of the strength of the chemical bonds between the gem's constituent atoms (how tightly they are bound to one another).

The hardness of a gem affects its wearability, luster, and resistance to cutting and polishing. All other factors being equal, harder gems are more useable in jewelry, develop a brighter surface luster, and take more time and effort to cut and polish. They will retain their polish longer than softer gems, given equal wear and tear.

The familiar 1-10 Mohs' Scale of hardness, is not an absolute measure, but rather a relative one --> a kind of "pecking order". Gems ranked at a higher number on the scale can scratch those ranked lower, and will in turn, be scratched by those whose number is higher than theirs.

Frederich Mohs, a 19th century German mineralogist was the originator, and we still use his scale, with the minerals which he designated as reference points today. For example, (softest) talc = 1, quartz = 7 and diamond = 10 (hardest).

[Talc, the softest on the Mohs' scale, diamond, the hardest]

In mineralogy, one of the key tests commonly used for purposes of identification is a "scratch" test, which is done with a set of implements known as hardness points. These, usually steel, "pencils" are tipped with various minerals (or metals) of known hardness. By drawing them across the surface of an unknown mineral sequentially, the tester can determine the sample's approximate hardness. In gemology, such tests are rarely used as they are destructive in nature. Exceptions might be in testing the bottom of a carving, or a piece of gem rough, or a bit of material which has broken off. Another drawback of the standard hardness points is that they are not precise, but limited to giving a "ballpark" estimate.

In a laboratory setting, exquisitely precise measurements can be made with sclerometers. These devices use diamond-tipped, hydraulically operated probes, and can give an absolute reading on the force necessary to penetrate the surface of a material.

Not many hikers, nature lovers, or rockhounds carry hardness points with around with them on their treks, but the use of just a few ordinary materials can allow such individuals to do pretty good hardness tests in the field.

The Practical or Field Mohs' Scale

1-2: easily scratched by fingernail

3-4: scratched by copper coin

5-6: easily, and not so easily, scratched with pocket knife

7: scratches window glass/scratched by steel file

8-10: scratches window glass, but not scratched by steel file:

Hardness can be directional. This is actually quite understandable, as it depends on chemical bonds which can differ in strength, and in distance from each other, depending on which axis of the crystal we are observing. Generally such differences are relatively small and of litttle consequence, but there are two notable cases where they are dramatic and important. 1) Kyanite is notoriously difficult to cut because of its extreme directional hardness differences. 2) Diamond cutting would scarcely be possible unless the cutters could use the directional hardness of that gem to their advantage .

SOFT GEMS:

[Ivory and jet: 2.5, pearl: 3, sphalerite: 3.5, fluorite: 4]

GEMS OF INTERMEDIATE HARDNESS

[Scapolite: 6, Tanzanite: 6.5; garnet: 7 - 7.5 depending on species, tourmaline: 7.5]

HARD GEMS

[Spinel & topaz: 8; chrysoberyl: 8.5, sapphire: 9]