Preface

Welcome to the Retailers’ Reference Guide: Diamonds, Gemstones, Pearls and Precious Metals. This ground-breaking piece of work is the result of the exceptional efforts of a large number of members in all the CIBJO Commissions. By coming together in this manner we are confident that this guide will assist jewellery retailing globally.

Research has shown that empowering staff with the vital knowledge about the products they sell leads to sustainable sales growth. Jewellery consumers all around the world are looking for greater information about the products we sell.

At the Marketing and Education Commission we are committed to providing jewellery retailers with the tools to sell more effectively. We can develop the most inspiring jewellery products in the world but if the retailing does not live up to the product we will fail to compete with other luxury products.

We have created this Guide to meet a need that has been highlighted by jewellery retailers around the world. Namely an accessible reference guide that allows jewellery retailers at all levels to benefit from the enormous knowledge contained within CIBJO.

I truly believe that this Guide will provide an excellent resource that will support and drive sales growth for all types of jewellery retailer and will become crucial to making CIBJO member businesses more successful.

Wishing you all future success.

Jonathan Kendall
President
Marketing and Education Commission, CIBJO
How to use the Retailers’ Reference Guide

This Guide is designed to provide retailers with a better understanding of the fundamentals of Diamonds, Gemstones, Pearls and Precious Metals.

It has two sections:

• **Key facts guides** that act as a quick reference guide. We recommend that these are printed and laminated to provide a simple reference on the shop floor.

• **Full chapters**, covering Diamonds, Gemstones, Pearls and Precious Metals in greater detail, that deliver a basic reference guide for jewellery retailers.

**Retailers’ Reference Guide contributors**

This guide is the result of a large number of individuals’ exceptionally hard work and the co-operation of all CIBJO’s Sector III and Precious Metal Commissions.

The CIBJO Marketing and Education Commission would especially like to thank:

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**Key facts: Diamonds**

- Diamonds are worn by people as potent symbols of love, devotion, pride, wealth and power.
- At least 13 factors affect diamond value, including fluorescence, table percentage, symmetry and other crucial details.
- The most important factors when determining the quality of a diamond are known as the 4 Cs. These are the diamond's carat weight, its cut, its colour and its clarity.
- The key thing to note is that no one C is more significant than another. A particular combination of the 4 Cs can be chosen to suit a particular budget, occasion, design or jewellery piece.

### Cut

Cut is the shape and cutting style of a diamond. The cut, polish and proportions of a diamond will determine its appearance. The shape of a diamond is a matter of personal taste, with the round brilliant cut the most popular. Other shapes are the asscher, cushion, emerald, heart, pear, marquise, oval, princess and trilliant.

<table>
<thead>
<tr>
<th>Cut</th>
<th>Common cutting styles</th>
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<td>Asscher</td>
<td><img src="image" alt="Asscher Cut" /></td>
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<td>Cushion</td>
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<td>Emerald</td>
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<td>Marquise</td>
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<td>Pear</td>
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<td>Princess</td>
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<td>Round</td>
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<tr>
<td>Trilliant</td>
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### Carat

Carat is often mistakenly used to refer to a diamond's size, but it is actually a measure of weight. One carat (equivalent to 200 milligrams) can be divided into 100 "points". A 0.75 carat diamond may also be described as a 75-point or ¾ carat diamond.

Larger diamonds are found less frequently in nature, so they can command a significantly higher price. For instance, a one carat diamond will cost more than two ½ carat diamonds of equal colour, clarity and cut.

<table>
<thead>
<tr>
<th>Common cutting styles</th>
<th>Guide to approximate carat size</th>
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<tbody>
<tr>
<td>Asscher</td>
<td><img src="image" alt="2 CTS" /> 75 points</td>
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<tr>
<td>Cushion</td>
<td><img src="image" alt="1.5 CTS" /> 50 points</td>
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<td>Emerald</td>
<td><img src="image" alt="1.25 CTS" /> 25 points</td>
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<td>Heart</td>
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<td>Marquise</td>
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<td>Pear</td>
<td><img src="image" alt="0.50 CTS" /> 5 points</td>
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<tr>
<td>Princess</td>
<td><img src="image" alt="0.25 CTS" /> 2 points</td>
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<td>Oval</td>
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<td>Round</td>
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<td>Trilliant</td>
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Colour

Diamonds are found in almost every colour of the rainbow, but white-coloured diamonds remain the most popular. There are more than 20 subtle grades of colour, identified in alphabetical order from D-Z. Variations are so slight that colours must be graded by an expert under controlled lighting conditions and compared against a master set for accuracy. Those at the upper end of the scale will be more expensive, as they are rarer. However, they are difficult to discern with the naked eye.

<table>
<thead>
<tr>
<th>Colour Grading scales*</th>
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<td>GIA</td>
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<td>Y</td>
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<td>Z</td>
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</table>

Clarity

Every diamond is unique. Nature ensures that each diamond is as individual as the person who wears it. Naturally-occurring features – known as inclusions – provide a special fingerprint within the stone. Usually invisible to the naked eye, these tiny marks are minerals or fractures which appeared while the diamonds were forming in the earth.

<table>
<thead>
<tr>
<th>Clarity Grading scales*</th>
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<td>GIA</td>
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<td>FL</td>
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<tr>
<td>FL</td>
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<td>VVS1</td>
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<td>I2</td>
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<td>I3</td>
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<td>I4</td>
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</tbody>
</table>

Key:
- LC: Loupe clean
- F: Flawless
- IF: Internally flawless
- VVS: Very, very slightly included (very, very small inclusions)
- VS: Very slightly included (very small inclusions)
- SI: Slightly included (small inclusions)
- I: Included
- P: Piqué

* There are other grading systems used by laboratories around the world.
Most gems are natural, inorganic minerals that have a specific chemical composition and a characteristic structure. Some gem minerals, such as opals or natural glass do not have an orderly crystal structure; these gems are amorphous. Some gems are organic, meaning they come from plants or animals, such as: pearls, amber, coral and ivory. To be called a “gem” any of the above-mentioned materials must embody three important traits: beauty, rarity and relative durability.

Properties in a gemstone species are a series of generally repeatable traits, which help distinguish gem varieties from one another, and gem species and groups from one another:

- **Chemical formula** – The chemical makeup of a gemstone.
- **Refractive Index** – An optical measure of the extent to which light is bent as it enters or leaves a gemstone at an angle other than perpendicular to the surface. It is expressed as the ratio of the speed of light in air to its speed in the gemstone.
- **Birefringence** – The strength of double refraction measured by the difference between the highest and the lowest refractive indices. Birefringence is only measurable in a doubly refractive gemstone.
- **Specific Gravity** – The ratio of the weight of a material to that of an equal volume of water at 4˚ Celsius.
- **Mohs Hardness Scale** – Developed by Frederich Mohs in 1822, the Mohs scale is a comparative scale of the hardness of different minerals.

Natural gemstones covered in the CIBJO Retailers’ Reference Guide

Alexandrite and other chrysoberyls, Amethyst, Aquamarine, Other beryls, Citrine, Emerald, The feldspar group, The garnet group, Jade, Kunzite, Lapis lazuli, Opal.
Gem materials are occasionally treated to improve their appearance. The aim of treatments is to strengthen colour, improve clarity, accentuate phenomena, improve luster and/or improve durability of the stone.

Treatments include: dyeing or coating gems; heating to improve colour and clarity; lead glass, wax or resin impregnations of a gem’s fractures pits or fissures; lattice diffusion of gemstones and irradiation or bleaching. In some cases, a combination of treatments may take place to achieve the treater’s desired result.

Additionally, different gem treatments require different care requirements. Because treatments affect the value of gemstones, there is a need to inform and/or disclose how a gem has been treated. Information about gem treatments should occur at every step of the buying and selling process from wholesale to retail, and ultimately to members of the buying public.

For specific information about how to do this, see panel (right).

There are many products in the gem and jewelry business that look like gems but are not, and they are sometimes called "simulants." These products are not described in the Retailers’ Reference Guide, but CIBJO describes such products as follows:

**Artificial stones** – artificial crystalline products with no known natural counterparts.

**Imitations** – artificial products that imitate the appearance of precious stones, gemstones, ornamental stones or organic substances without having their chemical composition and/or their physical properties and/or their structure.

Many important natural gemstones (such as ruby, sapphire, spinel, and emerald and other beryls) have man-made counterparts that are manufactured in a laboratory. Such materials are called synthetic because they have virtually the same chemical, physical and optical characteristics as their natural counterparts. While synthetic products are not covered in this Retailers’ Reference Guide, it is important to follow CIBJO’s nomenclature when discussing, selling or buying such materials.

For more information about CIBJO standards and rules regarding treatments, artificial and imitation products, or synthetic stones, please download a free pdf copy of CIBJO’s Coloured Gemstone Bluebook here: [www.cibjo.org](http://www.cibjo.org)
### Key facts: Cultured pearls

<table>
<thead>
<tr>
<th>Types of pearls</th>
<th>Varieties of cultured pearls</th>
</tr>
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<tbody>
<tr>
<td><strong>Natural pearls</strong> are pearls accidentally formed in the interior of a mollusc without human intervention.</td>
<td></td>
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<tr>
<td><strong>Cultured pearls</strong> are formed within molluscs with human intervention. This intervention should only instigate the formation of the nacre – the substance normally produced by the various “pearl oysters” for the formation of both the shell and pearls.</td>
<td></td>
</tr>
<tr>
<td><strong>Imitation pearls</strong> are artificial products not formed in molluscs but manufactured by imitating the appearance, colour and other features of natural or cultured pearls. This is irrespective of whether physical or chemical properties are the same as natural and/or cultured pearls.</td>
<td></td>
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| Akoya cultured pearls are cultured in Japan, China and Vietnam using Akoya oysters (Pinctada fucata (martensi)). Compared with other “pearl oysters”, the Akoya oyster is rather small; hence the size of pearl produced is less than 10mm. The most popular sizes are 6 and 7mm |
| Silver/Gold-lipped cultured pearls are cultured in Australia, Indonesia and Philippines using Silver/Gold-lipped pearl oysters (Pinctada maxima). Australia produces large sized high quality pearls over 10mm while in Indonesia smaller sized pearls of below 10mm are also produced. The Philippines produce many golden pearls using Gold-lipped oyster. |
| Black-lipped cultured pearls are cultured mainly in French Polynesia using Black-lipped pearl oyster (Pinctada margaritifera). They appear in the markets under the trade term of “Tahiti cultured pearl”. Common size is over 10mm, but recently smaller-sized pearls have been increasing. In addition to common natural grey or black colour, there is a wide variety of shades from purplish to greenish. |
| Freshwater cultured pearls are cultured in China, Japan and United States. Most are non-beaded cultured pearl. Chinese pearls cultured with “Triangle mussel” (Hyriopsis cumingii) are dominant. By improving the culturing technique, large, round and smooth-surfaced cultured pearls are produced. There is a wide variety of colours the three usual being white, orange and purple. |
### Cultured pearl quality factors

#### Size
Sizes of cultured pearls are measured in millimeters (mm). Size range is dependent on pearl producing oyster species.
- Akoya cultured pearl: 2-10mm
- Silver/Gold-lipped and Black-lipped cultured pearl: 8-16mm
- Freshwater cultured pearl: 2-13mm

#### Shape
Perfectly round is highly valued. Shapes are divided into: round, semi-round, oval, drop, button, and semi-baroque.

#### Nacre thickness
Degree of nacre coating of the beaded cultured pearls. It has some impact of their colour, luster and durability. X-rays are used to measure nacre thickness and assist in observing nacre quality.

#### Surface condition
The surface of a cultured pearl is examined in terms of the number, size, kind and location of the imperfections. In evaluating the surface of cultured pearls, imperfections are taken into account – whether the pearl has a clean surface, one spot or many spots.

### Lustre
Lustre is defined by the quality of the reflected light. A lustrous pearl has a strong bright and sharp reflection. A low lustre pearl is not bright and its reflection is dull. The lustre of a pearl may be closely related to the homogeneity, light transmittance and thickness of the nacre.

### Colour
A pearl’s colour contains three basic components, hue, tone and saturation. Colour characteristics differ according to the mollusc species.
- **Akoya cultured pearl:** Pink, green pink, silver pink, cream pink, white, green, cream, gold.
- **Silver/Gold-lipped cultured pearl:** Silver, silver pink, pink, grey, cream, yellow, golden, white.
- **Black-lipped cultured pearl:** Black, green, brown, blue, peacock, red.
- **Freshwater cultured pearl:** Three basic colours (orange, purple, white)

### Pearl treatments
Any action by man that alters the appearance of a pearl or cultured pearl is considered to be a treatment.
- Treatments that do not need to be declared: drilling, polishing, buffing, peeling and cleaning.
- Treatments that must be declared: bleaching, coating, cutting, dyeing (tinting), filling, heating, irradiation, oiling, waxing and working.

### More information
For more information about CIBJO standards and rules regarding treatments, please download a free pdf copy of CIBJO’s Pearl Bluebook here: [www.cibjo.org](http://www.cibjo.org)
Key facts: Precious metals

- A precious metal is a rare metallic chemical element which is of high economic value.
- The best known precious metals are silver, gold and the platinum group.
- Assaying is the process of measuring the metallurgical content of gold, silver or platinum in precious metals. There are numerous methods which can be used and the choice usually depends on how accurate the measurement needs to be as well as the cost.
- Assaying will usually be carried out by an assay office in order to determine if the purity is equal or better than that claimed by the maker. Once an assay office has determined the purity, they will stamp a hallmark on the item to certify it.

<table>
<thead>
<tr>
<th></th>
<th>Gold</th>
<th>Silver</th>
<th>Platinum</th>
<th>Palladium</th>
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<tr>
<td></td>
<td><strong>Gold</strong> is a rare metallic element. Its chemical symbol, Au, is short for the Latin word for gold, “Aurum”, which literally means “Glowing Dawn”. Pure gold has a bright yellow colour and is one of only two coloured metal elements, the other being copper. All other metals are silver or grey. White golds are gold alloys that look white rather than yellow. The white colour is achieved by careful choice of the alloying metals, which bleach the deep yellow of pure gold.</td>
<td><strong>Silver</strong> is a soft, white, lustrous transition metal and is used in currency, ornaments and jewellery. It has the highest electrical and thermal conductivity for a metal. Sterling silver is an alloy of silver containing 92.5% pure silver and 7.5% other metals, usually copper. Britannia silver is an alternative hallmark-quality standard containing 95.8% silver, often used to make silver tableware and wrought plate.</td>
<td><strong>Platinum</strong> is an extremely rare, naturally white metal that is found in only a few places worldwide. It is an ideal jewellery metal on account of being ductile and durable giving the craftsman more scope for creating intricate and lasting jewellery. These qualities also ensure that gemstones are held securely. Similar to other precious metals, platinum is not scratch-proof. It does differ from them however in that when scratched no metal is lost, merely displaced, so a platinum piece will retain the same metal weight generations after purchase.</td>
<td><strong>Palladium</strong> is one of the platinum group metals but is considered a precious metal in its own right. It is naturally white, which means there is no need for rhodium plating and as such it is a good alternative to 9Kt white gold. It is more precious than silver and lighter than platinum (nearly half the weight) so larger necklaces and bracelets can be made capable of bearing bigger gemstones with no gain in overall weight. For the same reason palladium is considered to be a good choice for earrings although unlike platinum it is not hypoallergenic.</td>
</tr>
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</table>
A hallmark, is a mark or series of marks struck on items made of precious metals – platinum, gold, silver and in some nations, palladium. Hallmarks are applied by an assay office and they guarantee a certain purity or fineness of the metal.

As a pre-requisite to official hallmarking, the maker or sponsor of a piece of jeweller must provide a responsibility mark and claim of fitness. The hallmarking by an assay office is to confirm this claim.

Hallmarking systems differ from country to country. The Vienna Convention of 1973 was an attempt to standardise the legislation on the inspection of precious metals and to facilitate international trade.

Articles which are assayed and found to be in conformity by the qualifying office of a signatory country receive a mark, known as the Common Control Mark.

The countries that have signed up to the Vienna Convention have done so to facilitate international trade in precious metals. It does not mean they have compulsory hallmarking in their domestic market. Some have compulsory hallmarking, such as the Czech Republic, Ireland, Netherlands, Poland, Switzerland and UK, while others have a voluntary system allowing jewellery to be sold either with or without hallmarks, for example Austria, Denmark, Finland and Sweden.
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27 Treatments

The information in the following chapter was provided by the CIBJO Diamond Commission with images provided by DeBeers and HRD.
Natural diamonds can be as old as 3.3 billion years and have always been a gemstone associated with mystery, myth and magic. From the earliest civilisations, diamonds have been prized possessions. Their rarity, and the immense skill required to release their extraordinary brilliance, makes them unlike any other jewel. Worn by people as potent symbols of love, devotion, pride, wealth and power – they convey a variety of emotions.

**Origin of diamonds**

Thought to have been created in the earth’s upper mantle 150-200 kilometres below the earth’s surface and under tremendous heat and pressure, diamonds were carried to the planet’s surface by volcanic forces so violent we know nothing like it today. They then had to endure nature’s wrath over countless millennia.

There are two main types of diamond deposits:

- **Primary deposits**: These are diamondiferous pipes which are bodies of solidified Kimberlite or Lamproite. It is interesting to note that diamonds do not form in these volcanic bodies but are merely transported to the surface in them.

- **Secondary deposits**: These are deposits that contain diamonds which have weather worn out of the host body and then travelled some distance from their original source. For example, the diamonds that are now found in Namibia have travelled over 1,500 kilometres from their original source in southern Africa.

Diamonds are mined in over 20 countries around the world and they can be found in remote deserts, frozen tundra and even ocean beds. However, main production comes from Botswana, Russia, South Africa, Canada and Australia.

Diamond mining methods include open-cast mining, alluvial, underground mining and marine mining. In general terms, only about 20% of the volumes of all diamonds mined are good enough quality to be used for jewellery. Every pipe in the world produces different qualities and quantities but generally even a profitable mine removes over one tonne of host rock to produce one carat of gem quality diamonds.
Properties of diamond

Diamond is a unique mineral. It possesses certain physical and optical properties that make it special not only in jewellery but also for industrial applications. It is a crystalline material composed of pure carbon. It grows in the cubic crystal system with a refractive index of 2.417, specific gravity of 3.52, dispersion of 0.044 and hardness of 10 on the Mohs scale (see right).

Durability

Durability is a gemstone’s ability to withstand wear, heat, impact and chemicals. Durability is broken down into three categories hardness, toughness and stability.

Hardness: Hardness of a material is related to its resistance to scratching or its response to a sharp point being dragged across its surface. Diamond is generally recognised as the hardest substance known to man. The hardness of a diamond varies slightly in different directions. Polishers rely on directional hardness in diamond in order to use diamond to polish a diamond.

Toughness: Diamond is not a tough stone. Toughness is the resistance to breaking, chipping or cracking when impacted with a blow. Diamond can chip and sometimes if hit just right will actually cleave along a flat planar surface. Most chips on a diamond will occur around the girdle or edge. Jade is actually a lot tougher than diamond but not anywhere near as hard.

Stability: Diamond will burn at around 750°C which can be reached with a jeweller’s torch. A diamond that has just had the surface burned will be hazy looking and will need to be re-polished to remove the burnt surface. The more dangerous situation for a diamond is thermal shock or the sudden change in extreme temperatures. Diamond can fracture or have inclusions extended from thermal shock.

Mohs scale

<table>
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<tr>
<th>Mineral</th>
<th>Hardness</th>
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<tr>
<td>Diamond</td>
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<tr>
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<tr>
<td>Topaz</td>
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<tr>
<td>Quartz</td>
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<tr>
<td>Orthoclase feldspar</td>
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<td>Apatite</td>
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<tr>
<td>Fluorite</td>
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</tr>
<tr>
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</tr>
<tr>
<td>Gypsum</td>
<td>2</td>
</tr>
<tr>
<td>Talc</td>
<td>1</td>
</tr>
</tbody>
</table>

The Mohs scale was developed in 1822 by Friedrich Mohs, and has been used to assess hardness for over 150 years. There are ten minerals in this series. Diamond is the hardest mineral, it is at the top of the scale. However, this is not a linear scale but merely an order as every mineral in the scale will scratch all minerals below it. For example, there is very little difference in hardness between talc and gypsum, but an enormous difference between corundum and diamond.
Classifying diamonds into types

Diamonds can be classified into two basic types and then subdivided into seven sub-categories.

The two basic types are Type I and Type II.

**Type I** diamonds contain appreciable levels of nitrogen as an impurity incorporated within the (crystal) atomic structure. These are known as impurities, as opposed to “inclusions”, which are merely enclosed within the stone but not actually incorporated into its molecular structure.

**Type II** diamonds contain virtually no nitrogen. However, there is a continuum of nitrogen concentrations from zero to over 1%, so a stone may show “mixed” or intermediate characteristics. Type II diamonds are the type of diamond that can typically be treated by HPHT (see page 29) to change their body colour.
When extracted from the ground, diamonds often display characteristic crystal surfaces with high lustre or a frosted appearance. It is the skill and experience of a diamond cutter that will bring the beauty out of a stone.

The images to the right show just a few of the varied shapes a rough diamond comes in.

In trying to get the best quality and biggest size from a rough diamond, the cutter must strike a balance between loss of weight and the ideal proportions for beauty and economic profit.
From rough to polished

PROCESSES

A variety of processes or steps are required to take a rough diamond and bring it through to a polished stone suitable for use in jewellery. Basically these are:

- **Design and marking** – entails accurate marking and estimating optimal outcomes from the rough crystal.

- **Cleaving** – is splitting a diamond along its natural crystal grain. This is rarely done today as it is risky although it can be faster and cheaper.

- **Sawing** – is the main choice for dividing rough diamonds. There is traditional sawing with a very thin blade and diamond paste and there is also laser sawing. Laser sawing, while more expensive, is the method of choice for tricky rough and more expensive crystals because of the lower risk of damage, and the possibility to saw in any crystal direction.

- **Bruting** – shaping the original outline of the rough crystal and to prepare the girdle.

- **Blocking and brillianteering** – faceting of the rough diamond. Blocking is the initial step in faceting. It determines the shape, weight and symmetry. Brillianteering is the act of placing the final facets on the blocked diamond.

- **Polishing** – or finishing is the sequence in the process of putting on the final polish, raising the lustre (reflectivity) to the maximum level for a diamond.
The 4 Cs

Around the world customers, diamontaires and retailers discuss diamonds in terms of the 4 Cs: Carat, Cut, Colour and Clarity. The 4 Cs provide a precise and systematic language that enables everyone to compare and value diamonds.

A diamond’s value is based on the combination of all of the 4 Cs. Each of the 4 Cs has a range of possible outcomes and only rarely will you find a diamond that is graded as the most desirable in each of the 4 Cs. Rarity and value are directly related, so the rarer the characteristic the more valuable the diamond.

In basic terms the best in each of the 4Cs will yield the highest value diamond. The final value of a diamond is like a perfectly balanced old fashioned weight scale, with value on one side and the 4 Cs on the other. Changing any one of the 4 Cs on one side of the scale means you must change the value in order to balance the scale again. For instance if your customer decides they want to buy a bigger diamond than they were originally offered then they will have to pay more or they can choose to lower one or more of the remaining 3 Cs to balance the scale.

It is important to remember that while each diamond can be described by its own special combination of the 4 Cs, its observed beauty is usually much more than just a list of characteristics.
Carat

Carat is often used to refer to a diamond’s size, but it is actually a metric measure of weight. It is often abbreviated as “ct”. One carat (equivalent to 200 milligrams) can also be divided into 100 “points”. The “points” do not refer to facet junctions, only to the diamond’s total weight. A 0.75 carat diamond may also be described as a ¾ carat diamond or 75 points. The term “point” or “pointers” is only used for diamonds weighing less than 1 carat. For anything over a carat then the rules change a little. A 1.08-ct diamond may be called either a “one point eight carat” diamond or a “one point zero eight carat” diamond. In the wholesale trade there is also a term of a “grainer”. A one grainer diamond equals approximately one quarter of a carat so then a five grainer is approximately a 1.25 carat diamond.

Diamonds are weighed to the thousandth of a carat (0.001 carats) then for final sale or certification rounded to the hundredth of a carat. Each country has specific regulations for rounding up or down to the next hundredth of a carat. Many countries only allow rounding up to the next carat when the last thousandth decimal place is a 9, then 1.299 carats could be rounded up to 1.30 carats.

Do not confuse the term carat with karat. As you have read the term carat is a metric weight for gemstones, while karat is a measure of the purity or fineness of gold. (see Precious Metals section of Retailers’ Reference Guide).

Larger diamonds are found less frequently in nature, therefore they are rarer and so they can command a significantly higher price compared to equal quality smaller diamonds. For instance, a one carat diamond will cost more than two ½ carat diamonds of equal colour, clarity and cut.

<table>
<thead>
<tr>
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</tr>
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<tr>
<td>0.75 CTS</td>
<td>75 points</td>
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<td>1 carat</td>
</tr>
<tr>
<td>1.25 CTS</td>
<td>1.25 carat</td>
</tr>
<tr>
<td>1.50 CTS</td>
<td>1.5 carat</td>
</tr>
</tbody>
</table>

Guide to approximate carat size
Cut is the C that is most affected by the skill and expertise of the markers, cutters and polishers. The proper cut will ultimately unlock the true beauty of a rough diamond and also reveal its maximum economic potential.

A well cut diamond is a special balance between three important factors — brilliance, dispersion and scintillation. Brilliance is the return of white light to the viewer’s eyes from the internal and external surfaces of a diamond. Dispersion or as it is more commonly known “fire” are the flashes of spectral colours that come from a diamond. Scintillation is the sparkle or flashes of light you see as the diamond or light source moves.

The cut of diamond at the most basic level refers to a diamond’s shape outline such as round, pear, heart, etc. It can also refer to the style of faceting such as brilliant, step cut or mixed cut or it can also refer to a combination of both shape and faceting like emerald cut or princess. On a higher level a professional diamond grader will refer to a diamond’s cut it terms of proportions, symmetry and finish.

Light performance and ideal

The concept of an ideal cut diamond is not new as diamond manufacturers have been striving for perfection since diamond cutting began. The goal is to achieve the perfect balance of brilliance, fire and scintillation in a polished diamond or the “ideal” cut.

Experts to this day do not agree on one single set of cutting parameters for the ultimate title of “ideal” for all but they do agree that there is a range of parameters that do produce the most pleasing looking diamond. With the current availability of electronic light performance measuring equipment and scientific analysis the data collected has become astounding.

One point all experts agree on is that cutting to these exacting standards does lose the most amount from the rough and that the cutting costs are higher. So as you can imagine you should expect to pay more for an “ideal” cut of any brand.

Shapes

The most common shapes in the market today are asscher, cushion, round, emerald, heart, marquise, pear, princess, oval, round and trillion (see following pages). There are also many modified shapes and novelty cuts some of which are patented. More likely though you will hear of trademarked, copyrighted or “branded cuts” which have been developed by individual companies. A branded cut will have something unusual or a parameter that is different than the standard cut. Shapes other than round are referred to as fancy shapes.
Cut

COMMON CUTTING STYLES

Asscher  Cushion  Emerald  Heart  Marquise

[Images of diamond cuts for each style]
Common Cutting Styles

Pear | Princess | Oval | Round | Trillion
---|---|---|---|---
![Pear Cut](image1.png) | ![Princess Cut](image2.png) | ![Oval Cut](image3.png) | ![Round Cut](image4.png) | ![Trillion Cut](image5.png)

Cut styles for diamonds include Pear, Princess, Oval, Round, and Trillion. Each has its distinct shape and features, impacting the diamond's appearance and value.
A brilliant cut is a general term used for diamonds that are cut with triangular or kite shaped facets. A facet is a flat planar surface cut and polished on the surface of the diamond. For brilliant cut the facets start at a central point and radiate towards the edge or girdle. The most popular of all the diamonds is a round brilliant with 57 or 58 facets which in smaller sizes may be referred to as a full cut. A single cut diamond has 17 or 18 facets and is typically under 0.03 carats in weight.

A step cut is a term used for a diamond with long narrow trapezoidal facets usually arranged in three rows parallel to the girdle. A good example of this is the emerald cut diamond with a rectangular shape outline and bevelled corners. A baguette cut is step cut as well. It can be straight or tapered with fewer parallel rows than the emerald cut and sharp corners. It is often smaller in size and used en masse or as side stones.

Mixed cut diamonds have a combination of both step cut and brilliant cut facets. The two different styles of faceting are arranged so one is either on the top which is known as the crown or on the bottom which is known as the pavilion of the diamond.

Proportions, symmetry and finish

Proportions – refer to the dimensions and angles of the main parts of the diamond.

Symmetry – is the exactness of the balance and symmetry of the diamond’s shape and faceting.

Finish – this is sometimes referred to as polish, it is a measure of the quality of the diamond’s polished surfaces and edges.
The rating of a diamond’s overall cut grade or make is one of the more complex assessments in the diamond trade. Previously overall make was an individual assessment of proportions and finish (polish and symmetry).

Now many laboratories issue overall cut grades on their reports which are based on a combination of several factors not just by measured parameters, but also visual observations. The GIA and AGS both have overall cut grades available on their reports. Both use a deductive system in which a diamonds cumulative cut grade is determined by a combination of the diamond’s proportions, polish and symmetry.

The most commonly used cut quality grading system is for standard round brilliant cut diamonds in D-Z colours only and 0.15cts and larger.

The GIA uses word terms Excellent, Very good, Good, Fair and Poor. The AGS uses the number system from 0 to 10 with 0 being the best. All systems suggest a final grade based on their own research that indicates the degree of acceptability to the consumer.

**Background**

A polished diamond’s beauty lies in its complex relationship with light: how light strikes the surface, how much enters the diamond, and how, and in what form light returns to your eye.

The face up appearance or light performance is a display of three attributes.

1. **Brightness** is the result of all internal and external reflections of white light.
2. **Fire** which results when white light is dispersed into its spectral colours.
3. **Scintillation** describes the sparkle of light you see in a diamond, and the overall pattern of bright and dark areas when you look at a diamond face-up.

Proportions are a measured parameter that are an important determinate in a diamonds cut quality grade but they are not the sole determinate. Proportions do affect a diamonds light performance, which in turn affects its beauty and overall appeal. Diamonds with better proportions optimize the interaction with light, and generally have better brilliance, fire, and scintillation.

Other considerations in a diamonds overall cut quality grade are a combination of the diamond’s design, proportions and finish (polish and symmetry).
As we talk about a diamond’s colour we can talk about two different aspects. When most people talk about a diamond’s colour they are actually referring to colourless or near colourless diamonds. Colourless or near colourless diamonds remain the most available and the most popular with consumers. However, what most consumers are unaware of is that diamonds are found in almost every colour. Diamonds occur – albeit rarely – in red, blue, green and all other colours of the rainbow (see Fancy colours, page 17).

**Colourless and near colourless**

There are several colour grading systems being used in the jewellery trade today. All of the systems work on the same principle of comparing an unknown sample to a known sample or master stone. In conjunction with human graders most large laboratories are now using scientific colour grading instruments to determine the colour grade of a diamond. Colour is considered a range from colourless to light yellow or brown.

The most prevalent systems use a letter grade, a word term or a number to designate the final colour. The stones are viewed with controlled lighting, upside down in a colour tray because face up the true body colour may be masked by the cut.

The most widely used of all the existing systems is the one used by the Gemmological Institute of America (GIA). It has over 20 subtle grades of colour, identified in alphabetical order from D-Z. The American Gem Society uses a number system from 0.00 to 10.00. CIBJO uses eight word terms ranging from Exceptional White to Tinted Colour.

For the tinted colour category (GIA M-Z) the diamonds are accurately described by colour terms like Yellowish to Yellow and Brownish to Brown. Those at the upper end of the scale (closer to D) will be more expensive, as they are rarer.

There are other grading systems used by laboratories around the world.
## Colour

### COLOUR GRADING SCALES

<table>
<thead>
<tr>
<th>Colour</th>
<th>GIA</th>
<th>CIBJO / IDC</th>
<th>Scan. D.N.</th>
<th>AGS</th>
<th>GIA</th>
</tr>
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<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>D</td>
<td>Exceptional White +</td>
<td>River</td>
<td>0</td>
<td>D</td>
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<tr>
<td></td>
<td>F</td>
<td>Rare White +</td>
<td>Top Wesselton</td>
<td>2</td>
<td>F</td>
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<tr>
<td>Near colourless</td>
<td>G</td>
<td>Rare White</td>
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<td>3</td>
<td>G</td>
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<tr>
<td></td>
<td>H</td>
<td>White</td>
<td>Wesselton</td>
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<td>H</td>
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<tr>
<td></td>
<td>I</td>
<td>Slightly Tinted White</td>
<td>Top Crystal</td>
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<td></td>
<td>J</td>
<td>Tinted White</td>
<td>Crystal</td>
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<td></td>
<td>Z</td>
<td></td>
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</tr>
</tbody>
</table>

Visual colour grading of polished diamonds

1. CIBJO Rules (1991) permit combining the Exceptional White and Rare White divisions into one level each for stones under 0.47ct.
2. Traditional terms; Scan.D.N. (1979) also allows use of two alternate sets of descriptive terms.
Colour

FANCY COLOURS

The D-Z colour grades mainly apply to yellow and brown-tinged stones. If these colours are intense (Z+) in a diamond, they are referred to as “fancy-coloured”. For other colours such as blue, pink, red, green, etc., the colour does not need to be intense to be considered fancy as these colours are rare and highly prized.

For fancy colour diamonds, the market value is determined almost exclusively by the intensity of the colour, which can in some diamonds significantly outweigh the effects of lower clarity and of a poor make.

The term “fancy” covers a wide range of colours: the range within fancy yellow is approximately three times greater than the range of colours between D and Z on the normal colour scale. Therefore, some modifications were made to the fancy colour descriptions in 1995. The term “fancy” was expanded to include Fancy Light, Fancy, Fancy Intense, Fancy Dark, Fancy Deep and Fancy Vivid. In colours other than yellow and brown, the grading system also has the following categories: Faint, Very Light and Light.
Colour

**Cause of colour in diamonds**

A diamond crystal is colourless. Any colour found in a diamond is caused by impurities within its crystal lattice structure or damage to the lattice.

Impurities within a diamond absorb light and the result is a coloured stone. When small amounts of impurities, such as nitrogen, boron or hydrogen, on an atomic scale, enter the lattice of carbon atoms, replacing some of them, the colour of the stone may dramatically change. For instance, nitrogen impurities will result in yellow hues and boron impurities will result in blue hues in a diamond.

In some brown, pink or reddish colour hues internal lattice defects can be the cause. The natural green colour seen in diamonds is in most cases the result of a natural irradiation by radioactive minerals or due to radioactive ground waters in secondary deposits. Such natural diamonds are completely safe to wear.

A black diamond of natural colouration owes its colour to the presence of black inclusions (usually sulphides) or graphitised fractures.

**Ultraviolet fluorescence**

Diamonds sometimes show a fluorescent reaction or glow under a UV source of light. Diamonds can fluoresce many colours but the most typical colour is blue. Fluorescence is graded on a scale of none to strong.

Strong and very strong fluorescence may have an impact on the perceived colour of a diamond. A diamond with strong or very strong fluorescence may show an oily appearance under daylight (or UV) conditions. This will make a yellowish stone appear to be more colourless than it really is. Therefore, fluorescence can improve the perceived colour in stones with a yellow tinge. For higher colour stones (D-I) very strong fluorescence can affect the value negatively as the oily look is a distraction.
Clarity

Clarity is one of the Cs that your customer is most familiar with. It is tangible and visual so besides carat it is the easiest one of the 4Cs to show. Clarity grading has a certain level of subjectivity to it as no two stones are alike. A professional will view the diamond at 10 power (10x) magnification in a controlled environment and arrive at a conclusion of the clarity grade based on systematically examining the diamond for clarity characteristics.

Clarity characteristics include a wide range of features but they are generally broken down into two basic categories.

**Blemishes** – include surface features like scratches and nicks. Sometimes these can be easily removed by re-polishing.

**Inclusions** – include internal features like feathers and crystals (see images on page 19). These have an impact on the final clarity grade and are not easily removed.

Clarity grading is the art and science of assessing the visibility and effects of a diamond’s blemishes and inclusions. A professional will view each diamond for clarity grading with four simple words in his mind, size, nature, location and number. The grader will then assess the overall impact and visibility of both the inclusions and blemishes. Each of these is considered carefully in combination with each other before arriving at the final clarity grade.

**Size** – The larger the inclusion the lower the grade. Very large inclusions can be dangerous to the durability of the diamond as well.

**Nature** – Internal clarity characteristics generally affect the grade more than external characteristics. Highly contrasted inclusions are less desirable.

**Location** – Inclusions centrally located, especially under the table, are more visible than those near the edge or under a bezel facet. A cleavage near the surface is more dangerous than one that is completely enclosed in the stone.

**Number** – Generally, the more inclusions there are, the lower the clarity grade. This is carefully considered in tandem with the size, nature and location of the inclusions.

Clarity characteristics may be thought of as a negative but they can be a positive too. Most natural diamond inclusions help gemologists separate diamond from its imitators and they can also help in identifying the same diamond later on if a plot of the inclusions was done.
Clarity

EXAMPLES OF INCLUSIONS

An example of a crystal inclusion

An example of a feather inclusion
Clarity grading is a visual process, however there are several systems that use word terms to help us arrive at the appropriate clarity grade. The most widely used of all the existing systems is the one used by the Gemological Institute of America (GIA). It has 11 clarity grades; they are from Flawless to Included 3. The American Gem Society uses a number system from 0 to 10. CIBJO uses word terms Loupe Clean to Piqué 3. Those at the upper end of the scale (closer to flawless) will be more expensive, as they are rarer. For more grading terms details see the following page.

Find below basic word terms for the GIA Clarity grades. These are meant as a very general guideline only.

**FL** – Flawless – Free from all inclusions or blemishes at 10x magnification.

**IF** – Internally Flawless – No inclusions visible at 10x but will have insignificant surface blemishes only.

**VVS₁** – Very Very Slightly Included 1 – Minute inclusions that are extremely difficult to see at 10x.

**VVS₂** – Very Very Slightly Included 2 – Minute inclusions that are very difficult to see at 10x.

**VS₁** – Very Slightly Included 1 – Minor inclusions that are difficult to see face up at 10x.

**VS₂** – Very Slightly Included 2 – Minor inclusions that are somewhat easy to see face up at 10x.

**SI₁** – Slightly Included 1 – Noticeable inclusions that are easy to see at 10x.

**SI₂** – Slightly Included 2 – Noticeable inclusions that are very easy to see at 10x. They may also be barely eye visible in larger stones or in smaller stones through the pavilion.

**I₁** – Included 1 – Obvious inclusions at 10x and visible to the unaided eye.

**I₂** – Included 2 – Obvious inclusions at 10x and easily visible to the unaided eye and they may pose a durability issue.

**I₃** – Included 3 – Prominent inclusions that are extremely easy to see with the unaided eye and usually will affect the durability.

**Note:** There exists in the jewellery trade an SI₃ grade. It is intended to bridge the large gap in value and grading between SI₂ and I₁. It is not used by GIA, AGS or CIBJO.
# Clarity

## GRADING SCALES

<table>
<thead>
<tr>
<th>GIA</th>
<th>CIBJO / IDC</th>
<th>Scan. D.N.</th>
<th>AGS</th>
</tr>
</thead>
<tbody>
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<td>FL</td>
<td>LC</td>
<td>FL</td>
<td>0</td>
</tr>
<tr>
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<td>IF</td>
<td>IF</td>
<td>1</td>
</tr>
<tr>
<td>VVS₁</td>
<td>VVS₁</td>
<td>VVS₁</td>
<td>2</td>
</tr>
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<td>VVS₂</td>
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<td>3</td>
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<tr>
<td>I₃</td>
<td>P₃</td>
<td>P₃</td>
<td></td>
</tr>
</tbody>
</table>

**Key:**

- **LC** Loupe clean
- **F** Flawless
- **IF** Internally flawless
- **VVS** Very, very slightly included (very, very small inclusions)
- **VS** Very slightly included (very small inclusions)
- **SI** Slightly included (small inclusions)
- **I** Included
- **P** Piqué
Certification of diamonds

Diamond grading certificates have become a very large part of the jewellery business. This is because the average consumer is unable to evaluate a diamond’s characteristics.

Legitimate certificates play a very important role in accurately recording the nature and quality of a diamond which in turn gives the consumer confidence in what they are purchasing. Not every diamond, however, has a certificate and not all certificates are equal. Whether a stone gets certified is a matter of value and sometimes and internal company policy.

Large, very low quality stones and smaller stones are usually not certificated because of the cost involved, although even this is changing. Prices for a certificate vary depending upon its type, the issuing laboratory and the weight of the stone. Each retailer will have to establish which certificates are trustworthy and reliable for their own purposes. Remember the certificate you use to sell a diamond will reflect on your store too. Consult your local jewellers association or CIBJO for who has the ethics and level of professionalism that you need for your store.
"Synthetic diamonds" refers to diamonds that are manufactured by man. Synthetic diamonds are not a new product as they have been around since the 1950s in industrial quality and in commercial jewellery quantities and qualities since the 1990s. They have essentially the same chemical composition, physical and optical properties. Synthetic diamonds should not be confused with other diamond imitations and simulants (see Diamond simulants section, page 24).

Some synthetic diamonds provide gemologists with easy to understand tell-tale signs of their non-natural origin. However most synthetic diamonds will require sophisticated laboratory equipment in order to positively identify their origin. There are two types of jewellery quality synthetic diamonds on the market, HPHT and CVD.

**HPHT**
HPHT stands for High Pressure High Temperature diamond synthesis and is a complex and costly procedure. In this well-established technique, graphite or diamond powder is mixed with a solvent-catalyst such as nickel or cobalt and subjected to high pressure (60kb) and high pressure (1400°C) for periods of hours or days. Most of these synthetic diamonds are produced for the jewellery market in hues of yellow, orange, pink, black and blue. HPHT synthetics now account for most of the synthetic diamonds on the market.

**CVD**
Scientists can also produce diamond from the plasma phase using a technique called Chemical Vapour Deposition (CVD) or thin film synthesis. This method when used for gem size synthetic diamonds is a very complex and costly procedure as well. This was first achieved in 1952, and the method is now capable of producing both single-crystal and polycrystalline diamond. These jewellery-quality synthetic diamonds are generally brownish upon completion and then HPHT treated in order to attain a colourless to near colourless synthetic diamond. Colourless CVD synthetic diamonds are more difficult to identify compared to most HPHT synthetic diamonds, however they are also not currently available in larger quantities in the jewellery market.

For more information about CIBJO standards and rules regarding diamond treatments, simulants and synthetics please download a free pdf copy of the CIBJO Diamond Bluebook: [www.cibjo.org](http://www.cibjo.org)
Diamond simulants

Diamonds are rare and valuable gems. This has inspired people to search for, or create, materials that look and feel like diamond, but which are less expensive. In order to be a plausible substitute for diamond, a simulant needs to have a high brilliance, a high degree of hardness and an almost total lack of colour.

A diamond simulant is any product produced to resemble a diamond. These products may be similar in appearance to a diamond, but have different chemical or physical properties. Synthetic Moissanite and Cubic Zirconia are examples of products which may be sold as simulants.

A diamond simulant does not have the same chemical, physical, or optical properties so cannot be called synthetic diamonds (see page 23). In recent years, important advances have been made in the production of simulants. It used to be easy to identify simulants because they lacked a diamond’s special fire and brilliance but, in some cases, identification is now becoming more challenging.

**Colourless glass**
Since Egyptian times, glass has been used as a simulant. The best imitations are made from glass containing a high proportion of lead oxide, as this has high fire and brilliance. Diamanté, paste (from pâte de verre), Strass and rhinestone are other names for glass imitations.

**Colourless topaz**
Natural colourless topaz was used for many years as a diamond substitute. The inclusions found in topaz differ from those seen in diamond. Rough crystals have often misled people into thinking they were diamonds, because they are relatively dense and hard, and are sometimes found in alluvial deposits. Colourless topaz does not have enough dispersion to be truly convincing as a diamond simulant, although it can make a bright stone.

**Colourless zircon**
This is a natural gemstone and has a pleasant fire and brilliance. Because of its high double refraction, it can have a ‘fuzzy’ appearance; you can see the double images of the facets as you look through the stone. Zircon also pits at the same facet junctions very easily. Do not confuse zircon with Cubic Zirconia (CZ) (see page 25).

**Natural and synthetic white sapphire**
These have been occasionally used as a diamond simulant. Natural colourless white sapphire is currently sold as a natural substitute for diamond. Both natural and synthetic colourless white sapphires do not have enough dispersion to be truly convincing as a diamond simulant but are very decent wearing stones for everyday use.
Diamond simulants

**Strontium Titanate**

This diamond imitation is an artificial product that has no natural counterpart, it has almost the same refractive index as diamond but over four times the fire. To the trained eye, it looks far too 'colourful' to be a diamond.

**YAG (Yttrium-Aluminium Garnet) and GGG (Gadolinium Gallium Garnet)**

These artificial products, which have no natural counterpart and hail from the 1960s and 1970s. They were very popular in their day as they closely resembled the appearance of diamond. In 1972, at the peak of YAG production, 40 million carats were produced. Production of both has now virtually ceased as it has been superseded by the better imitation CZ.

**Cubic Zirconia**

Cubic Zirconia (CZ) was introduced in the mid-1970s and is still one of the most effective imitators of diamond. It virtually halted production of the other colourless imitators. It has a hardness on the Mohs scale of 7.5-8.5 which allows it to have a high-quality polish and sharp facets. It is manufactured in very large quantities today. It has a high refractive index compared to other imitations and it is inexpensive to manufacture, making it the most popular diamond simulant on the market. It has slightly too much dispersion to the trained eye to be a diamond, but when cut properly it is convincing, particularly in smaller sizes. When examined with a 10x loupe, however, it cannot match the surface flatness, lustre and sharp facet edges of a diamond.

**Moissanite**

Moissanite was named after Dr Henri Moissan, who discovered this very rare mineral in 1893. The Mohs hardness of moissanite is above 9, making it the hardest mineral after diamond. Moissanite used in jewellery is a manufactured gem and is well recognised as a diamond simulant. Although it is more expensive than Cubic Zirconia, its optical properties (refractive index and dispersion) are actually higher than those of diamond, making it an extremely brilliant and colourless stone. Its hardness is the highest of all the simulants and so is very durable when worn in jewellery. Synthetic moissanite has a number of properties that make it easily distinguishable from diamond. For example slightly yellow body colour and double refraction.

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Some diamonds are created in nature with features that make them less desirable or valuable. This has led to the development of a variety of treatments to improve the face-up appearance of certain stones, by altering or disguising their clarity or colour.

Clarity treatments
Clarity treatments were developed in the 1970s and consist of laser drilling, fracture filling, or a combination of the two.

Laser drilling
In order to make an inclusion in a diamond far less visible to the unaided eye it is possible to use a laser to burn a channel between the piqué inclusion and the surface of the stone. Any part of the piqué not vaporised by the laser is then “bleached” with acid. A laser drilled diamond was once very easy to recognise as very small “tunnels” were reaching the surface, but now with the advances in lasering the identity of the laser “tunnel” can easily be disguised by irregular feathery looking holes. Laser drilling is a permanent, irreversible technique that is accepted by the trade, as long as it is disclosed.
Fracture filling

Developed in the 1980s and also known as "clarity enhancement", the process of fracture filling is to force a foreign liquid into surface-reaching feathers or cavities. The filler material is commonly a lead-based glass with a high refractive index. Any crack with filler material in it becomes much less visible and therefore improves the look of the diamond. Laser drill holes are sometimes filled.

Fracture filling is not regarded as being permanent, because the filler material may discolour with age or leak from the stone when being heated during jewellery repair. For day-to-day wear it is considered stable and durable.

The treatment can be detected under magnification, by looking for a colourful, reflective 'green-pink or purple-yellow' 'flash effect'.

Colour treatments

There are two basic types of colour treatment. The first type involves coating the surface of a diamond to disguise or alter its colour. The second involves actually altering the body colour of the diamond. Colour treatments are the oldest form of treatment, dating back to before the 16th century, and have normally, but not always, been used to make a poor stone more desirable.
Treatments

Surface treatment

'Foiling' of diamonds was quite common in the 18th and 19th centuries. It involves sticking highly reflective foils to the pavilion of a diamond and then mounting it in jewellery with a closed back.

Similar results to foiling can be obtained by 'painting' the pavilion or the girdle area of the stone. Felt pen, nail varnish and many other substances have been used.

To the trained eye, diamonds coloured with artificial coatings often “don’t look right”, because they have an unnatural-looking colour. Foils and coatings have a tendency to tarnish, rub off and/or discolour over time, and are detectable with the 10x loupe. If in good condition, antique foiled diamond jewellery can sometimes be a valuable collector’s item.

Body treatment: irradiation

To actually change the colour of a diamond, new colour-causing defects can be created artificially. A stone can be bombarded (i.e. irradiated) by either atomic or subatomic particles; these particles damage the diamond’s internal structure, which may change the colour. The colours created usually range from blue to green.

Longer exposure to irradiation causes the colour to become more intense. The colour can be further changed by heat treatment. By heat treating the irradiated stone fancy yellow, orange or pink diamonds, for example, can be created. Not all diamonds respond similarly to this treatment process. It is accepted in the trade only if it is properly disclosed.

Body treatment: High Pressure, High Temperature

The most recent and sophisticated development in diamond colour improvement is to treat brownish coloured diamonds to improve their colour. The colour change is to either colourless or fancy yellow/green depending on the starting material ('diamond type'). The stones are treated using the High Pressure, High Temperature process (HPHT), using presses similar to the ones used to produce synthetics. These treatments are irreversible and permanent. Their detection is difficult with simple visual inspection and must be tested by advanced laboratory equipment to reveal the HPHT treatment. HPHT treatments are accepted in the trade but only if they are properly disclosed. HPHT treatment of diamonds of different types will produce fancy colours.

For more information about CIBJO standards and rules regarding diamond treatments, simulants and synthetics please download a free pdf copy of the CIBJO Diamond Bluebook: www.cibjo.org
Gemstones
Retailers’ Reference Guide
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Alexandrite and other chrysoberyls

Appreciation for alexandrite and other chrysoberyls

Of all of the mineral species, chrysoberyl is the most phenomenal – in the sense that two of its three varieties possess unique optical characteristics we've come to know as phenomena. Alexandrites are the best-known variety of chrysoberyl, exhibiting chameleon-like colour-change characteristics. On rare occasions, these colour-change gems exhibit a second phenomenon, called cat's eye effect.

The colour change effect in alexandrites is caused by the selective absorption and transmission of light, which in turn is caused by the colour temperature of the light in which the gem is viewed. Alexandrites exhibit warm reddish hues in incandescent light and bluish-green hues in daylight. Alexandrites were discovered in Russia’s Ural Mountains in 1830, in deposits along the Takovaya River. The colour change gem was named after Czar Alexander II, who is said to have come of age the day the gem was discovered.

Additionally, the colour changes of alexandrite – primarily red to green – heralded the official colours of imperial Russia.

Among the most cherished gems that exhibit chatoyancy (an optical phenomenon in certain gems that causes the viewer to see a “floating” line through the gem) is the cat’s eye chrysoberyl, which appears to move as the gem or the light source is moved. This phenomenon is caused by inclusions; minute fibres of the mineral sillimanite that are oriented parallel to one another throughout the chrysoberyl. In gems that are properly oriented and cut en cabochon, this silvery, floating line appears when a strong or pinpointed light is directed in a direction perpendicular to the gem. Cat’s eyes are best viewed in direct light such as sunlight. An indistinct cat’s eye effect, observed as a broader sheen along the gem’s surface, is caused by a multitude of randomly oriented included needles – this effect is sometimes referred to as cymophane.

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Alexandrite and other chrysoberyls on the calendar

Alexandrite is an alternate gemstone for the month of June. Alexandrite is also a 55th anniversary gemstone.

Yellow to greenish chrysoberyls are the only non-phenomenal variety of chrysoberyl – but are the standard bearers for the name of the species. Chrysos is a Greek work meaning “golden,” and berilos (also Greek), form the root for the chrysoberyl name. It is worth noting that chrysoberyl is not a form of beryl, which is an entirely different species.
What chrysoberyl is

This species of gem is an aluminate of beryllium, with the chemical formula: BeAl₂O₄, which forms in the orthorhombic crystal system. Three main varieties comprise the species: golden chrysoberyl, alexandrite and cat’s eye chrysoberyl. Non-phenomenal chrysoberyl is transparent to semi-transparent, comprising a range of colours. The alexandrite variety contains gems that vary from transparent to semi-transparent, and whose colour appears different depending on the light it is viewed in. Here again, in the case of alexandrite and cat’s eye, a trained gemologist may easily separate them from other visually similar gems.

Colours:

- **Chrysoberyl (non-phenomenal):** Light to medium yellow to yellowish green, greyish green, brown to yellow-brown to light blue.
- **Alexandrite, daylight:** Yellowish or greyish green, brownish red to purplish red.
- **Alexandrite incandescent light:** Orangy or brownish red to purplish red.
- **Cat’s eye:** Yellow to yellowish green; greyish green; brown to brownish yellow.

Refractive Index: 1.746 to 1.755
Birefringence: 0.008 to 0.010
Specific Gravity: 3.73 (+/- 0.02)

Cause(s) of colour: Predominantly iron and chromium in chrysoberyls; Chromium in alexandrites and iron (and sometimes chromium in rare, cat’s eye alexandrites).

Hardness: 8.5 on the Mohs Hardness Scale.

Internal identifying characteristics: multi-phase inclusions, mica platelets, calcite, and pyrite inclusions in chrysoberyls and alexandrites. Silky fibres of sillimanite inclusions are found in cat’s eyes.

Chrysoberyl treatments

While chrysoberyls in general are never treated to enhance colour or diminish the appearance of inclusions, one well-known case of treated brown cat’s eye chrysoberyls exists. In the 1990s some parcels of dark brown cat’s eye chrysoberyls began appearing on the market. It was found that the material had been irradiated at a nuclear facility to deepen their brown colours. The material was also found to be highly radioactive and, because of that and the accompanying negative publicity, these cat’s eyes were soon removed from the market. Nevertheless it was cautioned that any deep brown cat’s eye chrysoberyls whose provenance could not be ascertained – be sent to a qualified lab for further testing and assurance.
Alexandrite and other chrysoberyls

Collector chrysoberyls

Alexandrites and cat’s eye chrysoberyls are quite rare to begin with and as such highly collectible due to their exotic, phenomenal qualities. A premium is placed on gems that contain strong colour change qualities, since with alexandrites a predominantly “muddy” mix of greens, browns and reds tends to be the norm, resulting in a vague colour change.

With cat’s eyes, a strong, sharp and unwavering silvery line that is visible from girdle-to-girdle is highly desirable, accompanied by rich green, yellow or brown colours. Cat’s eye alexandrites are especially collectible since they exhibit two forms of phenomena. An additional and easy confirmation of quality for cat’s eyes is to shine a direct light towards the gem at an oblique angle. In fine, semi-translucent gems a “milk and honey” effect can be observed. This shows strong brownish to honey colours on one side of the gem, and a milky translucence on the other. In all collector varieties, size matters since alexandrite as well as cat’s eyes tend to be found mostly in under a carat, small sizes.

Finally, collectors have become much more discriminating about the quality of cut – symmetry, orientation, crisp facets and facet junctions and appealing outlines – since such aspects tend to show phenomena at its very best and because the overall effect is more pleasing to the eye.

Chrysoberyl localities

Chrysoberyl, while rare as an occurrence, is found on several continents – Africa, South America and Asia. Sources for chrysoberyls, alexandrites and cat’s eyes include Russia, Sri Lanka, Brazil, Kenya, Tanzania, Madagascar, India and Burma.

Care of chrysoberyls

With a hardness of 8.5 and excellent toughness, chrysoberyls of all types are extremely resilient for use in jewellery. It is never a good idea to wear gems during any type of arduous work or exercise. However, chrysoberyls may be worn daily under normal conditions. Most chrysoberyl jewellery may be cleaned in an ultrasonic cleaner unless there are preconditions (such as a fractured gem) or if the jewellery metal is worn thin. Otherwise, a damp cloth and warm soapy water are generally enough to clean chrysoberyl gems and jewellery.

Cat’s eye chrysoberyl may appear in a variety of colours, including colour change. Cabochons such as this one are, in part, judged by how straight and unwavering the “eye” is.

Alexandrite is the most prominent variety of chrysoberyl. This is how one such alexandrite appears in daylight.

Here is how the same alexandrite appears in incandescent lighting.

The non-phenomenal varieties of chrysoberyl include golden and green to bluish green colours.
Amethyst

Appreciation for amethyst
Enthusiasts who appreciate quartz’s diverse family of gems often single out amethyst as the most significant variety of the quartz mineral. Amethyst has been used in personal adornment for centuries, often sought out by royalty or important members of the clergy.

In Medieval Europe particularly, the colour purple was worn in rare dyed textiles that could only be afforded by the very wealthy. Amethyst’s bold purple colour, and rare reddish flashes, coupled with the fact that only a few mines for it existed in ancient times, further contributed to its selection as a “royal gem.” Important amethysts feature prominently in British regalia. The name amethyst has a peculiar derivation. It comes from the Greek word améthystos, which translates to “not drunk.” An ancient belief that amethyst protected its wearer from inebriation (even following copious consumption of alcohol) consequently made the gem highly desirable by those so inclined.

Amethyst on the calendar
Amethyst is the Birthstone for February. It is also considered to be a 6th anniversary gem.

What an amethyst is
Amethyst is a variety of quartz that grows in a hexagonal crystal system and has the following chemical composition: SiO₂.

Colour(s): Transparent to translucent lilac to purple through bluish purple, with a reddish purple colour-shift that is sometimes visible in incandescent light. In ametrine, a unique form of quartz mined from a single locality in Bolivia, the colours are both yellow and purple in areas of zoning. Such gems are sometimes cut in a way that mixes the colours, and at other times to show the division of colours.

Refractive Index: 1.544 to 1.553
Birefringence: 0.009
Specific Gravity: 2.66 (+0.03, -0.02)
Cause(s) of colour: are colour centres in quartz, natural irradiation in the mine, combined with traces of iron.

Hardness: 7 on the Mohs Hardness Scale.
Internal identifying characteristics: Amethysts often contain areas of colour next to areas that have no colour – called colour zoning. Amethyst, which has a hydrothermal geologic formation, often has liquid inclusions containing solids and gases, so-called two and threephase inclusions. Inclusions of other minerals such as rutile and hematite sometimes can be found in amethyst as well.

Amethyst’s treatments
Amethyst is sometimes subject to heat treatment, which in a controlled environment may cause overly dark amethysts to be lightened. Occasionally heating amethyst from some sources may turn them yellow. Heating may remove a smoky component in some amethysts.

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Collector amethysts

Collectors of amethyst look for depth of the purple colour with red flashes if the gem is cut conventionally. Many famous lapidaries (cutters) work with amethysts to make unusual carvings or cuts, which are also highly prized. Because the bi-coloured ametrine comes from only one mine in the world, it is sometimes collected if the depth of colour and the division of colour is strong, or if it has been skillfully or cleverly carved.

Amethyst localities

Russia is considered the "classic" source for amethysts because that is where it came from before the discovery of amethysts in the New World, "Uralian" or "Siberian" amethysts, at their best, exhibit deep reddish purple, to purple red colours. The discoveries of amethysts in Brazil, Uruguay, Bolivia and Zambia have changed the dynamics of the market because much larger volumes of material became available in the 20th Century.

Some important localities in the United States, particularly in Arizona, are also contributing supplies of amethyst to world markets.

The cutting and care of amethysts

Amethyst – once considered rare – today has thankfully become one of the world’s most plentiful, and thus democratic of gems. It can be found in many sizes. Amethyst is offered in many different kinds of cuts and carvings. Amethyst is also fairly resilient and can be worn extensively. Care should be taken not to knock the gem during use, as small fissures or cracks may develop, especially along facet junctions. It can be cleaned with warm, sudsy water or a dampened cloth. Some amethysts may lighten in tone over time upon prolonged exposure to bright light.

Amethyst is the most significant variety of the quartz gemstones.

Ametrine, a combination of amethyst and citrine colours, is only found commercially in the country of Bolivia.

Amethyst inclusions are often liquid in nature and may contain 2 or 3 phase inclusions.

Amethyst
Aquamarine

Appreciation for aquamarine
Aquamarines remind us of the sea; their watery greenish blue colours have elicited such comparisons for centuries. In 1609, German gem cutter Anselm Boetius de Boodt first drew this association and his description became universal. The Latin root names, *aqua* and *marina*, literally translate to “water of the sea.” Aquamarine is a gem of subtlety with its light and clear pastel hue; it is often worn for evening events when the gems can gleam enticingly, even in low lighting conditions. Despite the understanding that subtlety is part of an aquamarine’s character, depth of colour remains an important characteristic as well.

Aquamarines differ greatly from emeralds, despite being members of the same family. Unlike emeralds, for instance, aquamarines frequently form as large crystals – sometimes weighing hundreds of carats. Additionally, they frequently possess a vitreous clarity not found in emeralds. For this reason, aquamarines may be fashioned as exceptional clean gems and carvings. That said, some aquamarines are sufficiently included to impart a slightly milky appearance. In other rare cases, the inclusions are miniscule, hollow growth tubes that form parallel to one another, causing chatoyancy (cat’s eye effect) in the gem.

Aquamarine on the calendar
Aquamarine is the birthstone for March. It is also considered to be a 19th anniversary gemstone.

What an aquamarine is
Aquamarine is an important member of the beryl family of gems, and forms in the hexagonal crystal system. It has the following composition: Be₃Al₂Si₆O₁₈.

Colour(s):
Generally transparent and greenish blue, to blue green and generally light in tone. Some highly included aquamarines may have a milky, translucent quality about them.

Refractive Index: 1.577 to 1.583 (+/- 0.017)
Birefringence: 0.005 to 0.009
Specific Gravity: 2.72
Cause(s) of colour: iron

Hardness: 7.5 to 8.0 on the Mohs Hardness Scale.

Internal identifying characteristics: Inclusions in fine aquamarines are sometimes hard to find. However liquid inclusions and “fingerprint” inclusions as well as 2 and 3-phase inclusions (containing a liquid, a solid and a gas) are sometimes found. In cat’s eye aquamarines, parallel hollow growth tubes are the cause of chatoyancy.

Aquamarine’s treatments
More often than not, aquamarines are heat-treated, causing them to lose their secondary greenish colour component. Most aquamarine in today’s market is considered to be heat-treated, though it is generally impossible to determine that fact gemologically.
Aquamarine

Collector aquamarines
Aquamarines that have saturated, light blue colours are especially desirable, though a few beryl collectors prefer a slight greenish tinge. Such gems are considered to follow a more “classic” description of aquamarine. Unusually cut gems are also popular, especially in gems that have been fashioned by an important lapidary artist. Aquamarines and other beryls often lend themselves to sculptures because of their size. Locality plays a role in collecting as well. Aquamarines from desirable localities, such as Santa Maria aquamarines from Itabira, in Brazil, are collectible in accordance to their legendary depth-of-colour. Ukrainian green beryls and aquamarines also became sought after as mineral specimens thanks to their startling sizes, peculiar growth etching and deep colours.

Aquamarine localities
Aquamarines form in pegmatite localities on almost all continents on earth. Brazil is perhaps one of the best-known localities for aquamarine — as well as various other beryls. The gem-rich state of Minas Gerais is Brazil’s strongest producer, though fabulous finds have occurred in Rio de Janeiro, Espírito Santo and Bahia as well. Other strong producers include Pakistan’s Skardu district and Ukrainian beryls from Russia. Other Asian localities include Tajikistan and China — China particularly is emerging as an important producer. Aquamarine is also mined at several localities in the United States, but perhaps the most significant is Mt. Antero in Colorado. African aquamarines have been found at deposits in Kenya, Malawi, Tanzania, Namibia and Madagascar.

The cutting and care of aquamarines
Aquamarine’s rating of 7.5 to 8.0 on the Mohs Hardness Scale, combined with its relatively inclusion-free crystallography gives it good toughness as a gemstone if it is worn under normal use. Larger aquamarines should be worn with care, especially in settings such as rings that can be easily knocked. It is best when prongs are placed in corners of square-shaped gems, because they can protect the gems from chipping at sharp angles and facet junctions. An aquamarine may be placed in an ultrasonic cleaner if it is judged that it does not have inclusions that might expand or endanger the integrity of the gem. Sudsy water followed by wiping with a damp cloth is a good and safe way to clean an aquamarine.

Aquamarine are found in various tonalities.

Carving aquamarines to this degree of fineness requires enormous skill, particularly since aquamarine is a very hard gemstone.

Some aquamarines may be lightly heated to remove a slight greenish component.
Appreciation for beryls

Aficionados often praise the many pastel colours available in the beryl species – notably the subtle blues observed in aquamarine. But a handful of other colour varieties grace it as well. Pink to peach colours, yellow, colourless, light green, deep blue and —very rare — red colours are also part of this family. It is worth pausing for a moment to remember that emerald is also a beryl variety.

Emerald's importance as the deep green gem par excellence is well established throughout history. Aquamarine is a significant beryl too, and for that reason individual chapters for these two gems have been written. (See Emerald p. 15 or Aquamarine p. 8). Pink beryl was first discovered in Pala, California (together with other gems including kunzite and tourmaline). The new gem was soon named morganite in honor of U.S. financial mogul, John Pierpont Morgan, who was an avid collector, particularly of North American gems. Morgan was reputed to have had the largest collection of gems and minerals in the United States during the late 1800s. In 1889, his collection was shown at the World's Fair in Paris, France (at the time the Eiffel Tower was first built). Despite this prominent link, morganite is in shorter supply than aquamarine, and consequently is less well known. However, morganites occasionally form as large crystals, as such are suitable for oversized gems or carvings. This is also true for heliodor, the bright yellow beryl whose name is derived from the Greek word helios, meaning sun. Occasionally, if the yellow colour of the gem is deep enough, or contains some orange colour, the gem is also referred to as golden beryl. Goshenite, named after Goshen, Massachusetts where it was found describes a beryl crystal or cut gemstone that is essentially colourless. All of the varieties of beryl owe their colour to trace impurities of another element; goshenite is the purest form of the species, and thus colourless. Green beryl is a unique gem: it is not sufficiently toned or saturated enough to be called an emerald, which is why this gem classified separately. It is no surprise that borderline emerald/green beryl gems sometimes a challenge to determine.

Red beryl – (also named bixbite, after its discoverer, Maynard Bixby) is not pastel coloured but a strong, red colour, and generally very small — under one carat. Red beryls were discovered as rare, non-commercial crystals in the early 1900s, but it was only in the 1950’s that larger quantities, sufficient enough to build a business were found. Red beryl remains unique to North America, and production is sporadic at best. It is a gem for collectors.

Maxixe beryls, primarily found at a locality in the State of Minas Gerais, Brazil, are a medium to dark blue when mined and extracted from the earth, but the colours fade quickly upon exposure to light (or heat). Much like red beryl has its followers, so too does maxixe. Collectors take great pride in their collections of the deep blue beryl. But they only take them out of their dark containers every once in a while to remind themselves of the beautiful, if ephemeral, deep blue colour.

Other beryls
Other beryls

Beryls on the calendar

Only emerald and aquamarine are considered as birthstones and anniversaries. Please look at the specific chapters for these gems for additional details.

What beryls are:

Beryls form in the hexagonal crystal system. They have the following chemical composition: Be₃Al₂Si₆O₁₈.

Regarding colour ranges, green beryl (other than emerald) may be strongly bluish green to green to yellowish green (generally in lighter tones and saturations). Morganite may be reddish orange through slightly purplish red (generally in lighter tones and saturations). Yellow beryl may be greenish yellow through orangy yellow (generally in lighter tones and saturations). Red beryl is far more saturated than morganite and maxixe should be more saturated than aquamarine.

**Refractive Index:** 1.577 to 1.583 (+/-0.017)

**Birefringence:** 0.005 to 0.009

**Specific Gravity:** 2.72 (+0.18, -0.05)

**Cause(s) of colour:** pink and red are cause by manganese; yellow is caused by iron; green is caused by chromium, vanadium and iron. Maxixe's colour is caused by unstable colour centres. Note: Studies indicate that maxixe’s colour can be temporarily restored through irradiation treatment, though the colour is not stable.

**Hardness:** 7.5 to 8 on the Mohs Hardness Scale.

**Internal identifying characteristics:** The pastel coloured gems tend to have fewer inclusions than saturated varieties. Liquid fingerprints, two phase inclusions and hollow growth tubes are possible in all varieties, sometimes causing chatoyancy (cats eye effect).

**Beryl treatments:**

b. **Irradiation** – Sometimes goshenites (colourless beryls) may be irradiated to produce yellow colours. This colour is considered stable. Maxixe colours may be restored through irradiation, through the colour also fades to light and heat. Note: For all intents and purposes, maxixe beryl is almost always irradiated –either naturally as it comes out of the ground, or in a laboratory. Some colourless and light pink beryl from Minas Gerais is irradiated to produce maxixe beryl.

c. **Oil impregnation** – While oils and polymer resins are rarely used with pastel colour beryls, colourless oil and resins are sometimes used to hide fissures in red beryl.

Collector beryls

Large beryls that exhibit a high degree of saturation are always in demand. Collectors often like to have all the varieties in a species. Other collectors prefer to specialize in rare gems, such as red beryls. Borderline gems (Is it an emerald? Or a green beryl?) also have admirers. Cat’s eye beryls are rare and therefore collected.

Beryl localities

Brazil produces much of the world’s pastel beryls – and maxixe. Afghanistan, Russia, Madagascar, Zimbabwe, United States also produce various kinds of beryls. Only the United States commercially produces red beryl.
Other beryls

The cutting and care of beryls

Beryls may be cut several different ways, though emerald cut and oval cut gems tend to predominate. Beryls are generally quite hardy unless they are strongly included. Red beryls tend to be more like emerald in this respect and may be fragile if the gem has many surface reaching fissures. For safety’s sake, ultrasonic cleaners and steamers should be avoided. A dampened, non-abrasive cloth is best used to clean beryl jewellery.

Pastel coloured beryls have plenty of devotees of their own, though emerald (the deep green gem bottom, centre) is probably the best known of the beryl family. Here you can see goshenite (top row left), golden beryl, morganite, and green beryl. In the second row (starting left): morganite, maxixe beryl, green beryl, heliodor, and green beryl. Third row: red beryl (or bixbite) and emerald.

While some may find it difficult to determine the separation between green beryl and emerald, the emerald (centre) is always more vivid in colour.
Appreciation for citrine

The description for citrine is contained in its name. Citrine, from the French word citron literally means "lemon," in deference to a multitude of rich yellow hues. There are several sources for the gem, and consequently the gem is available to many people around the world who love gemstones.

Citrines actually cover a much wider range of yellows than do most lemons, including rich, orangy yellow colours. In deep orange, it is reminiscent of a gem from a different species called topaz. There is no relation between topaz and citrine whatsoever, despite misnomers such as "topaz quartz" or "Madeira topaz" which are sometimes incorrectly used to describe a particular hue of citrine quartz. In fact, citrine has significant attributes of its own to stand upon: aside from its rich and optimistic colours, it is found in an impressive range of sizes and quantities, making it a favourite for well known gem carvers to work with.

While citrine quartzes are found in nature and on a variety of continents, the majority of these gems began their lives as amethysts, which, upon being heated, turn a brownish yellow or yellow colour. Citrines are greatly esteemed for their warm, earthy colours and for their vivacious sparkle, especially among lighter toned gems.

Citrine on the calendar

Citrine is an alternate birthstone for November. It is also considered a 13th anniversary gem.

What a citrine is:

Citrine is a variety of quartz that grows in a hexagonal crystal system and has the following chemical composition: SiO₂.

Colour(s): Citrine is transparent to translucent pale yellow to deep orange and/or brownish orange colours.

Refractive Index: 1.544 to 1.553

Birefringence: 0.009

Specific Gravity: 2.66 (+0.03, -0.02)

Cause(s) of colour: Traces of iron are the principal cause of yellow. Heat treatment of certain kinds of amethyst under controlled conditions also causes the yellow colour.

Hardness: 7 on the Mohs Hardness Scale.

Internal identifying characteristics: Citrines are often devoid of eye-visible inclusions though some material may show colour zoning. In some cases, fluid inclusions and negative crystals may be seen. Inclusions of other minerals such as goethite or rutile can also be found in citrine.

Citrine’s treatments

Many citrines start out as amethysts but are heat treated to turn yellow to yellowish brown. Heat treatment of amethyst requires considerable experience, and not all amethysts may respond in a manner that is expected. However, altered colour is considered stable.

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Citrine

Collector citrines
Collectors of citrine look for a pure yellow or orange colour to begin with. Many famous lapidaries (cutters) work with citrines to make unusual carvings or cuts, which are also highly prized. Because ametrine – a form of quartz that combines the colours of amethyst and citrine – comes from only one mine in the world, it is collectible if the depth of colour and the division of colour is strong, or if it has been cleverly carved and fashioned.

Citrine localities
Brazil is considered one of the main sources of citrine; particularly from the gem rich states of Minas Gerais and Rio Grande do Sul. Bolivia’s Anahi mine has also become a leading producer of citrine. It is also found in African countries such as Tanzania, Namibia and Zambia.

The cutting and care of citrines
Citrine is thankfully one of the world’s most plentiful gems. It can be found in many sizes. Citrine is often cut as large gems or in carvings. Citrine is also fairly resilient and may be worn extensively, though wearing citrine during any type of manual labor or strenuous activity should be avoided. Care should be taken not to knock the gem during use, as small fissures or cracks may develop, especially along facet junctions. It is best cleaned with warm, sudsy water or a damp cleaning cloth.

Viewed at 30x through a microscope, sprays of the mineral goethite may be found in some citrines and other quartzes.

Citrine quartz is generally perceived as an optimistic yellow colour. The gem may exhibit stronger and weaker zones of colours throughout the gem, such as with this gemstone.

Different shades of yellow quartz are all known as citrine. Some citrines are a darker tone as well and may be seen as orange to brown.
Emerald

Appreciation for emeralds

It is an emerald’s appearance and colour that make this gemstone instantly and universally recognized. The rich, green hue has also been the primary reason for the gemstone’s tremendous popularity throughout human history. In many instances, the word “emerald” is used to define saturated variations of green, such as the lush vegetation of the “emerald isle,” or an “emerald green ocean.” Marbod, the medieval poet of Rennes, France, loved emerald’s colour, causing him in 1120 A.D. to have observed the following:

“Of all green things, which the bounteous earth supplies, Nothing in greenness with the emerald vies.”

Hundreds of years earlier, the naturalist Pliny the Elder (23 A.D. to 79 A.D.) declared his sentiments as well:

“We delight in feasting our eyes on the pleasant green grasses and leaves, but the enjoyment of beholding an emerald is incomparably greater, for its green is most soothing.”

Pliny was one of the first to classify gemstones, including emeralds. But appreciation for emeralds was evident long before him. It is thought that emeralds were first used as gemstones circa 3500 B.C., during the first dynastic reigns of Egypt’s kings and so, for thousands of years, Egypt was the world’s main emerald source. Actress Elizabeth Taylor, who played Queen Cleopatra on film, was equally enamored of emeralds as the Egyptian she portrayed. Aside from wearing magnificent emerald jewellery throughout her life, Taylor used the colour and popularity of emeralds to launch a perfume in recent years.

Emeralds have also been celebrated as birthstones for those lucky enough to be born in the month of May. It represents rebirth and eternal spring. Its colour denotes honesty, and integrity; finally, emeralds have long been thought to be capable of soothing one’s eyes. The Roman Emperor Nero is said to have watched gladiator fights through emerald slices for that very reason!

Emerald on the calendar

Emerald is the birthstone for the month of May. It is also considered a 20th anniversary gem.

What an emerald is

Emeralds are a variety of the beryl species of minerals and are composed of the following elements: Be₃Al₂Si₆O₁₈.

Beryls include the following other gemstone varieties: aquamarine, morganite, red beryl, green beryl, heliodor and goshenite. (Note: more about the beryl family in specific chapters on: Aquamarine, and also: Other Beryls.) Emeralds and other beryls grow as hexagonal (six-sided) crystals. The following optical, physical and chemical factors help distinguish the emeralds:

- **Colour:** Vibrant, deep green colour that is often described as very strongly bluish green through green.
- **Refractive Index:** 1.577 to 1.583
- **Birefringence:** 0.005 to 0.009
- **Specific Gravity:** 2.72 (+0.18, -0.05)

Emerald on the calendar

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Emerald

**Cause of colour:** Chromium generally, sometimes vanadium and sometimes a combination of chromium and vanadium.

**Hardness:** 7.5 to 8 on the Mohs Hardness Scale.

**Internal identifying characteristics:** multi-phase inclusions, mica platelets, calcite, and pyrite inclusions. It is worth reflecting further on an emerald’s unique internal characteristics since they are so prevalent in emeralds. Inclusions in emeralds are considered customary and expected. While emeralds with no eye-visible inclusions do exist – these gems are extraordinarily rare. Some inclusions in emerald are referred to as jardin, (meaning garden in both French and Spanish) and may consist of networks of tiny liquid filled inclusions and minute fissures that permeate the gem, lending it the appearance of a lush garden – hence the term. These inclusions also impart the emerald with a distinctive, somewhat hazy appearance because they diffuse and spread light through the gemstone. Emerald’s transparency and surface luster is often described as glassy or vitreous. Included crystals, such as pyrite, are fascinating to examine through a microscope, and provide positive proof of the gemstone’s natural origin. Occasional larger fissures (especially those located at corners where a prong might be placed) should be avoided. The majority of emeralds are very durable gemstones that will bring joy to successive generations if handled with appropriate care. Emerald shares similar inclusion characteristics with red beryl, due in part to their colour causing impurities and their mode of formation. Conversely, lighter beryls, such as aquamarine and morganite, are very often eye-clean (viewed without magnification) even in sizes larger than 5 carats.

**Emerald treatments**
The minute fissures that are found in many emeralds lend themselves to a form of treatment by humans, aimed at diminishing or masking the inclusion’s appearance. These fissures often reach the surface and may be filled with substances including oils, paraffin, resins and polymers. The manipulation of an emerald’s appearance (other than cutting or fashioning) was first described by Pliny and as such has probably been practiced to varying degrees for centuries. Because introducing substances into emeralds may substantially change their appearance (and perceived value) the presence of these kinds of treatments needs to be disclosed from the seller to the buyer along the supply chain. Even when such treatments are fully disclosed, new care considerations need to be explained as well. Some oils, paraffin and some resins may seep out of the fissures, especially when subjected to heat or pressure. Others may oxidize over time so it becomes important for sellers to be able to offer services to clean and re-treat an emerald if so required.

**Collector emeralds**
Deeply coloured, large, relatively clear and non-treated emeralds are rare and collectible. There are also two rare kinds of unusual collector emeralds that are rarely seen commercially:

**Cat’s eye** – These beryls are green enough to be classified as emerald, and have multiple, microscopic hollow growth tubes that form in a parallel fashion to one another throughout the gem. Emeralds such as these are fashioned en cabochon and the domed surface of these gems exhibits a cat’s eye phenomenon in direct (non-diffused) lighting.

**Trapiche** – These Colombian emeralds celebrate unique six-spoke inclusions, (similar to spokes on a bicycle wheel) containing either black carbonaceous shale (the host in which these emeralds form), or white albite (a form of feldspar) spokes. These gems are cut as slices or as cabochons to show the spokes radiating out from the centre. The name comes from wheel-like sugar cane crushers found in Colombia, called trapiches.

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Emerald

Emerald localities

South America has stood out as the world’s primary source for the green gemstone since the discovery of the New World. The Incas traded emeralds throughout their Andean empire until the arrival of Spanish Conquistadors. But the Spanish discovery of emeralds in Colombia in the 1500s changed the balance of power in South America. Egypt’s emerald sources were quickly forgotten as European nobility demanded Colombia’s superb emeralds. This South American source quickly became the world’s most significant producer of fine emeralds, and remains so today. However, many other sources are gaining importance, including mines in Brazil, Zambia, Madagascar, Pakistan, Afghanistan, Russia and China. A few emeralds have been found on the North American continent as well; Hidden, North Carolina, is the U.S.’ historic emerald source, and some emerald material has also been discovered in the Yukon Territories, Canada. Neither location is commercially active, though rare collector gems surface from time to time.

Cutting and care of emeralds

Emeralds are the only gems that have a specific cut named after them. The term “emerald cut” is a square or rectangular outline step-cut, containing tapered corners. Many emeralds are cut this way because it orients the gem to show its strongest colour. These cuts contain large table facets through which an admirer can best view the emerald’s rich colour and its fascinating inclusion panorama. Emeralds are increasingly cut in other shapes, including round, oval, free form, pear and marquise. With the latter two cuts in emerald it is important to closely examine pointed corners for durability issues. It might be recommended for such gems to be mounted in earrings, pins or pendants (rather than rings) in order to minimize potential damage to sharp points. It is also recommended that emerald jewellery owners have their jewelers examine prongs periodically to ensure the emerald’s security in the mount. It is not recommended that emeralds be inserted in ultrasonic cleaning machines because the heat and vibration may harm or remove emerald treatments. Emeralds should not be immersed in detergents for similar reasons, and are best cleaned with a water-dampened, soft cloth. Common sense indicates it is not a good idea to wear an emerald ring during gardening or other intense physical activity.

This fine emerald comes from the Colombian emerald region of Chivor.

Even fine emeralds, such as this deep green gem, generally contain inclusions that may be visible to the eye. These characteristics are signatures of the emerald’s natural origin, and are often referred to as “jardin,” – meaning garden – in both French and Spanish.

Three-phase inclusions in emeralds from Muzo, Colombia, can be seen through a microscope at magnifications of 10x and higher. They are so-called because they contain a fluid, a gas (the rounded bubble), and a solid (the square crystal of halide).
Appreciation for feldspars

Feldspars, as a gem group, include an extremely diverse group of gems combining several species and varieties. Many varieties in this family of gems possess unique optical phenomena. Feldspars are mostly classified as common rock minerals; they are found on every continent. (It is estimated that feldspars make up well over half of the earth’s crust). However, the rare feldspars are those beautiful gems that are sought after and revered, as they have been for centuries. In India, for example, moonstones (a variety of orthoclase feldspar) have long been thought to be sacred. George Frederick Kunz, a famous gemologist and consultant to Tiffany & Co in the late 1800s, notes in his book, *The Curious Lore of Precious Stones*, that “As a gift for lovers the moonstone takes high rank, for it is believed to arouse the tender passion.”

It is easy to see why: the way moonstones interact with light often reveals their most alluring characteristic. Under direct (and sometimes subdued) lighting conditions, moonstones exhibit adularescence, which is described as a “billowy” light effect, or sheen, observed along the gems’ surface. In moonstones with a white body colour, “billowy blue” colour may be seen. In yet other moonstones, asteriation or cat’s eye effects (other phenomena) can sometimes be observed. Moonstones may have orangy, brownish or greenish body colour.

Not to be outdone in moonstone’s celestial designation, another feldspar variety is called plagioclase sunstone. This gem often exhibits warm red to brown and yellow body colours, an allusion to the name. Its phenomenal nature, however, is equally captivating. When interacting with light, similarly oriented, miniscule inclusions of copper or hematite platelets exhibit glittering, spangled reflections, shimmering through different depths within the gem. Some experts refer to this phenomenon as aventurescence; others refer to this optical effect as schiller.

Labradorite, named after the first place it was discovered – the Labrador Peninsula in Canada, is yet another form of plagioclase feldspar that has a phenomenal effect. In certain light conditions, a broad, multi-coloured sheen appears to float along the gem’s surface, particularly visible as the gem, or the light source, is moved. This iridescent effect is called labroarescence.

In recent years, andesine – rare, albite-rich plagioclase feldspar has gained recognition. It began entering the market in surprising quantities in 2002. The material has been found to come from at least two known localities: Inner Mongolia and Tibet.

Microcline feldspar has one gem variety called amazonite, which is bluish green to green in colour, and may be semi-translucent to opaque. Interestingly, the name has nothing to do with the actual Amazon rainforest, where it has not been found as a source. The beauty and intrigue of amazonite is revealed under direct lighting, when a fibrous interlacing between green and white streaks can clearly be seen along the gem’s surface. On rare occasions, the gemstone may also have a slight glittery effect under different lights, also caused by inclusions. In this case the effect is called aventurescence.
Gem feldspars occur in non-phenomenal, transparent varieties as well, particularly in plagioclase, oligoclase and orthoclase species. In this case, the body colour is generally yellow – but greenish yellow and colourless varieties occur as well.

**Feldspars on the calendar**

Moonstones are birthstones for June, together with pearls and alexandrites.

**What Feldspars are**

The chemical composition for feldspars is KAlSi₃O₈. Microcline feldspars (amazonite) are part of the triclinic crystal system; orthoclase feldspars (moonstones and transparent varieties) are in the monoclinic crystal system; plagioclase and oligoclase feldspars (labradorite and sunstones and transparent varieties) are in the triclinic crystal system.

**Colour(s):**

- **Microcline:** (amazonite) light green to greenish blue, white and rarely light orange or pink.
- **Orthoclase:** (moonstone) colourless to white, green, yellow brown or grey and rarely black.
- **Plagioclase:** (labradorite) grey to black bodycolour, colourless, green, yellow orange to brown or brownish red. (Oligoclase) yellow to green as well as transparent.

**Refractive Index:**

- **Microcline:** 1.522 to 1.530
- **Orthoclase:** 1.518 to 1.526
- **Plagioclase:** 1.559 to 1.568 (labradorite), 1.537 to 1.547 (oligoclase)

**Birefringence:**

- **Microcline:** 0.008
- **Orthoclase:** 0.05 to 0.008
- **Plagioclase:** 0.007 to 0.10

**Specific Gravity**

- **Microcline:** 2.56
- **Orthoclase:** 2.58
- **Plagioclase:** 2.70 (labradorite), 2.65 (oligoclase)

**Cause(s) of colour:** The causes of colour in feldspars have much to do with the makeup of the gem trace elements and inclusions they host. In amazonite, the colour appears to be caused by lead (rather than copper, as commonly thought), and the yellow reddish to brown colours often by hematite, copper or iron traces. In sunstones from Oregon, the colour is predominantly caused by copper inclusions.

**Hardness:** all feldspar species and varieties: 6 to 6.5 on the Mohs Hardness Scale.

**Identifying Feldspar’s characteristics:**

The most important thing to remember is that the inclusions in feldspars are what provide them with their phenomenal characteristics. In sunstones from Oregon, colour is largely influenced by the copper content of the gems, and the spangled inclusions are themselves extremely small copper platelets. Sunstones from Africa contain different inclusions composed mainly of hematite and mica platelets, which also cause the aventurescent effect. In moonstones interesting inclusions with a “centipede” appearance may sometimes be seen. Such inclusions are considered identifying features for the gem.

**Feldspar’s treatments**

Treatments in feldspars are not generally common, though wax impregnations of tiny fissures that reach the surface of some amazonites has been reported. This gives the gem a more uniform look. However, such treatment is not permanent and can be affected by heat and pressure. It has also been reported that some white microcline varieties may be irradiated to achieve deep blue-greenish colours associated with amazonite. In some instances moonstones and transparent labradorites may be backed with a black coating to better exhibit their phenomenal characteristics. In un-mounted gems, this treatment is easily discernible. Some andesine was recently revealed to be treated by diffusion to achieve rich red and yellow colours similar to those found in sunstone.
Collector feldspars
Feldspars that exhibit double phenomena (adularescence or cat’s eye) are collector’s gems because of their rarity. Large gems and richness of colour are also factors which collectors consider. Though feldspars have perfect cleavage (they can separate along planes of atomic growth in the crystal), and can be damaged during the fashioning process, they are sometimes carved.

Feldspar localities
**Microcline:** Amazonite is found in the United States, mainly in the State of Colorado, but also in Madagascar, Burma (Myanmar), Germany and Russia.

**Orthoclase:** Sri Lanka, India and Burma are the major sources of moonstones. Canada, Mexico, Madagascar and the United States are major sources of transparent orthoclase.

**Plagioclase:** Finland is a classic source for labradorite (gems from this source are sometimes referred to as “spectrolite”) but Madagascar is also a very strong source of the material. Transparent plagioclases (and oligoclase) are found in the United States and Canada. The most plentiful source of sunstone is the United States—primarily in south central Oregon State. As noted, new mines for andesine have been reported in Tibet and Inner Mongolia.

The cutting and care of feldspars
Feldspars, properly cared for, may last for a lifetime, despite being somewhat brittle at times. Cutters, who properly understand the hardness and toughness of feldspars, often cut them as cabochons, which (unlike faceted gems) are less subject to abrasion along facet junctions. Additionally, cabochons are more likely to exhibit the phenomenal aspects of these gems. Some lapidary artists choose to carve these gems. Clearly, feldspars are somewhat delicate and care must be taken in setting them.

Feldspars should never be placed in ultrasonic cleaners. A clean, water-dampened cloth, containing no soaps or cleaning agents, is the best way to clean the gems.

Plagioclase feldspars, such as these include labradorite (top) which exhibits labradorescence; as well as a variety of colours of transparent and semi translucent sunstones (below).

Inclusions in feldspars of all kinds are the principal cause of optical phenomena in many of the more celebrated varieties, such as the aventurescence in the copper containing sunstone, (left). Inclusions also cause cat’s eye moonstone (centre), and the sunstone containing glittering hematite platelets (right).
Feldspar group

Moonstones are appreciated for the soft, billowy glow that appears to float over the surface of the gems under particular lighting conditions. These moonstones exhibit a blue adularescence.

Moonstones, which can be both orthoclase or plagioclase feldspars, can occur in several colours, such as the ones seen here.

A network of white, fibrous inclusions are part of the charm and character of amazonite feldspar.
Appreciation for garnets

Several colorful gemstone species and varieties are members of the garnet group. The diversity of garnets – principally in color and appearance, places them among gemology’s most alluring, yet contentious, subjects. The allure is because these gems are found in variations of almost every hue. These various kinds of garnets are linked to one another by their common crystal growth structure and basic chemical composition. There the beautiful similarities wane, and the controversy begins. The optical, physical and chemical properties of many garnets overlap, making it difficult even for gemologists to pinpoint the distinct species and varieties of the garnet group. Gemologists’ attempts to classify garnets have led at times to academic disagreements that luckily have no bearing on consumer’s tastes for the colors and beauty that garnets impart. Certainly, garnets have always been appreciated, even long before the birth of Jesus. Garnets are mentioned in the Bible as well: the famous breastplate of the Jewish High Priest is said to have contained a garnet amongst its twelve featured gems.

Most people tend to think of garnets as red, and in fact the Latin derivation of the name reflects that. The phrase malum granatum refers to the striking resemblance some red garnets have to pomegranate seeds – especially when the garnets are in the rough. Red garnets include pyrope (from the Greek pyropos, meaning fiery). Another red garnet is almandine. Some garnets fall between pyrope and almandine in composition. For example, a violetish red variation is known as rhodolite garnet in the trade. Since ancient times, reddish garnets have also been described as “carbuncles,” a reference to hot, glowing coals. This is seen as yet another attempt to describe the gems’ brilliance and blazing red color.

But garnets form in deep yellow, (and no less fiery), orange colors as well. Spessartine garnets, (sometimes called spessarites in the trade) are named after the region of Spessart, Germany where they were first found, are a deep yellow and sometimes orange color. A spessartine garnet locality in Namibia produces a glowing orangy gem that has come to be known as a “mandarin” garnet in the trade.

Not all garnets are found in the warm hues. Demantoid, from the andradite garnet family, is bright green, though other forms of andradite may be yellowish or brown in color. Demantoid derives its name from the word “deman” which is itself a derivation of the German word for diamond – diaman, though the two species of gem are not related. While Demantoid colors certainly don’t bring diamonds to mind, their incredible brilliance and scintillation do. Curiously, pyrope garnets are often found in association with diamonds during the mining process, and diamond miners think of garnets as “indicator minerals” in their search for diamonds.

Grossular garnets are principally known through the brilliant green tsavorites, garnets that are found in East Africa, principally Kenya, not far from the Tsavo National Park. Africa is the principal source of many garnets that are challenging to classify. The malaya garnet, a pyrope spessartine mix, is often found in unique purplish to brownish colors.
Garnets are also appreciated for their interesting phenomenal varieties. In the United States, Idaho produces an interesting four-rayed star garnet. In New Mexico (and in Mexico) a form of andradite garnet displays incredible iridescent colors in bright lights. A garnet rarely found in Madagascar displays remarkable alexandrite-like, color-change characteristics. A pyrope spessartine mix, this gem changes from a gray or violetish blue in daylight, to a deep, purplish red in incandescent light.

**Garnets on the calendar**

Garnets are the birthstone for January – and while consumers sometimes believe they are limited to choosing only red garnets, it is clear they can choose many different colors. Garnets are a gem of choice for second anniversaries.

**What garnets are:**

Garnets are a group of minerals in the cubic crystal system, whose chemical formula varies as follows:

- **Almandine:** Fe$_3$Al$_2$(SiO$_4$)$_3$
- **Andradite:** Ca$_3$Fe$_2$(SiO$_4$)$_3$
- **Grossular:** Ca$_3$Al$_2$(SiO$_4$)$_3$
- **Hydrogrossular:** Ca$_3$Al$_2$H$_{12}$O$_{12}$
- **Pyrope:** Mg$_3$Al$_2$(SiO$_4$)$_3$
- **Spessartine:** Mn$_3$Al$_2$(SiO$_4$)$_3$

**Colour(s):** Garnets predominate in red, orange and yellow color variations but can also be found in variations of green, blue, violet and black. Minute variations in chemical composition are the principal cause of the color variations in garnet.

**Refractive Index:**

- **Almandine (also called almandite):** 1.790 (+/- 0.030)
- **Andradite:** 1.888 (+0.007, -0.033)
- **Grossular:** 1.740 (+0.020, -0.010)
- **Hydrogrossular:** 1.720 (+0.010, 0.050)
- **Malaia:** 1.760 (+0.020, -0.018)
- **Pyrope:** 1.714 to over 1.742, 1.74 is normal
- **Rhodolite:** 1.760 (+0.010, -0.020)
- **Spessartine:** 1.810 (+0.004, -0.020)

**Birefringence:** None. Garnets are singly refractive.

**Specific Gravity:**

- **Almandine:** 4.05
- **Andradite:** 3.84
- **Grossular:** 3.61
- **Hydrogrossular:** 3.47
- **Malaia:** 3.78
- **Pyrope:** 3.78
- **Rhodolite:** 3.84
- **Spessartine:** 4.15

**Cause(s) of colour:** In red garnets a mix or iron, magnesium and manganese causes the colors we see. Iron, and combinations of iron and manganese, is the principal cause of color in yellow and orange garnets. Chromium is the principal cause for andradite garnet’s green color. In tsavorites a mix of chromium and vanadium results in the greens.
Garnet group

**Hardness:** Most garnets: 7.0 to 7.5 on the Mohs Hardness Scale. Andradite and grossular garnets may be softer; often between 6.0 and 7.0 on the Mohs scale.

**Internal identifying characteristics:**
In almandine, pyrope and rhodolite: tiny, oriented rutile needles may be seen in clusters (or nests). These sometimes are prevalent enough though the gem to cause a star effect (asterism). Other included crystals are found in these garnets.

**Garnet treatments**
Garnets are one of the few gems that are rarely treated to enhance color or clarity. In rare instances green andradite garnets may be heated to enhance colors. This treatment involves low heat so as not to damage the collectible “horsetail” inclusions.

**Collector garnets**
Garnets have been used since antiquity, especially as engraved gemstones, and such gems are highly collectible. In reddish garnets the size and pureness of color is highly desirable. Green garnets are almost always small – gems over 3 carats are considered rare and are therefore collectible. Demantoids often have signature “horsetail” inclusions composed of byssolite and/or chrysotile. Clever cutters will attempt to leave such inclusions in the center of the gem to exhibit a classic, collectible gem.

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East African countries such as Tanzania are principal sources for garnets such as the rhodolite (a pyrope) and malaya (a mix of pyrope, spessartine and almandine garnets).

Garnets are part of a diverse and complex gem group. Shown here are several types of garnets including (top row) spessartine, rhodolite pyrope and grossular. (Bottom row) includes spessartine, rhodolite and andradite (demantoid) garnets.
Garnet group

**Garnet localities**

- **Almandine:** India, Sri Lanka, Madagascar, Brazil, Greenland, Kenya, Pakistan, Tanzania, and the United States.
- **Andradite:** Italy, Korea, Russia, (the classic source for Demantoids) Namibia, Mexico and United States, especially for the phenomenal iridescent variety.
- **Grossular:** Sri Lanka, Kenya, Tanzania, Brazil, Canada, India and United States.
- **Hydrogrossular:** South Africa, Canada, United States, Burma and China.
- **Malaya:** Tanzania.
- **Pyrope:** Austria, Czechoslovakia (the classic source in the 1800s), South Africa and United States.
- **Rhodolite:** Sri Lanka, Tanzania, Zimbabwe, Madagascar and United States.
- **Spessartine:** Brazil, Sri Lanka, Nigeria, Kenya, Tanzania, Australia, India, Madagascar, United States.

**The cutting and care of garnets**

Garnets are generally somewhat susceptible to heat (and to some acids) so it is recommended that garnets be cleaned with soft, non-abrasive, dampened cloths. Garnets may abrade along facet junctions if scraped.

Green grossular garnets’ vivid green colour competes with many other species of green gemstones. Those who appreciate garnets often point to a garnet’s brightness and durability.

Demantoid garnets from Russia are well known, and celebrated for their characteristic “horse-tail” inclusions that often radiate throughout the gemstones.
Jade

Jadeite & nephrite

Jade is a blanket term used to describe a metamorphic mineral group that comprises two separate species of gem: jadeite jade and nephrite jade. The name for jade (as it is known in the West) comes from the Spanish piedra de hijada, referring to the stones’ shape as they were found, resembling kidneys. In China, where appreciation and knowledge about both forms of jade far surpasses that of the West, and has since approximately 5000 B.C., the word for nephrite jade is yu. It is often said that in China, the value and appreciation for jade surpasses that of gold and other valuable minerals. What the Chinese valued in nephrite jade was its incredible toughness; as such the gem was often carved into statues, sculptures, hollowed beads, bowls and weapons. The Chinese philosopher Confucius, who was born five centuries before the birth of Jesus, appreciated jade as well, and is widely quoted in regards to the gem:

“The wise liken jade to virtue. Its polish and brilliancy represent purity. Its extreme hardness is intelligence. Its angles, which do not cut, although they seem sharp, are justice. The pure and prolonged sound, which it sings when one strikes it, are music. Its colour is loyalty. Its iridescent brightness represents heaven.”

When jadeite jade was discovered in neighboring Burma (Myanmar) in the 18th Century, it became an immediate success in China as well. Enthusiasts of jadeite jade appreciate its vivid variety of colours including red, orange yellow, green, violet (lavender) and black. (Note: while blue jade is not found in Burma, very small and rare quantities of blue Guatemalan jadeite jades have been found.) In Central America, one of the other historic sources of jadeite jade, the Mayas and Aztecs appreciated the gem for its hardness and colours as well. Today, deep colour and relative transparency are the yardsticks by which both jades are measured – but deep uniform green translucent jadeite gemstones, are especially coveted.

Jade on the calendar

Jade is considered a 12th anniversary gemstone.

What jadeite & nephrite are

Jadeite jade is composed of the following minerals: NaAlSi$_2$O$_6$. Nephrite has the following composition: Ca$_2$(Mg,Fe)$_4$Si$_8$O$_{22}$(OH)$_2$.

Colour(s):

Jadeite jade: Appearance is semi-transparent to opaque often with mottled colours in white, green, yellow to reddish orange, brown, grey, black, light purple.

Nephrite jade: Transparent to opaque, creamy, often with mottled colours in light to dark green, yellow to brown, white, grey, black.

Refractive Index:

Jadeite jade: 1.666 to 1.680 (+/-0.008)

Nephrite jade: 1.606 to 1.632 (+0.009, 0.006)
Birefringence:
Jadeite jade: Usually not detectable
Nephrite jade: Usually not detectable

Specific Gravity
Jadeite jade: 3.34 (+0.06, -0.09)
Nephrite jade: 2.95 (+0.15, -0.05)

Cause(s) of colour:
In green jadeite: chromium (and/or iron). Iron is the main cause of colour in lavender, orange and brown jadeite. In nephrite jade, iron is the cause of many colours.

Hardness: on the Mohs Hardness Scale:
Jadeite jade: 6.5 to 7 hardness; toughness is exceptional.
Nephrite jade: 6 to 6.5 hardness; toughness is exceptional, exceeding that of jadeite.

Internal identifying characteristics:
Jadeite jade: mottled colours, a granular (sugary) appearance in cracked or unfinished areas of a gemstone.

Jadeite jade: Usually not detectable
Nephrite jade: Usually not detectable

Jadeite jade: 3.34 (+0.06, -0.09)
Nephrite jade: 2.95 (+0.15, -0.05)

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Internal identifying characteristics:
Jadeite jade: mottled colours, a granular (sugary) appearance in cracked or unfinished areas of a gemstone.

Jade’s treatments

In jadeite jade:
Wax Impregnating: Jadeites are sometimes cleaned in acids and neutralizing solutions, followed by boiling in water to clean off any residue. Following this they are dipped in wax as part of the polishing process. The wax enters tiny fissures and pits in the jadeite, giving the gem a more uniform appearance. Purely natural jadeite and some which have been slightly waxed during polishing are sometimes referred to as “A” jadeites in the trade.

Acid Bleaching / polymer impregnation: Here jadeites with stained surfaces are submerged in acids with the aim of bleaching the stains. The treatment causes such jades to become more porous; a subsequent polymer resin impregnation renders the jadeite more evenly coloured and translucent. Treatments with acid followed by polymer resin impregnation are sometimes referred to as “B” jadeites in the trade.

Dyeing: Dyeing of some jadeites follows bleaching treatments, using various colours. Some colours may fade over time, especially exposed to strong light sources. As a final step, some jades are then polymer impregnated to make them appear homogenous. Such treatments result in jadeites that are sometimes referred to as “C” jadeites in the trade.

Heating: Some jadeites are heated in an effort to change their colour. Heating may lighten some overly dark greens or cause yellow staining to turn a deeper reddish colour.

In nephrite jade:
Dyeing: Some nephrite jades may be impregnated with dyes to improve the colour – though the treatment is considered rare.

Paraffin impregnation: Some nephrite may treated with paraffin to conceal surface irregularities (such as cracks or fissures) in the gem.

Heating: Some heating results in the lightening of overly dark colours of nephrite.

Jade’s treatments

In jadeite jade:
Wax Impregnating: Jadeites are sometimes cleaned in acids and neutralizing solutions, followed by boiling in water to clean off any residue. Following this they are dipped in wax as part of the polishing process. The wax enters tiny fissures and pits in the jadeite, giving the gem a more uniform appearance. Purely natural jadeite and some which have been slightly waxed during polishing are sometimes referred to as “A” jadeites in the trade.

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Dyeing: Some nephrite jades may be impregnated with dyes to improve the colour – though the treatment is considered rare.

Paraffin impregnation: Some nephrite may treated with paraffin to conceal surface irregularities (such as cracks or fissures) in the gem.

Heating: Some heating results in the lightening of overly dark colours of nephrite.

Jadeite jades occur in a variety of colours, though by far the most coveted is “imperial jade,” a vivid green, nearly transparent or translucent gem such as the smallest jadeite cabochon shown here.
Collector jades

Deep natural colour and the homogeneity of the colour plays a large role in the appreciation of jadeite jade. Deep green, translucent jadeite is revered, but apple green jades are also highly appreciated. Lavender jades are also popular and rare, while yellow, orange and greyish jades may contain unique symbolic meaning that is linked to their colour. While solid colours in a gem are always appreciated, mottled streaks of colour or a combination of colours might be perceived as symbolic; obviously these are highly coveted. Nephrite jades with strong natural colours as well as materials that are carved into symbols are meaningful to collectors. So too are sophisticated carvings. Because of the durability of both forms of jade, clever carvings that exhibit a three-dimensional object (such as a hollow bead in which jade material had to be carved out) are also objects of desire.

Jade localities

Jadeite jade: The classic and most important source of jadeite is Burma (Myanmar), and it remains the principal producer of the gem today. Another commercial source is Guatemala, though production is not as sustained as the Asian source. Russia and Uzbekistan are also considered sporadic sources of jadeite. Significantly, Burmese jade remains the classic standard by which other jadeites are compared.

Nephrite jade: China is the classic source for nephrite jade, but it is found on almost all continents. Other important sources are Canada, New Zealand, United States, Russia and Australia.

The cutting and care of jades

Both jades are considered extremely durable – even though they don’t rank as very hard on the Mohs Hardness Scale. This is because of their extremely compact, fibrous and granular structures. Both forms of jade are vulnerable to strong acids and heat. However, assuming the colour is natural and untreated, both jades are safe for steaming and immersion in an ultrasonic cleaner. If it is not known whether the gem was treated, a soft bristle toothbrush or damp, non-abrasive cloth should be used for cleaning.

Jade

Mottled jadeite jades, where two or more colours can be seen, are often used in carvings. Carvings were (and are) often Chinese in origin because China has a long history of appreciation for nephrite and jadeite jades.

Nephrite jade is extremely tough and durable. Aside from fashioning it into gems for traditional use in jewellery, it can also be fashioned into extremely intricate, pierced carvings. Nephrite has a long history of appreciation in Asia where it was once considered more valuable than precious metals.
Appreciation for kunzite

Delicacy and subtlety of colour is this gem’s most notable attribute, making it an excellent choice for eveningwear, where its understated pink to lilac colour flashes can be divined and admired even at a distance. Rarity also lends this gem an added sense of exclusivity. It is not widespread enough to be known by all gem aficionados, but those who have developed a passion for it are quick to extol its virtues. Kunzites, while rare, may still be found as large crystals and as such are excellent candidates for jewellery designs that feature large and impressive centre stones. This gem was first discovered near Pala, in California’s San Diego County in 1902. Crystals were sent for identification to America’s top gem expert, George Frederick Kunz, a notable jeweler, author and gemologist based at Tiffany & Co at the time. In a report about the new gem, Kunz wrote: “As this is an entirely new gem of a peculiar beauty, a name will be given to it as soon as its characteristics are definitely determined.” Of course the gem was soon named after him. It was also determined that the gem belonged to the spodumene species, a source for lithium which was often used for industrial purposes. Certainly spodumene, as it had been found till then, hardly qualified for use as a gemstone. But the delicate lilacs and deep purples, which approached the beauty of amethysts, definitely classified kunzite as a gem. Kunzite has since been found in several other localities around the world. Together with hiddenite (a greenish variety found in Hidden, North Carolina), it is a gem variety of spodumene.

Kunzite on the calendar

Kunzite is not on the calendar as a particular birthstone, though Kunz patriotically suggested kunzite as an alternate American birthstone for the month of September, in his book The Curious Lore of Precious Stones (1913).

What kunzite is

Kunzite is a variety of the spodumene species. It forms in the monoclinic crystal system and is composed of LiAlSi2O6

Colour(s): Light in tone, pink to bluish purple.

Refractive Index: 1.660 to 1.676 (+/- 0.005)

Birefringence: 0.014 to 0.016

Specific Gravity: 3.18 (+/- 0.03)

Cause(s) of colour: Manganese

Hardness: 6.5 to 7 on the Mohs Hardness Scale.

Internal identifying characteristics: Kunzite rarely has inclusions, but being of pegmatitic origin, sometimes has a few liquid inclusions. However kunzite has perfect cleavage, meaning it has directional planes of atomic weakness that are prone to parting.
Kunzite’s treatments
Irradiation may produce pink or deeper pink colours from colourless to pink varieties of spodumene. Kunzite’s colour, including irradiated colour, is susceptible to fading upon prolonged exposure to light.

Collector kunzites
Because kunzites are often thought of as uniquely American gemstones (though they are also mined elsewhere), gems from the Pala district possess a unique provenance, especially since they were named after a famous American. Depth of colour, especially in rich magenta coloured gems, is appreciated.

Kunzite localities
United States (the classic source), Afghanistan, Burma, Brazil and Madagascar.

The cutting and care of kunzites
Kunzites are often fashioned as large, step cut gems and rarely carved because of their directional cleavage. Care must be taken, especially with gems set in rings, because they tend to absorb the most physical impact. Kunzites should not be placed in an ultrasonic cleaner. It is best to clean them with a damp, non-abrasive cloth. Because of their susceptibility to fade upon prolonged exposure to bright light, kunzites are best placed in a dark storage container when not in use.

Kunzite has a delicate lilac colour that has many devotees. The gem is considered quite rare as it is only found sporadically at a few sources around the world.

Some kunzites are prone to fading when exposed to bright lights, over long periods of time. Consequently, gemologists often recommend that kunzite jewellery be stored in a dark container when not in use.
Lapis lazuli

Appreciation for lapis lazuli

Technically, the gemstone lapis lazuli is a rock since it is an aggregate of more than one mineral. But, what a rock! Lapis lazuli’s intense blue colour, at times flecked with white calcite and golden coloured pyrite crystals, has captivated people’s attention for thousands of years. The Assyrians and Babylonians prized lapis lazuli for use as carved seals. It was used throughout many of Egypt’s dynasties, and was referred to by them as “heaven’s stone.” Pharaoh Cleopatra VII had a particular affinity for it; aside from using it in jewellery and as an inlay for artifacts, she had it ground into a powder, which could then be emulsified for use as eye shadow makeup. It was used as a pigment (called ultramarine) for many centuries thereafter. It is thought that lapis lazuli was one of twelve gems that comprised the Jewish high priest’s breastplate – during the Exodus from Egypt. Lapis Lazuli, which has long been mined in Afghanistan in an area traveled by merchants along ancient Silk Road, spread appreciation for the blue gem in the Far East as well.

Interestingly, the material was long described as sapphir, though what was known as sapphir in ancient times was probably lapis lazuli – and not sapphire. Even Pliny the Elder used the word sapphir in describing a blue gemstone with golden spots. It is important to bear in mind that, as far as gem colours was concerned, lapis lazuli was the blue gem to covet and cherish, long before blue sapphires came to be appreciated. Today, lapis lazuli is valued as a bold ornamental gem that can be beaded, fashioned into cabochons and carved.

Lapis lazuli on the calendar

While lapis lazuli is not mentioned as a birthstone in modern lists, it was once suggested as an alternate gem for the month of December, together with turquoise. It is considered a 9th anniversary gemstone.

What lapis lazuli is

A rock composed primarily of lazulite, calcite and pyrite. It may also contain hâiynite, sodalite, and diopside.

Colour(s): Medium to dark, slightly greenish blue to purplish blue, often containing metallic looking pyrite crystals and/or white to grey flecks of calcite inclusions.

Refractive Index: 1.50 or 1.67 (with lots of calcite) It can be challenging to obtain a refractive index reading for lapis lazuli.

Birefringence: None

Specific Gravity: 2.75 (+/- 0.25) (This may vary due to mineral content)

Cause(s) of colour: In lazurite, sulfur-related colour centres.

Hardness: 5 to 6 on the Mohs Hardness Scale; it varies due to impurities.

Internal identifying characteristics: randomly scattered pyrite crystals (that appear as yellow metallic flecks) and mottled white calcite crystals.
Lapis lazuli

Lapis lazuli’s treatments

a. **Dyeing** – Lapis lazuli, which is naturally porous, is easily dyed to deepen the colour and give the stone a more uniform appearance.

b. **Paraffin coating or impregnation** – This treatment sometimes follows dyeing in an attempt to seal the gem surface, continue to deepen the colour and help improve its polish.

c. **Oiling** – Some lapis lazuli may be treated with oil in an attempt to deepen its colour.

Collector lapis lazuli

Lapis lazuli that is naturally deep and uniformly blue in colour, is the most collectible form of the gem. Care must be taken to determine if the material has been dyed. If so, it is not considered collectible quality. Some collectors appreciate a discreet spray of pyrite crystals, which serve as further proof of the gem’s natural origin, though calcite’s mottled white flecks are not as well appreciated. Because of lapis lazuli’s ancient past, jewels with known provenance are considered collectible. Carvings, seals and intaglios that have been fashioned by known artists are also collectible.

Lapis lazuli localities

Afghanistan’s mountainous Northeastern area of Badakshan is the world’s most famous locality. It still produces the standard qualities by which other sources are compared. Deposits in Iran, Chile and Russia produce lighter, less saturated varieties of lapis lazuli.

The cutting and care of lapis lazuli

This gem is generally cut in the form of cabochons or tablets, and these kinds of cuts wear well since they have no sharp edges to abrade. Beads also wear well for the same reason. Free form cuts and carvings are also popular with lapis lazuli. A soft damp cloth is ideal for cleaning the gem and because the gem is naturally porous, it should be kept away from substances that could permeate the gem’s surface. Nail polish remover (acetone) and other chemicals may harm dyed lapis lazuli.

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Unevenly coloured lapis lazuli is often used for carvings, whereas pure, deep blues are reserved for use in fine jewellery, much like these square cabochons are.

Lapis lazuli has been admired and used for thousands of years. It is extremely versatile and can be carved into spheres (or beads), tablets or even faceted gems.

Examined up close, it is easy to see why lapis lazuli is considered a composite stone: the white parts are calcite; the metallic golden flecks are pyrite crystals and the deep blue colour is lazulite.
Appreciation for opal

The name opal derives from the Latin word opalus as well as the Greek word opallios. The words refer to a person's ability to perceive a change of colours. These concepts form opal’s principal features: their phenomenal nature and extraordinary range of hues. In the numerous phenomenal varieties of opal, many spectral colours can be enjoyed within a single gem. It is this colourful complexity about opals that caused naturalist, Pliny the Elder– in the first century AD, to write following:

“There is in them a softer fire than the ruby, there is the brilliant purple of the amethyst, and the sea green of the emerald, all shining together in incredible union. Some by their splendor rival the colours of the painters, others the flame of burning sulfur or of fire quickened by oil.”

In 1550, Italy’s brilliant mathematician and naturalist, Girolamo Cardano, noted in his monograph, De Subtilitate Rerum, (The Subtlety of Things), a study of natural phenomena, that he had once bought [an opal] for fifteen gold crowns. His enthusiastic observation was that, compared to a diamond costing him thirty three times as much, the opal had brought him much greater pleasure. Part of his enchantment may have been that one opal never looks like another because play-of-colour patterns change from gem to gem. Like the people who wear them, each opal is unique.

Other writers have invoked opal as well. Shakespeare alludes to the changeable nature of opal in his play, Twelfth Night, when he contrasts the versatile personality of one of its characters to the gem. He also described opal as “the queen of gems.”

Opal’s phenomenal nature has clearly brought enjoyment to many, but it has also evoked unwarranted superstitions. Because of a work of fiction by Sir Walter Scott, written in the 1800s, attributing “enchanted powers” to an opal, some readers mistakenly began to think of opal as an unlucky gem. In the century elapsed since then, opals have regained their rightful reputation as an adaptable gem of beauty. In Australia, where the vast majority of the world’s opals are mined, the gem – especially black opal – is in fact perceived as lucky. Australian aborigines, for example, attributed opal’s discovery with the simultaneous, and fortuitous discovery of how fire can be tamed and utilised to cook food.

While fiery colours – and play-of-colour has always been opals’ principal asset, they can also be colourless, composed of a single bodycolour, or be opaque, translucent or transparent.

One characteristic of opal that is not always as appreciated, as it should be, is the ability of opal to form as a pseudomorph. In the case of opal, this literally means the substitution of another mineral or substance with opal material. As such, opals may form as fossils in clam shells, snail shells, bones, trees or tree branches, and in the hollow inside joints of bamboo stalks. Here, the opals take on the outward appearance of the item they have replaced! However, most opals generally form in seams or cracks within harder rocks such as sandstone or basalt.
It is not surprising that there are several dozen types or varieties of opal, not all of which can be described here. The main commercial varieties are:

**White opal** – is translucent to semi-translucent opal, with play-of-colour, against a white bodycolour.

**Black opal** – is translucent to opaque opal, with play-of-colour, against black, grey, blue, green or brown bodycolour.

**Crystal opal** – is transparent to semi-transparent gem opal that has an essentially colourless bodycolour. However, the colour we perceive is through the play-of-colour phenomenon.

**Fire opal** – is transparent to semi-transparent opal with a range of light yellow to deep orange bodycolour. These gems may have play-of-colour or none at all.

**Jelly opal** – (also called water opal) is transparent to semi transparent, and exhibits no play-of-colour.

**Contra-luz opal** – is a transparent opal shows play-of-colour when light is reflected or transmitted through it. Many Mexican opals show this characteristic. The words contra luz literally translates to “against the light.”

**Boulder opal** – is an opal seam naturally attached to the sandstone matrix where it formed. These can be very thin but still exhibit extraordinary play-of-colour.

**Moss opal** – is an opal containing dendrite inclusions of another mineral that cause a moss or fern-like appearance within the gem.

**Oolitic opal** – is an opal containing dark black or brown spherical inclusions that look like fish roe in appearance.

**Hydrophane** – is an opal that appears as common opal when dry, but which develops play-of-colour phenomena when immersed in liquid.

Black opals are those which exhibit extraordinary play-of-colour against a dark background. In this extraordinary Australian black opal the play-of-colour is so pronounced that the gem’s bodycolour is not discernible.

White opals are those that exhibit play-of-colour against a white or light grey bodycolour.
Opal

Opals on the calendar
Opals are birthstone for the month of October. Opals are also considered gifts to commemorate 14th anniversaries.

What an opal is
Opals are part of a mineral species with an amorphous structure, composed of the following elements: SiO₂·nH₂O. The composition of opals is up to 20% water. Tightly packed and arranged, microscopic spheres of silica, of which opal is composed, cause play-of-colour. Light reflecting off and passing through these spheres, frequently causes interference and diffraction of light, which we are able to perceive as play-of-colour. This phenomenon may be compared to rainbows, which form as light passes through water droplets in air. So while opals may be essentially colourless, they can still have play-of-colour that is revealed as the gem catches the light.

Colour(s): Many colours are seen in opal. Body colours can vary from white to dark blue and to black, with brown, red orange in between. In recent years, a turquoise blue and a pink opal variety, owing their colour to traces of copper, has been discovered in Peru. A milky, green opal found in Tanzania is called prase-opal due to its similarity to the chalcedony variety of prase. Because these gems have no play-of-colour, but are attractive for the body colour they exhibit, they are often faceted or cut as cabochon gems or beads. Play-of-colour is an optical phenomenon independent of the gem’s body colour that can include all spectral colours in unison. Opal may be transparent to opaque; most opal is translucent.

Refractive Index: 1.450 (+0.020, -0.080)
Mexican opal may have lower readings, (1.37 to 1.43)

Birefringence: None

Specific Gravity: 2.15 (+0.08, -0.90)

Cause(s) of colour: Light diffraction affects from tiny irregular spheres of silica, causing the colours we see in the play-of-colour of an opal. If the body colour is green, it is caused by traces of nickel impurities.

Hardness: 5 to 6.5 on the Mohs Hardness Scale.

Internal identifying characteristics:
Occasionally, small amounts of matrix can be seen through thin seams in boulder opal. Consequently, opals often contain elements of the environment in which they formed. Pyrite, hematite and other minerals may occur as stain plumes or tiny, included crystals. Two and three phase inclusions are rare but may occur. Cristobalite inclusions are common in Mexican opal.

A growing popularity of boulder opal from Australia is because thin seams of opal against a dark ironstone matrix can exhibit vivid play-of-colour. Such gems can be cut to include the ironstone as a form of natural backing to the opal seam.
Opal's treatments

There are many kinds of treatments that opals are subjected to. Most are designed to "stabilize" the gem, or deepen the colour, or cause the play-of-colour to stand out against a darker body colour.

a. **Impregnation with oils, wax or plastic** – this treatment may improve play-of-colour and mask the effects of crazing.

b. **Dyeing** – this treatment causes lighter opals to look like darker, black opals, which are considered more valuable.

c. **Smoke impregnation** – this creates the appearance of black opal.

d. **Reflective foil-backing** – this treatment darkens the gem and improves play-of-colour. When the opal is in jewellery, foil backing is not immediately evident.

e. **Black paint backing** – this treatment works in similar fashion to foil backing by darkening the gem and improving the effects of play-of-colour.

Opal doublet (or triplet) – While not within the classic definition of treatments, doublets constitute a man-made measure taken to make thin seams of opal usable in jewellery. A doublet is a thin, natural opal slice that is glued to a strong black substrate, such as dyed black chalcedony. Some glued slices are then capped with transparent quartz cabochons in an effort to protect the thin seam of opal. Two separate materials glued together are called doublets. If a third cap is also used, it is considered a triplet. These “combination” gems may also exhibit strong displays of play-of-colour.

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Collector opals

Collectors prize one-piece opals (without matrix or backing) that display strong play-of-colour. Collectors look for patterns such as “harlequin,” which shows a broad flash of colours when the gem or light source is moved; “pinfire,” which exhibits tiny flashes of multi-colour patches. White opals can also show these characteristics. Contra-luz opals are also collected because of their relative rarity, and because of their dramatic reactions to light. There are collectors of opal nodules from Yowah, an Australian locality. “Yowah nuts” are highly contrasting, large roundish opals, which formed within dark ironstone matrix. In fact there is a growing appreciation for boulder opals, due to their strongly contrasting hues and play-of-colour. Pink, blue and green opals are rare and therefore collectible as well.

Localities for opals

Australia produces well over half of the world’s opals, and some of the finest come from a locality called Lightning Ridge. In the 1950s L. Hudson, a postmaster for the region, wrote a poem describing the area, part of which follows:

*There’s a sleepy little township, out beyond the western plains, Lightning Ridge, the town of opal, where there’s heat and scantly rains. The location is not scenic, just rough ridges all around Nature sired her scenes of beauty, in black opal, underground.*

Several other Australian localities: Coober Pedy, Andamooka, Yowah and Koroit produce opals as well. Opals have been found in the United States, Mexico, Brazil, Peru, Kenya, Ethiopia and Indonesia.
Opal

The cutting and care of opals
Because opals have varying degrees of water content, they are delicate – especially when subjected to heat, temperature changes, changes in air pressure (such as in an airplane). Opals may develop a network of tiny fissures over time, or if subjected to heat or pressure. These fissures are referred to as “crazing” in the trade. Because opals are delicate, they require gentle, loving care in order to last a lifetime. Opals are rarely faceted because the facet edges and junctions are prone to abrasion. Most are cut en cabochon, which avoids abrasion along stark edges. (Some Mexican, Peruvian and crystal opals are faceted and these tend to exhibit a sleepy, milky appearance on colourless or coloured bodycolour). Cabochons are also an appropriate canvas upon which to best exhibit an opal’s play-of-colour. Dampened soft fabrics with no abrasive or chemical additives, or a soft bristle toothbrush doused with water are the best ways to clean opal jewellery. Some gemologists advise storing opal in a damp environment – or even in a submerged in water, to avoid crazing.

Fire opal, such as these gems from Mexico, sometimes are appreciated solely for their intense yellow to reddish body colours. Such gemstones are often faceted.

Opals from Mexico include common opal, fire opal, jelly opal. These gems may exhibit strong bodycolour with moderate to intense play-of-colour.

The jelly opal and contra-luz opal shown here exhibit strong play-of-colour. The gem on the right exhibits play-of-colour when light is directed at the gem and also when light is transmitted through the gem.
Appreciation for organic gems

People have adorned themselves with gem materials long before recorded history began. Prehistoric people probably did so with organics to begin with—because so many such materials were likely a side product of hunting, fishing and gathering during human evolution.

There is great appreciation for such gemstones, even today, because of this tie to life, and also because of the inherent beauty of the gems. As an example, amber’s heritage as a fossilised tree resin, results in the golden coloured gems we love today. It is treasured because it formed between 345 and 146 million years ago, when dinosaurs roamed the earth and humanity did not yet exist. Ancient Greeks believed that amber gems were tears shed by the gods, while others believed amber to be fragments of the setting sun. Entrapped insects and other animals occasionally found in amber dispelled those notions. Today, such inclusions are sought after and prized because they offer a fascinating glimpse into a vanished world. Humans are equally linked to the oceans through pearls, corals and tortoise shells. Cultured pearls remain the single largest organic product that humankind enjoys in jewellery today. As jewellery products, cultured pearls come in many shapes, textures and colours, and are easily put to use in design concepts. In recent years, the explosion of technology in freshwater cultured pearl growth, mainly in China, has added greatly to the choices that jewelers have. Conversely, the use of coral and tortoise shell in jewellery is diminishing over time, due mainly to a growing movement to protect and safeguard marine environments.

A similar principle has curtailed the sale of ivory since 1975, when international conventions prohibited hunting of elephants and walrus—major sources of ivory tusks. There was (and remains) a growing recognition of the need to protect these animals—particularly African elephants—from herd decimation through illicit poaching. A huge ivory industry existed from the mid 1800s to the mid 1900s, when people appreciated ivory carvings, inlays, jeweled accents, piano keys, bead necklaces, billiard balls and handles. That industry is a miniscule fraction of what it once was. Luckily for those who treasure the creamy soft texture of elephant ivory, there are substitutes, such as ivory nut palms, (also called tagua nuts) that are obviously organic as well; many believe this material has the look and feel of animal ivory. Tortoise shell falls under the same endangered species conventions.

Finally, it should be noted that several other—though rarely used—organic materials are sometimes used in jewellery, though they will not be discussed in this Guide. These include: rhinoceros horn, hippopotamus tooth, hornbill, boar, narwhal tusk, and deer antlers. During the 17th and 18th centuries, and through the Victorian era, a black material called jet was used. It is a form of lignite coal found in Whitby, England. Because jet is a fossil derived from decaying wood, it is considered an organic gemstone. Queen Victoria famously used jet jewellery in mourning. Human hair, also an organic substance, was also woven and set in jewellery during the Victorian Era.

[Note: The information about cultured pearls has been abbreviated here, since an entire section about pearls is contained in the CIBJO Retailers’ Reference Guide.]
Organic gems on the calendar

Of the organic gems, only natural or cultured pearls feature on the calendar. Pearls are the birthstone for the month of June, and the feature as a choice for both the 3rd and 30th anniversary.

What organic gems are:

Straightforwardly defined, organic gems are those whose compositions were once part of a living organism, coming from either the plant or animal kingdoms.

Refractive Index:
- **Amber**: 1.540 (+0.005, -0.001)
- **Cultured Pearls**: 1.530 to 1.685
- **Coral**: 1.486 to 1.658
- **Tortoise shell**: 1.550 (-0.010)
- **Ivory**: 1.535 to 1.540 (usually 1.540)
- **Conch pearls**: (a calcareous concretion found in conch shells) 1.530 to 1.685

Birefringence:
- **Amber**: (none)
- **Cultured Pearls**: 0.155
- **Coral**: 0.172
- **Tortoise shell**: (none)
- **Ivory**: (none)
- **Conch pearls**: 0.155

Specific Gravity
- **Amber**: 1.08 (+0.02, -0.08)
- **Cultured Pearls**: 2.72 to 2.78
- **Coral**: 2.65 (+/- 0.05)
- **Tortoise shell**: 1.29 (+0.06, -0.03)
- **Ivory**: 1.70 to 2.00
- **Conch pearls**: 2.85 (+0.02, -0.04)

Cause(s) of colour:
- **Amber** – (may be seen in yellow, orange and brown colours and rarely as blue and green.) Impurities and organic substances cause colours in amber. Green and blue ambers are so perceived due to strong fluorescence in some amber from the Dominican Republic.
- **Cultured Pearls** – pearls are composed of tightly overlaying organic platelets that cause us to see various colours as a result of light interference and diffraction.
- **Coral** – (Red, pink, orange, white and cream coloured.) Organic matter and carotenoids cause the colour in corals.
- **Tortoise shell** – (Mottled brown and tan with varying degrees of transparency.) Organic elements cause the colour.
- **Ivory** – (Creamy white to slightly yellowish white) organic elements.
- **Conch pearls** – (pink to red) Caused by organic molecules and various impurities.

Hardness:
- **Amber**: 2 to 2.5 on the Mohs Hardness Scale
- **Cultured Pearls**: 2.5 to 4 on the Mohs Hardness Scale
- **Coral**: 3.5 to 4 on the Mohs Hardness Scale
- **Tortoise shell**: 2.5 on the Mohs Hardness Scale
- **Ivory**: 2.25 to 2.75 on the Mohs Hardness Scale
- **Conch pearls**: 2.50 to 4 on the Mohs Hardness Scale

Identifying characteristics:
- **Amber** – two phase inclusions of gas and liquid, flow lines, inorganic inclusions, insects and small animals such as lizards. Heated amber causes some inclusions to expand, causing spangled, disc-like inclusions.
- **Cultured Pearls** – slight gritty sensation when rubbed against the cutting edge of your teeth. (Imitation pearls are smooth.)
Organic gems

Coral – Cavities from polyps, fibrous structure.

Tortoise shell – Mottled colouration. Numerous spherical particles are seen under magnification.

Ivory – Structured, parallel lines that intersect, a so-called "engine-turned" effect.

Conch pearls – Flame like structure when a bright light is directed at the pearl.

Organic gems’ treatments

Amber – Heating in oil causes some cloudy amber to clarify, or to produce darker amber colours. Amber is sometimes dyed to add a darker tone to lighter materials.

Cultured Pearls – Pearls are usually bleached, dyed or irradiated (See section on pearls for further information.)

Coral – Corals are commonly dyed or impregnated with epoxy like resins to fill surface cavities and/or to increase durability of the material. Additionally, some corals are dyed.

Tortoise Shell – Rarely tortoise shell is dyed to produce a variation on mottled colour. Some tortoise shell may be laminated together through heat and pressure to make larger pieces.

Ivory – Ivory is commonly bleached to lighten or remove stains, for a uniform colouration. This is sometimes followed by a dye to give the ivory an "antique" appearance. Finally, ivory is occasionally impregnated with colourless wax.

Conch pearls – None known.

Collector organic gems

Amber – Strong colours in amber are considered collector items, as is any amber containing unusual insects. Entomologists seeking to understand a bygone world often collect these amber samples for further study.

Cultured pearls – Cultured South Sea and Tahitian pearls or large size and unusual colour or orient are especially prized. There are some (though rare) faceted pearls strands that are occasionally collected. Natural (not cultured) pearls are always collectible since they are rarely found today. This is also true for antique jewels containing natural pearls.

Coral – Large, fine coral carvings of rich pin to deep red colours are most highly prized and very rare.

Tortoise shell – Antique hair ornaments and combs, boxes and objects of art,

Ivory – Intricate delicate Far Eastern carvings, cue balls, hair ornaments, fans and miniature 17th Century Netsuke sculptures are collected.

Conch pearls – Conch pearls that are uniformly spherical or oval in shape, which contain deep pink to red colour and highly visible “flame structure” patterns, are highly collectible.

Organic gem Localities

Amber – Dominican Republic, Baltic Sea (bordering Germany, Poland and Russia), Mexico.

Cultured pearls – Japan, China, South Sea (Tahiti), Philippines, Australia, United States, Mexico.

Coral – Mediterranean Ocean, (Algeria, France, Italy, Morocco and Tunisia); Taiwan, United States, Mexico, Dominican Republic, Australia, Malaysia.

Tortoise shell – Brazil, Caribbean, Pacific Ocean, West Indies, East Indies, Indian Ocean, Malay Archipelago.

Ivory – All African countries where elephants roam, Sri Lanka, Thailand, India.

Conch pearls – Mexico, Dominican Republic, South Pacific, United States.

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Organic gems

The cutting and care of organic gems

Most organic materials are fashioned as cabochons or rounded or free-form beads, and are rarely faceted. Ivories may be carved into very delicate, intricate, detailed carvings, and objects of art, particularly in Eastern Asia. While rings using organic materials are used, the user must take special care.

Avoid rough handling, heat and chemicals for all organic materials. They are soft, occasionally brittle, and porous enough to be attacked by acids. Cleaning may be performed using a dampened cloth or a moistened soft bristle toothbrush. Strung pearls should not be soaked in water, as this will cause the silk cord to stretch.

Gems from the sea include organic treasures such as the tortoise shell (top and butterfly pin), the pink, white, purple and red coral carvings and necklaces, and the trio of cultured pearls.

Organic gems found on land include ivory (top cabochon and carving), vegetable “ivory,” or tagua nut (bottom right), jet (bottom), and amber.

Amber is often prized for relics of the ancient past they may contain, such as these insects and plants enveloped in amber from the Jurassic period.

Extremely rare “conch pearls” are collected for their beautiful pink to reddish colours and their phenomenal “flame structure.” This effect is best seen when a bright light illuminates the gem.
Peridot

Appreciation for peridot
For anyone who loves hazy, yellowish green colours, peridot is sure to be appreciated. At its best, the gem exudes a soft, oily appearance; comparable to the deep greens you might see in a glass of olive oil. In ancient times, peridot was described as a gem “containing rays of sunshine.” It is easy to see why: in direct, brilliant sunshine, peridot often returns a warm, yellowish glow to the eyes. Additionally, peridot has very high double refraction (or birefringence), causing an optical effect in which a doubling of pavilion facets often is observed when looking through the table of the gem; this feature accentuates peridot’s soft, velvety look.

Peridot is a variety of the mineral olivine, and has been treasured as a gem for thousands of years. Egyptian slaves are said to have discovered the first source for it at Zabargad, a desolate island in the Red Sea. Zabargad is considered the classic source for the gem, though it no longer produces commercial quantities. Luckily, the mineral olivine occurs on every continent. As a transparent, bright green gem, peridot is much more elusive.

Even so, peridot has even been found in meteorites, suggesting that another continent like our own is not out of the realm of possibilities somewhere in space!

The source of the name is thought to be Arabic, deriving from the word faridat, meaning gem. However, French and 13th Century English root words have also been suggested as the name derivation for this gem.

Peridot on the calendar
Peridot is the birthstone for August. It is also a 15th anniversary gemstone.

What peridot is
Peridot is an olivine mineral that forms in the orthorhombic crystal system and is composed of the following elements: (MgFe)2SiO4.

Colours: yellowish green to greenish yellow to brownish green
Refractive Index: 1.65 to 1.69
Birefringence: 0.035 to 0.038

Specific Gravity: 3.34 (+0.14, -0.07)
Cause(s) of colour: traces of iron impurities.
Hardness: 6.5 to 7 on the Mohs Hardness Scale.
Internal identifying characteristics: Inclusions of biotite mica, chromite and biotite in the gem often cause internal stresses to occur. In turn, these stresses cause liquid filled discoid fractures known as lily pad inclusions.

Peridot’s treatments
None known.

Collector peridots
With peridots, locality, colour and size are the significant aspects to consider. Gems that can be proven to come from Zabargad (also called St John’s Island) are rare since that classic deposit has been largely depleted. Burma (Myanmar) and, more recently, Pakistan are sources that continue to provide exceptional gems of significant size, often over ten carats.
Because peridot is plentiful, collectors often opt for size (ten carats or above) with saturated, slightly yellowish green colours. Cutting has become an important factor as well: well balanced gems that efficiently return colour and light, together with crisp facet junctions, are always appreciated. On extremely rare occasions, a star peridot (sporting 4 rays) is reported.

**Peridot localities**

Egypt (St John’s Island) is the classic source, though it is no longer a commercial producer of the gem. Burma is considered a classic source too, if only because it has consistently produced large, clean peridots, which have become a global gauge to measure this gemstone’s beauty. In recent years, Pakistan has also become a producer of very fine material. The United States consistently mines for the gem in the State of Arizona, though these peridots are generally smaller and sometimes slightly brownish in colour. Australia, Brazil, China, Kenya, Ethiopia, Norway, Sri Lanka and the Antarctic have also produced it, though not in significant commercial quantities.

**The cutting and care of peridots**

Because peridot is not an extremely hard gem, ultrasonic cleaners are not an ideal way to clean peridot jewellery. Peridots are also susceptible to extreme heat, so steamers should not be used. Certain acids used in jewellery manufacturing may etch peridot, so it is recommended they not be used around this gem. Finally, a soft, damp cloth, or a soft bristle toothbrush is probably best to use when cleaning peridot jewellery.

**Very large peridots may occur at sources around the world, though they are not common in deeply coloured, exceptionally clean gems such as this one.**

**The characteristic colour of peridot ranges from a grassy green to a softly hazy yellowish green.**

**Crystals of chromite or biotite are known to cause these characteristic, discoid, “lily-pad” formations in peridot.**
Appreciation for unusual quartz and chalcedony

Were it not for gemological physical and chemical constants, multitudes of unique quartzes would certainly be appreciated as different gem species – because they can look so different from one another. Quartzes can be colourless or richly coloured, transparent or opaque, highly included or not. They can exhibit chatoyancy, asterism, aventurescence or iridescence. They can be as common as particles of sand on the beach, or deeply coveted gems that are spirited into private collections and insured at high values.

The noted Swiss gemologist, Dr. Eduard Gübelin, aptly referred to quartzes as the “jack of all trades.” Yet it is found on every continent on earth, standing in as one of the world’s most plentiful minerals.

In ancient times it was believed that quartz was a form of permanent ice, a suggestion first offered by the natural historian, Pliny the Elder. This belief evolved from what was once a major source for quartz: the snow and ice-covered Alps. The word crystal in fact derives from this mode of thinking.

The Ancient Greek word for ice is kristallos. In 1646, Sir Thomas Browne proved crystal quartz to be a mineral, rather than permanent ice. His book Pseudodoxia Epidemica, described this as one of his corrections to “vulgar errors.”

Colourless quartz, or rock crystal quartz, has long been cherished for its clarity – references to the clarity of crystal emanate from ancient writings, including the Bible. Some people have long believed that gazing into a large rounded crystal gave clairvoyants an ability to “see” the future.

Colourless quartz with bold and colourful inclusions of another mineral (such as tourmaline, hematite, mica or rutile are increasingly used in jewellery.) Generally, more colourful forms of quartz, such as amethyst and citrine, are predominantly used in jewellery. (For more about amethyst see page 6; for more about citrine, see page 13).

Closely related to citrine is a brown coloured gem, called smoky quartz. It was found in the Cairngorm Mountains of Scotland and extensively used in Scottish jewellery in the late nineteenth century. Since then the majority of brown quartz has been sourced in other localities around the world. There is also a small amount of natural green quartz available, called prasiolite. However, the majority of the green quartz available on the market today is pale amethyst treated to turn green.

Rose quartz is a semi transparent to transparent variety of quartz whose devotees appreciate its soft, pink colour. It tends to be very lightly saturated and when cut as a cabochon, and it occasionally exhibits asterism in direct lighting. The star effect is caused by light reflecting from tiny, oriented, included rutile needles that align themselves hexagonally during the crystal’s formation. Stars and cat’s eyes occasionally form in smoky quartz and (rarely) in colourless quartz as well.

Aventurine is yet another quartz that exhibits phenomena as a result of its inclusions. Curiously, the term “aventurescence” is named after an Italian glassmaker who accidentally tipped copper filings into a batch of molten glass. The result of his fortuitous accident was a glittering form of man-made glass.
His colleagues remarked he had found it “per avventura,” or by chance. The name stuck. Aventurine glass, which is still manufactured and faceted in Italy, should not be confused with aventurine quartz. Aventurine quartz is green in appearance and its aventurescent effect is generally less pronounced than in glass. Aventurescence in quartz is due to the granular interlocking of quartz crystals, combined with flat, disc-like inclusions of mica that produce glittering reflections in direct light. This optical effect is similar to schiller – which is used to describe glittering reflections in sunstone.

Rutilated and tourmalinated quartzes (also called sagenitic quartzes) contain large, highly visible inclusions that become a celebrated part of the gem itself. Rutile needles may be random, large and golden in colour, or may form in multi-rayed, star-like inclusions within the gem. Drusy quartz is occasionally used in jewellery design. This is an overgrowth of minute quartz crystals over other larger specimens, or matrix. The result is a glittering, rugged texture that is kept in its rough form and mounted in jewellery.

Chalcedony is a significant and historical form of quartz; a family with dozens of varieties and colours. Chalcedonies have been enjoyed and used in jewellery for thousands of years. Some estimates gauge the use of chalcedony in seals and ornaments – as far back as the Bronze Age, circa 1800 B.C. A more recent record for chalcedony dates back to the Israelites’ Exodus from Egypt. At least three varieties of chalcedony were used in the Jewish High Priest’s Breastplate. (Moses’ brother Aron wore the Breastplate, with inscribed gems representing the twelve tribes of Israel). The Breastplate included jasper, chrysoprase and sardonyx, and there is some debate as to whether other agates were also used.

Here are some of the principal chalcedony varieties used in jewellery today:

- **Agate** – The word “chalcedony” is sometimes used interchangeably with the word agate, though agate generally describes curved or angular-banded varieties of chalcedony.
- **Amethystine** – Semi translucent to opaque purple colour.
- **Bloodstone** – A dark green chalcedony with deep red spots.
- **Carnelian** – Semi transparent to translucent yellow orange to orangy red or brownish orange gem.
- **Chrysocolla-in-chalcedony** – Translucent to semi translucent intense light blue or blue green, owing its colour to chrysocolla, a copper silicate.
- **Chrysoberyl** – Transparent to semi translucent, light to medium yellowish green. A slightly less saturated green material is referred to as “prase.”
- **Dendritic Agate** – Chalcedony containing dark, branch-like or tree-like inclusions.
- **Fire agate** – semi translucent to opaque with iridescent phenomena against a brown bodycolour.
- **Landscape agate** – A chalcedony that contains trace impurities of other minerals that cause unusual colour combinations, which resemble landscapes.
- **Iris agate** – Semi transparent to translucent, exhibiting phenomenal iridescent colours when light, especially pinpoint lighting, is transmitted through the gem.
- **Jasper** – Translucent to opaque material, that may be any colour or combination of colours – except black.
- **Onyx** – Larger slabs with straight parallel layers of different colours and degrees of translucency are sometimes referred to as onyx.
- **Sard** – Semi transparent to translucent dark brownish red to brown or dark orange, but less saturated in colour than carnelian.
- **Sardonyx** – Semi transparent to translucent dark brownish red to brown or dark orange, but less saturated in colour than carnelian, containing white or black banded parallel layers.
Unusual quartzes and chalcedony

Other quartzes and chalcedonies on the calendar

Quartz: Rose quartz is sometimes regarded as an alternate birthstone for the month of January (along with garnet).

Chalcedony: Bloodstone (a variety of agate) is an alternate birthstone for the month of March. Onyx is suggested as a 7th anniversary gemstone.

What quartzes and chalcedonies are

Quartz and chalcedony are both mineral species with the chemical composition of SiO₂.

Quartz grows in the hexagonal crystal system, whereas chalcedony is an aggregate material. Some chalcedony grows in a botryoidal formation.

Refractive Index:
Quartz: 1.544 to 1.553
Chalcedony: 1.535 to 1.539

Birefringence:
Quartz: 0.009;
Chalcedony: usually not detectable.

Specific Gravity:
Quartz: 2.66 (+0.03, -0.02)
Chalcedony: 2.60 (+0.10, -0.50)

Cause(s) of colour:

Rose Quartz – Titanium traces and/or colour centres.
Smoky quartz – Colour centres involving aluminum impurities.
Aventurine quartz – The colour is caused by the inclusions of fuchsite and mica platelets.

Carnelian – Body colour due to iron impurities. Chromium may be present in redder colours.

Chrysocolla – Colouration normally due to impurities of copper.
Chrysoprase – Colouration normally due to impurities of nickel and/or iron.
Fire agate – Body colour due to iron impurities.
Sard – Body colour due to iron impurities. Chromium may be present in redder colours.

Hardness:
Quartz: 7 on the Mohs Hardness Scale.
Chalcedony: 6.5 to 7 on the Mohs Hardness Scale.

Internal identifying characteristics:
In transparent quartz varieties dendritic inclusions, and inclusions of other minerals such as mica, may be present (liquid inclusions can be found in all varieties of transparent quartz). There may be colour zoning. In chalcedony there may be inclusions of other minerals and occasionally organic inclusions – such as shells. Thick bands of colour often characterize chalcedony. Dendritic inclusions are seen in chalcedony as well.

Quartzes, other than the principal varieties of amethyst and citrine include (top row):
rock crystal quartz, smoky quartz, rutile-tipped quartz, rose quartz, rose quartz and ametrine.
Bottom row: smoky quartz, rutile-tipped quartz and praseolite.
Unusual quartzes and chalcedony

Quartz and chalcedony treatments

Quartz:

a. **Quench crackling** – Heating, followed by immersion in water causes thermal shock and the gem develops cracks and fissures. This by itself is not attractive, but it is followed by a dye impregnation to reach deep inside the quartz. The result, for example, can make a gem look surprisingly like emerald or ruby (depending on the dye used).

b. **Irradiation** – Colourless quartz can be irradiated to look smoky; rose quartz’s colour can sometimes be deepened through irradiation.

c. **Heat treatment** – Heating may lighten the colour of dark smoky quartz.

d. **Coating or foil backing** – Deepens the colour of some gems. May help with cat’s eye or star phenomena.

e. **Dyeing** – (Generally after quench crackling) may cause the material to appear a totally different colour.

Chalcedony:

a. **Dyeing** – Chalcedony can be dyed in practically all colours, due to its porous nature. Much of the black chalcedony sold on the market is dyed black. In banded material, some bands may be dyed while others remain white.

b. **Heating** – Some yellow to brown material may be heat treated to result in redder colours.

Collector quartzes and chalcedonies

Quartz: Rose quartzes and phenomenal quartzes are often collected with emphasis placed on depth of colour and strength of phenomena. Smoky quartzes are collected in antique jewellery – especially Scottish jewellery, due to the historical aspects.

Chalcedony: Chalcedony exhibiting unusual banding or landscape scenes are particularly prized, as are agates containing dramatic dendritic inclusions. Iris agates and fire agates exhibiting strong iridescent colours are also collected. Finally, carved chalcedony, such as intaglios or cameos, may be collectible if they have provenance that can be identified as typical of a certain era. Signed gems from a known lapidary artist are also collectible.

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Unusual quartzes and chalcedony

Quartz and chalcedony localities

**Quartz:** Germany, Hungary, India, Iran, Brazil, Bolivia, South Africa, Madagascar, Mexico, Sri Lanka, Scotland, Spain, Switzerland, United States.

**Chalcedony:** Germany, Brazil, India, Russia, Australia, Austria, Scotland, Italy, Mexico.

The cutting and care of quartzes and chalcedonies

**Quartz:** Skilled lapidary artists often carve rock crystal quartz into objects of art, or in unusual shapes. Gems exhibiting phenomena are often cut *en cabochon* or tablet shapes.

**Chalcedony:** Chalcedony is a gem composed of cryptocrystalline (microscopic) quartz crystals that form in tightly interlocking, fibrous masses. This provides chalcedonies with extraordinary toughness, allowing them to be carved in large flat cabochons, intaglios, cameos, tablets or even plates or bowls. Idar-Oberstein, twin cities in Germany, have been known for developing the cutting and carving industry for this gem since the 1700s. Artists there carved local chalcedonies, but later began to import agate from Brazil as supplies dwindled in Germany.

While quartz and agates are very durable in general, special care should be taken with subjecting them to temperature extremes. Quartzes may be cleaned in an ultrasonic cleaner if it is clear and there are no fissures that could endanger the durability of the stone.

Chalcedonies may be porous, so care must be taken not to immerse the gem in substances that could change its appearance. As with most gems, a damp, soft cloth, or scrubbing with a soft-bristle toothbrush, are the best ways to clean these two forms of quartz.

Unusual quartzes and chalcedony

Chalcedonies, forms of cryptocrystalline quartz, include chrysoprase (the green carving and cabochon), amethystine chalcedony, chrysocolla (the blue green cabochon), and the carnelian beads.
Unusual quartzes and chalcedony

Banded agate, such as this sardonyx, are often carved into beads, bowls or sculptures.

Some chalcedonies contain impurities that oxidize over time, resulting in highly collectible dendritic patterns.

Unusual varieties of quartz and agate are this rutilated quartz cabochon (left), and this fire agate, which exhibits rounded formations and iridescent colours.

Moss agates contain inclusions that look like moss. The reddish orange colouration is due to trace impurities of iron.
Appreciation for ruby

Throughout humanity, red has represented passion and romance. Ruby, the red gemstone of the corundum species, has been engaged for centuries to symbolize those sentiments. 17th Century English poet, Robert Herrick, made allusion to both passion and the gems’ colour when he wrote:

Some asked me where the rubies grew,
And nothing I did say;
But with my finger pointed to
The lips of Julia.

Rubies are mentioned in the Bible – and their value is clearly understood. The remark in Job, “The price of wisdom is above rubies,” is but one of several references. Ruby was chosen to represent one of the twelve tribes of Israel during Exodus, and was worn on the Breastplate of the Jewish High Priest.

The word ruby comes from the Latin, ruber, meaning red. While there are several red gemstones enjoyed by humankind, ruby is esteemed and regarded as the very definition of red. Descriptions of ruby’s colour have wandered into passions as well, with the old phrase “pigeon blood” sometimes used still to describe a fine ruby. For some, red spinels come close to be considered as equals, and in a few interesting historical cases were indeed thought to be rubies! The famous Black Prince’s Ruby, a 170-carat gem that graces the Imperial State Crown of England, nestled next to the famous Cullinan II diamond, is a case in point. Worn by successive Kings and Queens since the 1300s (and even in helmets going into battle) the gem was found, upon examination, to actually be a spinel. That said, the differences between ruby and spinel were not always understood in antiquity, and red gems in general were often simply described as “ruby.”

The Persian scientist, Abu Rayhan Biruni did classify differences between spinel and ruby gemstones in the 11th century, though his teachings did not make it into conventional thought until much later. Sources for rubies are as fraught with passion and romance as the gemstones they produce. The French traveler and merchant, Jean Baptiste Tavernier who traded in gemstones in the mid 1600s, identified Ceylon (Sri Lanka) and the Kingdom of Pegu (Burma – or Myanmar – today) as the main sources of ruby. In describing the perils inherent in hunting for gems, he notes that a voyage to Kyatpyen, where rubies were traded, should not be attempted by land: “…on account of the jungles which abound with lions, tigers and elephants,” he wrote. In 1904, traveler V.C. Scott O’Conner described Thabeit-Kyin as the port of Mogôk, Burma’s famous ruby and sapphire source: “Through this little postern gate the wealth of Capelan has passed for centuries on its way to the great world; to the treasuries of kings, to the fingers of princes, to the necks of beautiful women; to the making of one, the undoing of another.” And this is exactly how locality fits into appreciation. Because Burma has produced a standard of quality by which rubies from other localities are often measured, the term “Burmese ruby” has also come to be understood by many in the trade as a quality designation. But designations of that kind require additional qualification, as Burma produces both high and low end quality rubies.
Appreciation for rubies has a historical genesis in India, especially during the rule of the Mughals in the 1500s, whose leaders—particularly Shah Jahan, had an affinity for rubies and other gemstones. These were often carved with verses from the Qur’an and worn in turbans, articles of clothing and jewellery. The features of ruby, which have always been appreciated, are those that help define the meaning of gemstone: rubies are beautiful; they are durable and they are rare.

Ruby on the calendar
Ruby is a birthstone for the month of July. 15th and 40th anniversaries are celebrated with ruby.

What a ruby is
A variety of the mineral species corundum, forming in the hexagonal crystal system with the chemical composition of Al₂O₃. 

Colours: orange red to strongly purplish red; also brownish red. The dominant colour must be red.

Refractive Index: 1.762 to 1.770 (+0.009, -0.005)

Birefringence: 0.008 to 0.010
Specific Gravity: 4.00 (+/- 0.05)

Cause(s) of colour: Chromium with possible modifications of colour with iron and titanium.

Hardness: 9.00 on the Mohs Hardness Scale.

Internal identifying characteristics: “Silk,” networks of fine, included rutile needles, intersecting at 60 degree angles, are commonly seen in natural ruby. Included crystals of zircon, and related stress fractures (or halos) are sometimes seen. Liquid-filled “fingerprint” inclusions are also common.

Note some of these identifying characteristics may disappear, change or be diminished as a result of treatments.

Ruby’s treatments
a. Heating – This treatment dissolves or partially dissolves fine rutile needles thereby increasing the clarity and transparency of the gem. In certain cases, controlled heating helps re-define asterism in star rubies. It may also help remove purplish or brownish colour components in some gemstones, resulting in stronger red colours.

b. Diffusion – The diffusion of colour causing elements through intense heating is sometimes used to strengthen the colour of some rubies.

c. Oil and dye – Some rubies with surface reaching fissures may be treated with oil or dyes, resulting in stronger colours. The treatments are not considered durable and require special care considerations.

d. Glass filling in cavities and fissures – High lead content glass is sometimes used to fill surface reaching fissures, pits or cracks in certain rubies/corundum. The treatment increases the transparency of low-grade ruby/corundum.

Collector rubies
Location, or provenance, is particularly important with ruby. A fine ruby with a “Burme” designation may be perceived to be of a much higher value than an equally fine ruby from a different locality. Colour is of extreme importance. The more purely red a ruby is, without undue influences of purple or brown, the more collectible it becomes.

Clarity and size of the gem is also important, though the presence of silk or other inclusions is often valued since it not only points to a gem’s natural origin; it also suggests the gem has not been treated. Cut or carved rubies that have known provenance are also collectible.
Ruby

Star rubies are rare and collectible especially if the legs of the star reach from girdle to girdle of the cabochon, and are unwavering and sharp. Star rubies often have a milky complexion due to inclusions of rutile, so depth of colour and transparency are additional important factors in valuing and collecting star rubies.

Ruby localities

Thailand, Burma (Myanmar), Cambodia, Sri Lanka, Kenya, Afghanistan, India, Pakistan, Tanzania, Greenland, Tajikistan are all sources for rubies.

The cutting and care of rubies

Rubies are mostly cut in traditional pear, round, oval, cushion and emerald cut outlines. They are rarely engraved or carved today, though rubies were sometimes engraved during India’s Mughal Era. Rubies are extremely durable due to their hardness and toughness – second after diamond on the Mohs Hardness Scale. Ruby jewellery may be cleaned in an ultrasonic cleaner, or it may be steamed. But this should follow close inspection to determine if there are any surface reaching fissures that could expand, or if oils or dyes are present. As with most gemstones, a soft moistened cloth, or a soft bristle toothbrush may be used to clean the gem.

A ruby’s dominant colour must be red, such as in this gem from Mogok, Burma.

Star rubies are appreciated for their colour as well as the sharpness of the star effect.

Rutile needles in ruby are often fine enough to be labeled as “silk.” The needles are oriented in directions of the ruby’s hexagonal growth structure, and may cause asterism.
Appreciation for sapphire

If blue is the colour you think of when the word “sapphire” is said, you are very close to its root. It derives from Hebrew and Arabic terms safir, meaning blue, and saphheiros, meaning blue in Greek. In ancient times, such words referred to a blue gemstone, most likely what we know as lapis lazuli today. Conversely, the ancients called the today’s sapphire “hyacinth,” due to its colour similarity to blue hyacinths. Obviously that term has changed with the passage of time, though a lovely poem about gems by Marbodus, the Bishop of Rennes written approximately 1000 years ago speaks of the colours of hyacinth, as follows:

Three various kinds the skilled as Hyacinths name,
Varying in colour, and unlike in fame:
One, like pomegranate flowers
a fiery blaze
And one, the yellow citron’s hue displays
One charms with paley blue the gazer’s eye,
Like the mild tint that decks the northern sky,
A strengthening power the several kinds convey,

And grief and vain suspicions drive away.
The blue sort feels heaven’s changes as they play,
Bright on the sunny, dull when dark the day,
But best that gem which not too deep a hue,
O’erloads, nor yet degrades too light a blue.

Even then, a classification of “hyacinth’s beauty was tacitly underway. The reference to blue hyacinths, lovely flowers, remains an apt association. But the term began to fade. In the 15th Century, the naturalist Camillo Leonardo spoke and wrote about “sapphirini.”

Modern day usage of sapphire includes almost all colours of the spectrum other than just blue – as Marbod’s poem suggests. Sapphires, in fact, can be any colour but red. That’s because red corundum (though essentially the same mineral as sapphire) is classified as a ruby. In short, the difference between ruby and sapphire is that only ruby can be red! So in separate colours of sapphire, descriptions are preceded by a colour designation, such as “yellow sapphire.” Corundum, other than red or blue, may also be referred to as “fancy sapphire.” Blue sapphires in their best qualities have a flower comparison, as they did in ancient times: today their colour is compared with cornflowers.

The allusion to flowers does not end there. Colour variations are what make this variety of corundum so interesting, as are the “mixed colours.” One important gem with a blend of colours, which captivates the imagination, is the padparadscha sapphire. Padparadscha (which derives from Sinhalese language meaning lotus blossom) is an extraordinary and rare variety. This gem blends intense light to medium pinkish orange to orange-pink colours, in order to be thought of as padparadscha.

In recent years, there has been a growing appreciation for phenomenal gems – of which sapphire enjoys two principal varieties: Star sapphires in blue and various other colours, cut as cabochons, and colour-change sapphires have both received increasing attention in recent years.

Sapphire on the calendar

Sapphire is the birthstone for the month of September. It is used to celebrate 5th and 45th anniversaries.
Sapphire

What a Sapphire is

A variety of the mineral species corundum, forming in the hexagonal crystal system with the chemical composition of Al₂O₃.

Colours: Blue sapphire: very light to very dark violetish blue to greenish blue. Fancy colours: All colours of the corundum species excepting blue and red (blue sapphire and ruby respectively). These colours include green, yellow, orange, pink, purple, violet, brown, black, and colourless. Sapphires may also contain two colours, mixed colours or other variations. In recent years pale coloured sapphires of various colours have come to be known as “pastel sapphires” in the trade.

Refractive Index: 1.762 to 1.770 (+0.009, -0.005).

Birefringence: 0.008 to 0.010

Specific Gravity: 4.00 (+0.10, -0.05)

Cause(s) of colour: Blue: iron and titanium. Green: iron or iron and titanium. Yellow: iron; orange: iron (and possibly chromium in padparadscha variety). Purple: varying traces of iron, titanium and chromium.

Pink: chromium; possibly titanium. Colour change: combined presence of chromium, vanadium, iron and titanium.

Hardness: 9 on the Mohs Hardness Scale.

Internal identifying characteristics: Inclusions in sapphire may be composed of fine rutile needles (called silk), which may intersect at 60-degree angles. In such cases, when the gem is cut as a cabochon, star effect may occur. Included zircon crystals or crystals of different minerals may occur in sapphires and colour zoning, particularly seen in angular patterns. These are sometimes fingerprint inclusions.

Sapphire’s treatments

a. Heating – This treatment is designed to increase transparency by reducing the opacity of clouds of rutile inclusions. While the treatment helps to improve the clarity of slightly included gems, it has also been performed on low quality sapphire material known as geuda. This is a high temperature treatment that results in strong blue and yellow colours. Heating may also cause some overly dark blue or green sapphires to be lightened in tone, or to turn purplish sapphires into pink colours.

b. Diffusion – Heating certain sapphires to very high temperatures allows a secondary treatment, called diffusion, to take place. Elements, such as beryllium or titanium, are diffused into the corundum, causing colours in the gem being treated to deepen or change.

c. Coating – On rare occasions, some sapphires are coated with thin films that cause the colour of the sapphire to deepen or change.

d. Irradiation – In some cases, colourless to near colourless sapphire can be turned orange or yellow though irradiation. Colour in irradiated sapphires fades over time.

d. Glass filling in cavities and fissures – While this treatment is less prevalent in sapphires than in rubies, it should be noted that any gem material with surface reaching fissures might be subjected to infilling of glass or other substances, with the goal of increasing the transparency of the gem.

Collectors sapphires

Several factors may be used to judge fineness in sapphire, though ultimately beauty of a gemstone remains in the eye of the beholder. Blue sapphires – collector gems – should possess the ability to be spotted from across the room because of their depth and saturation. The transparency of the sapphires also comes into play. Because inclusions can cause some gems to have milky colouration, this becomes a detriment if it also causes a perceived loss of blue. In one notable exception, haziness is not only expected; it is desired – and that is in the top sapphires from Kashmir. The haziness (often referred to as sleepiness) acts to diffuse light and colour, resulting in magnificently even blue colouration.

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In recent years, Gemstones coming from various localities around the world, such as the island of Madagascar, or the Umba River Valley in East Africa, have supplied unique palettes of colours. Many such sapphires are unique enough to be considered for collections, especially in suites showing an array of hues. East Africa and Madagascar have joined other sources such as Sri Lanka in bringing to market rare colour change sapphires, many changing from a blue grey colour in daylight, to a violet or purple colour in incandescent light. Star sapphires with strong colour in which the “legs” of the star are girdle to girdle, straight and unwavering. Fine padparadschas are also considered collectible.

Sapphire localities

Sri Lanka and Burma are historic sources for sapphire and produce some of the world’s finest gems. In extremely high qualities, Kashmir has emerged as the preeminent source for blue sapphires as the standard for fineness. Sri Lanka is the classic source for padparadscha sapphires, though other sources also now produce mixes of pink and orange colours as well. Australia, Thailand, Cambodia, Kenya, India, Tanzania, Madagascar, United States all produce extremely fine blue sapphires, as well as many fancy coloured ones. Fancy sapphires are also produced in other countries such as Vietnam and Zimbabwe.

The cutting and care of sapphires

Sapphires are mostly cut in traditional pear, round, oval, cushion and emerald cut outlines. They are sometimes engraved or carved today, though sapphires were sometimes engraved during India’s Mughal Era. Sapphires are extremely durable due to their hardness and exceptional toughness; they are second after diamond on the Mohs Hardness Scale. Sapphire jewellery may be cleaned in an ultrasonic cleaner, or it may be steamed. But this should follow close inspection to determine if there is any surfacereaching fissure that could expand, causing damage. As with most gemstones, a soft moistened cloth, or a soft bristle toothbrush may be used to clean the gem.

Sapphires may contain fine needles inclusions of another mineral, such as rutile. These intersect at 60 degree angles and may cause asterism in some sapphires.
Appreciation for spinel

Spinel has long been one of the most underestimated gems on earth, but that factor is rapidly changing. With education, a greater understanding of the gemstone’s unique optical characteristics, its rarity, and versatility is taking place. Because spinel is one of the only species of gemstones in the world that is not treated commercially to enhance or change its characteristics, some gemological purists and collectors are also devoted to it.

Spinel has been known since ancient times, though it is likely the gem was often confused with corundum; blue and red spinel can look very similar to blue sapphire and ruby, respectively. For years it was referred to as “balas ruby” because a source for the material in present-day Badakshan in northeastern Afghanistan. In the chapter on ruby, it was noted that the Black Prince’s Ruby, the centrepiece of the British Imperial State Crown... is actually a spinel. Another gem set in the crown is the Timur Ruby, a 361-carat gemstone that is also a spinel. It is thought that many other gems decorating the crowns of Europe may in fact be spinel. Should that be the case, it is not a detriment. Spinels stand on their own as magnificent gems, capable at the very least of equal beauty as their corundum counterparts. Appreciation for spinels inevitably brings us to one of the world’s greatest collectors of gemstones. Among the Iranian crown jewels is one named the Samarian Spinel. Weighing in at 500 carats, it is thought to be the world’s largest spinel. Its provenance dates back to the 18th Century Persian conquest of India. An inscription on the back of the spinel confirms that the great Indian Mughal gem collector, Jehangir, had once owned it. Interestingly, the Timur Spinel in the British crown jewels bears an inscription indicating Jehangir had also owned it. Much of the appreciation for spinel is due to its unique gemology. There is a clarity and directness about spinel that many enthusiasts appreciate. Optically, spinels are singly refractive, meaning that light passing through them is not split into two rays, as it does with birefringent gems, such as corundum. Spinels have a high refractive index, and many transparent spinels are relatively inclusion-free. Finally, spinels have high dispersion.

This combination of optical characteristics render spinels bright and reflective, and capable of breaking up white light into spectral hues – what we call “fire.” It may be this fire that first gave spinel its name: one derivation of the word comes from the Greek spinter – meaning spark.

Spinel on the calendar

Spinel is not a birthstone on the modern calendar but is used to commemorate a 22nd anniversary.

What a Spinel is

Spinel is a mineral species whose varieties are primarily distinguished by their colour. It forms in the cubic crystal system, and its basic chemical composition is: MgAl₂O₄.

Colours: red, pink, orange, blue, violet, purple are the most common colours. Other colours include brown and black, and rarely, yellow, green and near colourless. Colour change spinels change from greyish blue in daylight to purple in incandescent light.

Refractive Index: 1.718 (+0.017, -0.008)

Birefringence: None
Spinel

Specific Gravity: 3.60 (+0.10, -0.03)

Cause(s) of colour: Blue: iron, cobalt. Red to pink: chromium.

Hardness: 8 on the Mohs Hardness Scale.

Internal identifying characteristics: Minute fingerprint inclusions may be seen in spinels. With sufficient magnification, tiny octahedral crystals may be seen. These octahedral crystals, if large enough, may be accompanied by strain halos.

Spinel’s treatments

Spinels are rarely treated, though occasional experimental heating of spinel has been reported. Spinels with surface reaching fissures are infrequently treated with oils or polymers.

Collector spinel

Colour, carat weight, clarity and origin all play a role in how spinels are valued and collected. Gems whose provenance can be ascertained always have collectors. Red spinels that are deep red, large and relatively free of inclusions are also highly desired. So too are rare, deep blue spinels, particularly when a gemological laboratory has determined that cobalt is the colouring agent. Locality is playing an important role for collectors as well. Rare spinels from the Pamir Mountains are collectible, as are spinels from Burma. New localities that produce desirable colour – anywhere from pink to deep red are collectible.

Spinel localities

Afghanistan – especially in the region of Badakshan, in the Pamir Mountains, remains a classic source for the gem. Burma is also a classic source and remains a strong producer of the material. Sri Lanka, Cambodia, Thailand, Kenya, Tanzania, Russia have all produced spinel. Recent spinel finds in East Africa have reinvigorated interest in the gem.

The cutting and care of spinels

Spinels are resilient and tough – more so than many gems (except corundum or diamond.) They may be cleaned in an ultrasonic cleaner or steam cleaned. It is preferable to simply use a damp soft cloth or a soft bristle toothbrush to clean the gemstones and spinel jewellery.
Appreciation for tanzanite

Tanzanite, a variety of the mineral zoisite, is a relatively new gemstone on the market so it does not share the depth of history presented by other gems. Its beauty, though, is no less appealing, and the history it does have is intriguing. In years to come, tanzanite’s find will clearly be looked back upon as one of the most significant new gem discoveries of the 20th Century.

Several stories relate the discovery of tanzanite. The one most often told is that of Manuel De Souza, an Indian tailor from Goa living in Arusha, Tanzania. On July 7, 1967 De Souza (who doubled as a gold and gemstone prospector) found himself in the hilly region of Merelani in the company of four Masai tribesmen he had hired to help him prospect. The region, at the foothills of majestic Mount Kilimanjaro, was dangerous: poisonous snakes, Cape buffalo, lions and other African animals roamed the area. Accounts say De Sousa was unarmed but for a few prospecting tools, seeking only what providence might offer. But rather than being discovered by man-eating beasts, De Sousa made a startling discovery himself. Around noon, he discovered a blue crystal lying on the ground. The crystal was unknown to him, though after consulting a few books, De Sousa soon discounted sapphire and iolite as possibilities. He finally decided it was a form of olivine, and on July 25 pegged a claim for it. Soon other claims were made near his – but the material was being called something else: zoisite. Zoisite is actually distantly related to olivine. According to John Saul, a geologist and gem miner from Tanzania, confirmations of the mineral zoisite soon came from the Gemological Institute of America and from other experts around the world.

Henry Platt, vice president of Tiffany & Co., who had been shown the material, and who had admired it, was the first to call it “tanzanite,” in honor of the country where it was found; the name was soon duly inscribed in new gemological texts. Indeed, tanzanite is not mined elsewhere on a commercial basis. While almost all of the material coming out of the mines at Merelani was (and is) a somewhat drab purplish to yellowish brown, it was soon found that low grade heating turned the gems into a deep purplish blue. While some blue zoisite is considered to be that colour naturally, it is understood that all of the commercially mined zoisite today is heated to induce the deep, velvety, blue to violet blue colours one associates with the gem.

There is much to appreciate about tanzanite: its deep blue to violet colours, are of course paramount. It can be found in sizable crystals and suitable for centre stones in jewellery. It is also trichroic, meaning that light entering the gem is split into three different wavelengths. As a result, tilting the gem in three different directions one is sometimes able to see three different colours of zoisite. Viewed in a polariscope, these colours become even more evident.

Tanzanite on the calendar

Tanzanite was recently added as an alternate birthstone for the month of December.
Tanzanite

What a tanzanite is
A variety of the mineral species zoisite, (in the epidote group), forming in the orthorhombic crystal system, and containing the following elements: Ca₂Al₃(SiO₄)₃(OH).

Colour(s): Transparent blue to violet to bluish purple. A few very rare variations of colour exist in zoisite from Merelani. These forms are sometimes referred to as “fancy colour” tanzanite. Colours including pink, orange, yellow and green transparent zoisites have been reported.

Refractive Index: 1.691 to 1.700 (+/- 0.005)
Birefringence: 0.008 to 0.013
Specific Gravity: 3.35 (+0.10, -0.25)
Cause(s) of colour: Blue: vanadium
Hardness: 6 to 7 on the Mohs Hardness Scale.
Internal identifying characteristics: Many tanzanites tend to be remarkably clean and transparent. Fingerprint inclusions are sometimes present. Very rare, tiny, parallel, hollow tubes in some tanzanites cause chatoyancy (cat’s eye effect).

Tanzanite’s treatments
Heating causes a change of colour from brown, purple or grey to bluish purple to purplish blue.

Collector tanzanites
Tanzanites in large sizes, and rich colour are desirable for collections. Some tanzanites are carved or sculpted by famous lapidary artists and as such are considered collectible.

Finally, multi colour transparent zoisites (fancy tanzanites) are also sought, particularly green and pink. On extremely rare occasion, collectible cat’s eye tanzanites are fashioned.

Tanzanite localities
Merelani, Tanzania. At the time of writing, Merelani is the only known locality for tanzanite in the world. While zoisite does occur in other places, no material matches the colour intensity of tanzanite.

The cutting and care of tanzanites
Tanzanites are delicate and should be worn with great care. Tanzanites should never be cleaned in an ultrasonic cleaner or steam cleaned. Warm soapy water or a damp soft cloth is considered a safe way to clean tanzanite jewellery.

Other colours of transparent zoisite include green and pink, which are very rare. The yellowish brown colour (centre), is generally treated with low heat to result in the blue colours associated with tanzanite. While some tanzanites are mined with the bluish purple colours, most on the market have been heat-treated.
Appreciation for topaz

There is an unmistakable characteristic about the colour of imperial topaz: a deep yellow verging on orange, tinged with gold. While some enthusiasts considered this golden colour the classic colour, pink to reddish orange hues are equally desired. Pablo Neruda, the Chilean poet, likened topaz to honey:

I invite you to a topaz.
To the honeycomb of yellow stone,
To its bees,
To the frozen honey of a topaz,
To its golden day...

Origin of the word topaz is quite mysterious as it was once reserved for greenish gemstones – most likely peridots. Topaz is Greek in origin, and refers to the gems from the island of “Topazios,” which is known today as Zabargad. However that Red Sea island is identified as the classic source of peridot. Dating back to Pliny the Elder’s time, topaz was described as a gem the colour of fresh green olive oil. Slowly, over time, other colours were included within the definition of topaz, including yellowish gems. It was not until the 11th Century that the name began to clearly point to a yellow or golden colour. Scholars suggest that this definition could have encompassed several other yellow gems that weren’t necessarily the topaz we identify today.

Yellow and golden colours are iconic for today’s definition of topaz, as Neruda clearly identifies in his poem. Actually the species occurs in a broader range of colours, as well as colourless. Topaz sometimes includes a soft blending of pinkish orange to reddish orange colours, which the gem trade has called “imperial topaz.” These colours have been found at various sources around the world. But curiously, the rich green colour with which topaz was first identified, does not exist – except rarely in very pale stones.

Topaz, in its purest colourless state was sometimes mistaken for diamond in ancient times. The so-called “Braganza Diamond,” a rounded pebble centrepiece of the Portuguese Crown Jewels in the 1700s, was said to be the largest diamond in the world at 1680 carats. Identity of the gem remains in dispute; it was thought at one time to have actually been a topaz.

A more recent inventory of the crown jewels uncovered a rounded pebble of aquamarine. It was of a similar weight and description, leading some to believe this might have been the gem in question.

While natural bluish topaz exists, it is generally quite pale. But one of the most prolific treated gemstones on the market today is a deep blue coloured topaz that is treated with a combination or irradiation and heating to achieve a broad range of popular blue colours.

Topaz on the calendar

Topaz is a birthstone for the month of November. It is used as an anniversary gemstone for a 4th anniversary – when blue topaz is given; and a 23rd anniversary, which is reserved for imperial topaz.
Topaz

What a topaz is

A mineral species in the orthorhombic crystal system. Its chemical composition is Al₂[(F,OH)₂]SiO₄.

**Colour(s):** Colourless, yellow, orange, brown, pink to red to purple red. Light blue to dark blue and light green.

**Refractive Index:** 1.619 to 1.627 (+/-0.010)

**Birefringence:** 0.008 to 0.010

**Specific Gravity:** 3.53 (+/- 0.04)

**Cause(s) of colour:** Pink and red topazes are principally coloured by chromium. Blue, yellow and brown owe their perceived colour to various colour centres, and possibly combined with traces of chromium in orange hues.

**Hardness:** 8 on the Mohs Hardness Scale.

Internal identifying characteristics:

Liquid inclusions that contain two and three phase inclusions are the most common, particularly in reddish or orange gems. Occasionally trapped minerals such as rutile can be found in topaz. In very rare cases, tiny ribbon like hollow tubes, forming in parallel fashion, cause cat’s eye effect.

Topaz treatments

a. **Heating** – In some cases, yellow or brown topaz may be changed to pink or red colours.

b. **Irradiation / followed by heating** – This treatment begins with induced irradiation causing colourless topaz to turn brown or brownish green. A heat treatment follows, turning the material blue. In rare cases, some material may retain residual radioactivity.

Collector topazes

Colour is the principal feature of topaz with pink to orange to reddish orange combinations being among the most collectible. Size of the gemstone is also an important attribute, even in irradiated material where huge museum-quality gems are occasionally available.

Topaz has perfect cleavage in one direction, so carvings are rare. When they do occur, especially by known artists, they are soon collected.

Topaz localities

Brazil – particularly the area near the town of Ouro Preto in Minas Gerais, produces much of the world’s supply of classic yellow to orangy pink colours. Other states produce it as well, but mostly in the colourless to pale blue range. Schneckenstein, a village in Germany, was a major classic source of European topaz in the 1700s. Pakistan produces some of the strongest pink to reddish colours at Katlang, near Peshawar. Topaz is also found at sources all around the world, such as Nigeria, Australia, Burma, Mexico, Namibia, Sri Lanka, United States and Russia.
Topaz

The cutting and care of topaz

While topaz is quite hard, its toughness and resistance to blows is considered poor because of its perfect directional cleavage. Treated gems may be even more vulnerable to cleaving. Ultrasonic cleaners and steamers should be avoided. A soft, damp cloth remains the best way to clean topaz and topaz jewellery.

Prevalent on the market are a wide range of deep blue coloured topaz, such as those shown here. These stones owe their colour to a combination of irradiation and heating treatments, which turn essentially colourless topaz into a varieties of pale to deep blue colours.

Topaz varieties contain fluid inclusions such as this one. These inclusions as best viewed under 10 to 60x magnification in a microscope.

Sought-after varieties of topaz, especially among collectors, are in the pink to pinkish orange to reddish orange colour range.
Tourmaline

Appreciation for tourmaline

Tourmaline is a group of closely related gem materials composed of several species and varieties of gemstones. The celebrated gemologist and author, Eduard Gübelin, referred to it as a "crystallized kaleidoscope" because of the diversity of colours that make up this rich family. Tourmaline comprises colours of the spectrum from red to violet and practically any degree of variations in between. Tourmaline can also be bi-coloured or black. Enthusiasts know that tourmaline’s variety names are often designated by these hues. However, most of the gem tourmalines used in jewellery today are members of the elbaite mineral species, which exhibits the strongest and brightest colours. The coloured varieties of elbaite, and their respective names, are listed below.

The name tourmaline derives from the Sinhalese word turamali, meaning gemstone with mixed colours. In the early 1700s, traders from Holland brought turamali back to Europe from Ceylon (Sri Lanka). They were fascinated with the material’s apparent electrical characteristics - which later were scientifically determined as this gem’s unique piezoelectric and pyroelectric properties. Those who smoked pipes, for example, appreciated the gems’ apparent magnetic ability to draw ashes out of their pipes; as the gems were heated, they developed positive and negative charges at the ends of the crystals. These tourmalines were nicknamed aschentrecker, which translates to “ashpuller.”

Curiously, tourmaline had already arrived on European shores at the time of Pliny the Elder. In his famous series of books on natural history, Pliny described similar electrical properties in a gemstone he named lychnis. Because he also noted that colours were reddish or violet in colour, it is believed the gem was probably tourmaline – the gem we know and enjoy today.

Confusion was sown in the 1500s when Portuguese explorers looking for emeralds in Brazil chanced upon rich, green, emerald-looking gemstones. Swiss naturalist, Conrad Gessner, saw this material in Europe. Though he classified it as “emerald,” he also included the word “Brazilian” in front of it. Obviously, in this case, Brazilian “emeralds” weren’t quite the same as the Colombian material. They were tourmalines!

In recent years, tourmaline has witnessed a true renaissance, particularly after the discovery of a copper-rich elbaite tourmaline from the State of Paraiba, Brazil. While the locality produced a modest quantity of material for a short time, its vivid colours, influenced by the copper impurities, were considered so unique that they revolutionized the tourmaline business. Demand for all tourmalines enjoyed an increase since the late 1980s, when the cuprian elbaite were first discovered. Since then, copper rich elbaite have been found at two other localities around the world.

Tourmaline on the calendar

Tourmaline is a birthstone for the month of October.
Tourmaline

What a tourmaline is

A group of mineral species that includes the following: dravite, uvite, olenite, schorl, elbaite, liddicoatite and buergerite. Gem varieties are contained in elbaite and liddicoatite species. Both form in the hexagonal crystal system, mostly as trigonal, prismatic crystals. Elbaite contains the following chemical compositions: (Ca, K, Na) (Al, Fe, Li, Mg, Mn)₃ (Al, Cr, Fe, V)₆ (BO₃)₃Si₆O₁₈ (OH, F)₄.

Principal colour varieties:

- Rubellite – Pink to red range, may also be brownish, orangy, or purplish.
- Verdelite – Yellow green to bluish green.
- Indicolite – Violetish to greenish blue.
- Dravite – Yellow to brown tourmalines. One bright yellow variety has been called “canary tourmaline” in the trade.
- Achromite – Colourless.
- Parti-colour – Two or more colours. (Note: if only two colours are seen, these gems are called bi-coloured.)

Watermelon – Pink centres with green around the outer margins of the stone.

Chrome tourmaline – A deep, solidly green, chromium-containing gem.

Cat’s eye tourmaline – Tiny hollow growth tubes in some cabochon-cut tourmalines cause a cat’s eye effect in direct lighting.

Liddicoatite – This species of tourmaline is calcium-rich, lithium tourmaline that was named its own species in 1977 – in honor of one of GIA’s founding fathers, the noted gemologist, Richard T. Liddicoat. This is a parti-colour tourmaline par excellence – a gem often exhibiting many colours in strongly zoned, geometric colour patterns.

Refractive Index: 1.624 to 1.644 (+0.011, -0.009)

Birefringence: 0.018 to 0.040

Specific Gravity: 3.06 (+0.20, -0.06)

Cause(s) of colour: Blue: iron. Red and pink: manganese and some titanium. Green: iron, chromium and vanadium.

Hardness: 7 to 7.5 on the Mohs Hardness Scale.

Internal identifying characteristics: Tourmalines have abundant liquid inclusions, which look like thin, threadlike and elongated fingerprints. Some tourmalines also contain elongated hollow tubes that form in parallel fashion during growth, and these exhibit cat’s eye phenomena.

Tourmaline’s treatments

a. Heating – This treatment aims to produce lighter green gems and blue green colours from overly dark gems. In cuprian elbaites, heating causes some dark purple material to become strongly greenish blue or deep blue. There are some undesirable effects of heating: some pink and red tourmaline may fade to nearly colourless upon heating.

b. Irradiation – This treatment was used to produce darker red gems from light pinks.

Collector tourmalines

The word “paraiba” – which rapidly became a widespread descriptor for cuprian tourmalines from Brazil’s Paraiba State, are highly sought after by many collectors.

Copper bearing gems from Mozambique and Nigeria have also become quite popular, particularly as production quantities at the original source has lagged.

Rubellites with strong colour – especially from sources that produced high qualities for short times, such as Nigeria, are collectible. Indicolites that exhibit strong blues are also very popular.

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Tourmaline

Bi-colour tourmalines showing strong colour zoning, parti-colour gems and cat’s eye tourmalines are also collected. In rare instances when “chrome” green tourmalines are found, they are collectible, especially in larger sizes because of their brilliant green colour.

Tourmaline localities
Brazil remains the world’s largest producer of tourmaline in all colours. The State of Paraiba produces Brazil’s most coveted cuprian tourmaline. Afghanistan is known for a very bright blue green quality of tourmaline, though it also produces some green and pink varieties. Burma, India, Kenya, Mozambique, Pakistan, Nigeria, Sri Lanka, Russia, Tanzania all produce significant quantities of material in various colours. United States – particularly the Pala district in California, is known for producing rich pink and rubellite varieties. Madagascar primarily produces rubellites and liddicoatite tourmalines.

The cutting and care of tourmalines
Tourmalines’ elongated, prismatic crystals dictate how the gemstones are cut, often resulting in very long, rectangular shapes. While tourmalines can be cut in all shapes and sizes, rectangular shapes predominate. Crystals often exhibit more than one colour; in such cases bi-colour or parti-colour gemstones result. On rare occasions, tourmalines are also carved.

While tourmalines have adequate hardness, there may be zones of weakness in some gems, particularly those that have many inclusions. Some bi-colour tourmalines are weaker along the colour boundaries.

Tourmalines should not be steam cleaned or placed in an ultrasonic cleaner for these reasons. Instead they should be cleaned with a soft damp cloth or a soft bristle toothbrush.

Tourmaline is assuredly the world’s most colourful gemstone family, containing all colours of the visible spectrum. Tourmalines with two or more colours within a single gem are also popular.

Among the most popular varieties of tourmaline are indicolite (left), rubellite (centre) and verdelite (right).

Copper-containing elbaite tourmalines from the State of Paraiba, Brazil have produced unique colours, including vivid greenish blue, deep blue, and bright, saturated greens such as the gems shown here. Collectors often compete to own such gems.

Tiny, hollow growth tubes in tourmaline may cause a cat’s eye effect in cabochon-cut gems.
Turquoise

Appreciation for turquoise

Turquoise’s startling blue colours and soft, slightly porous texture may be the reasons why it has been such an important opaque gem for thousands of years and across so many civilizations. Excavations from Pharoah mummies dating five millennia before the birth of Jesus contain evidence (turquoise bracelets) that the gem was highly prized in ancient Egypt – both as a gemstone and as an ornamental material. Successive Egyptian dynasties since then used also the gem as a symbol of good fortune. China was a source for turquoise during the time of Marco Polo’s travels, and he found that turquoise beads were traded and bartered all along the Silk Route. Along the same trading routes, magnificent Persian turquoise made its way to both the East and West! Asians used turquoise beads for adornment, but also as a form of currency and protection, until the 1800s.

In the West, ancient Aztecs and Mayas traded turquoise from sources now known as Southwestern U.S., and Mexico, and throughout the Americas. Further south, in Peru, the pre-Colombian Chimú culture traded turquoise beads throughout the Southern hemisphere.

Given its colour, it comes as no surprise that many civilizations felt turquoise embodied elements of both the sky and sea. However that colour comparison needs amplification: the colour of highly desired turquoise is described as the blue of a robins egg, pale blue to blue-green to dark blue. Further subtle variations of colours exist. Deposits in China, for example, are known to produce a light to dark green turquoise with little or no blue component.

The name, “turquoise,” comes from the 16th century French expression, pierre de turquie, which translates to stone from Turkey. While turquoise did not occur there, French merchants trading at Turkish bazaars likely believed that Persian turquoise traded there was from Turkey.

Turquoise on the calendar

Turquoise is the birthstone for December. It is also used to celebrate an 11th anniversary.

What a turquoise is

Turquoise is a hydrous copper phosphate mineral in the triclinic crystal system. Its chemical composition is CuAl₆(PO₄)₄(OH)₈.₅H₂O.

Colour(s): Light to medium blue, greenish blue to green, often mottled and may show dark splotches of veins of matrix.

Refractive Index: 1.610 to 1.650

Birefringence: not detectable.

Specific Gravity: 2.76 (+0.14, -0.36)

Cause(s) of colour: Copper for the bluish colours, whereas greens are caused by a combination of copper and iron.

Hardness: 5 to 6 on the Mohs Hardness Scale.

Internal identifying characteristics: Because turquoise is always opaque, internal characteristics are not noticeable.
However, turquoise may contain areas of deeper colour or variations of colour in the same gem. Matrix, a dark veining pattern that permeates some types of turquoise, is natural evidence of the element or substance in which turquoise was formed. Because matrix is softer than turquoise, it tends to weather (or erode) more quickly. As a result, the darker matrix areas are often deeper than the surrounding turquoise. Likewise, if natural turquoise is polished, matrix tends to be undercut. This means that the darker areas are generally deeper – not flush with the surface that is being polished.

Turquoise’s treatments

1. Plastic impregnation – This treatment introduces a polymer into the porous areas of turquoise. The result is a darker, more durable material.

2. Wax impregnation – Again, this works because of the porous nature of turquoise; a waxy substance lends the turquoise a more homogenous appearance. It does not make the gem more durable. The treatment is sensitive to even low heat.

3. Dyeing – This treatment also works because of turquoise’s porosity. The dyeing is sometimes used to deepen the colour of turquoise, or to simulate matrix.

4. Filling – Porosity and small cavities in natural turquoise can be filled with a polymer to create a homogenous surface. This form of treatment is often aided by vacuum pressure.

5. Surface coating – Some lacquers or polymers may be used to coat the surface of the gem, deepening the colour.

Reconstitution of turquoise, while not a treatment in the traditional sense (and thus not listed above) dramatically changes the appearance of low quality turquoise fragments. Here, smaller sizes of turquoise are combined and ground into a powder. Following this, the powder is bonded together in a solid mass using polymer resins. Its use in jewellery is widespread.

Collectors of Native American turquoise jewellery prize material from assorted top artists who use material from several mines across the Southwest. Large carvings of superb turquoise, especially when these have been fashioned by known artists, are also highly collectible.

Turquoise localities

United States – mainly Arizona, New Mexico, California and Nevada and Mexico are sources for material that has been traded through the Americas for centuries. Most of the world’s supply of turquoise comes from the United States and China today. Iran remains the classic source for fine turquoise, though little material is presently mined there. Australia and Chile are also sources for turquoise.
Turquoise

The cutting and care of turquoises

Turquoise can be fashioned into any shape, including carvings, though in most cases the material is cut in cabochon form. They are often fashioned as free-form beads (mostly with matrix) or perfectly homogenous, round beads with little or no matrix. Because of turquoise’s soft and porous nature, ultrasonic cleaners and steam cleaners should never be used to clean turquoise jewellery. The gem should be cleaned with a soft, dampened cloth. Turquoise beads may darken over time if they are in direct contact with skin.

Large chunks of turquoise are ideally suited for carving. It is rare for turquoise to be blemish free. In this case, turquoise material was ground and powdered, and then reconstituted using a polymer-resin binding agent. The larger block was then carved.

Natural turquoise may (or not) contain matrix, as these natural samples show. Notice also the uneven colouration of the beads; greener beads likely have a slightly higher iron content.

A highly desirable colour of turquoise is often described as a “robin’s egg” blue, such as in the sample on the left. In recent years, a bluish green variety of turquoise from China (on the right), has begun to enter the market in large quantities.
Zircon

Appreciation for zircon

Zircon is winning over fans because of its unique colours and brilliant optical characteristics. The first thing to know about zircon is that it has nothing to do with cubic zirconia (the trade name for a man-made product that simulates diamond). Zircon is a natural gem that might be confused with diamond in its colourless varieties, but easily separated upon closer examination. The appeal of zircon’s many colour varieties lies in its extraordinary luster, brilliance and fire, a product of high refractive indices and very high dispersion.

Three types of zircon have been identified: high, or alpha; low or gamma; or intermediate or beta. The classification ties into the gem’s crystal structure. High or alpha zircons have normal crystal structure – like most other crystalline gems. Low or gamma zircons are “metamict.” In such cases the crystal structure is changed by natural irradiation, and rendered amorphous. Partially crystalline gems, meanwhile, are in the intermediate classification. The appeal of metamict zircons lies in their unique, often phenomenal effects.

The word zircon derives from the Arabic zar gun, meaning gold coloured, though, as noted, zircon is found in many colours. A range of red to orange, yellow to brown, and blue to green are found – though natural blue zircon is quite rare.

Another optical characteristic of zircon (except in metamict types) is its extreme double refraction, which is often easily visible when looking through a gem’s table with the naked eye. The result is a perceived doubling of the pavilion facets and facet junctions – as well as its fire.

Zircon on the calendar

Zircon is a birthstone for the month of December, together with turquoise and tanzanite.

What a zircon is

Zircon is a mineral species of the tetragonal crystal system. Its chemical composition is ZrSiO₄.

Colour(s): Colourless, blue, yellow, green, brown, orange and red. Rarely: purple.

Refractive Index: The RI varies, as follows:
- High: 1.925 to 1.984 (+/-0.040)
- Medium: 1.875 to 1.905 (+/- 0.030)
- Low: 1.810 to 1.815 (+/- 0.030) On rare occasions the RI reading is below 1.80

Birefringence: 0.000 to 0.059 (low type has low birefringence, high type has higher birefringence).

Specific Gravity: 3.90 to 4.73 (Increases from low to high type).

Cause(s) of colour: Various colour centres.

Hardness: 6 for low type; 7.5 for high type on the Mohs Hardness Scale.

Internal identifying characteristics: In metamict zircons, angular colour zoning or angular markings can be seen, as well as an unusual milkiness in some stones. In some metamict gems, discoid fractures within the gem result in an unusual aventurescent effect. Apatite and garnet crystals are sometimes found in zircon.
Zircon

Zircon's treatments

Heat treatment – Most brown zircon is heat treated to result in different colours, including blue, red, orange or yellow. Green zircons are occasionally heated to lighten their tone. Induced changes in zircon's colour are not always stable and colours may revert to their original colour upon exposure to light.

Collector zircons

Some zircons are collected as colour groups to exhibit an array of colours, and large red zircons are particularly prized. Some collectors buy metamict gems that exhibit unique phenomenal characteristics such as avenurescence or cat’s eye. Cat’s eyes do occur in included material but the eye is generally indistinct.

Zircon localities

Cambodia, Sri Lanka, Burma, Australia and Thailand are the principal sources of Zircon. Brown zircons from East Africa have also entered the market in recent years.

The cutting and care of zircons

Zircons, whose optical characteristics are sometimes compared to diamonds' differ greatly in terms of hardness. Zircons are quite soft and it is recommended that when worn in jewellery, the jewellery not be subjected to rough wear (as in sports). Facet junctions in zircons often abrade over time with careless use. Warm soapy water or a damp cloth should be used to clean zircons. Ultrasonics or steam cleaners should not be used.

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At magnifications of between 10 - 60x, inclusions such as this iridescent, disc-like fissure may be seen in some zircons.
Contents: Pearls

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9 Pearl culturing and the molluscs
11 Quality of the cultured pearl
14 Treatment of a pearl or cultured pearl

The information in the following chapter was provided by the CIBJO Pearl Commission. Images provided for the Pearl chapter by GIA, Shigeru Akamatsu, Japan Pearls Exporters Association and the SSEF.

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Introduction – types of pearls

Types of pearls

Pearls may be natural (nacreous or non-nacreous) or cultured (nacreous only), they may come in a variety of colours, shapes and sizes and may be suitable to be strung in the form of necklaces, set in rings and brooches etc. Other important pearls have had significant collector potential and have become the centrepiece of displays in museums and personal collections throughout the world.

Natural pearls

Almost any mollusc can produce a natural pearl. Natural pearls form accidentally in the interior of molluscs without interference from man. Molluscs are an invertebrate with a soft unsegmented body, usually protected by a shell in one, or two, pieces. Most molluscs live in, or near, water. They occur in three basic forms; whole-round pearls, blister pearls and blisters.

Natural pearls may be nacreous or non-nacreous and come from either salt-water or freshwater.

Whole-round natural pearls

Pearls accidentally formed in a pearl sac within molluscs without assistance from man. A pearl-sac is derived from the internal or external layer of the epithelium of the mantle or of the gill plates. The epithelial cells of the pearl-sac secretes the nacre (or non-nacreous material) which becomes deposited over the foreign body, forming a pearl over time. Their entire surface is covered with nacre or non-nacreous material.

Natural blister pearls

Pearls accidentally formed on the inner surface of mollusc’s shell without assistance from man. They first form as natural pearls in a pearl sac, then break the sac to attach to the surface of the shell, where the host mollusc covers their surface with further layers of nacre or non-nacreous material.
Introduction – types of pearls

Natural blister
Nacreous or non-nacreous substance accidentally formed on the inner surface of the mollusc shell without any assistance from man. They originate from the intrusion of a foreign material into a space between mantle and inner surface of the nacreous or non-nacreous shell, or the repair of a hole in the shell bored by the intrusion of a sponge, parasite.

Cultured pearls
Cultured pearls are formed in molluscs with the assistance of man. However, this human intervention should only stimulate the mollusc to produce a pearl formation (see later) and the substance formed should only be that normally produced by the mollusc for form the shell or a natural pearl. Cultured pearls occur in three basic forms, the whole-round cultured pearl (which may be either beaded or non-beaded), cultured blister pearls and cultured blisters.

Whole-round cultured pearl
Cultured pearls formed in a pearl sac of a mollusc with the assistance of man. Human intervention only gives rise to the formation of the pearl sac and the introduction of a shell-bead (in the case of beaded cultured pearls). Whole round cultured pearls are classified into beaded cultured pearls and non-beaded cultured pearls.

Beaded cultured pearl
Cultured pearls formed in a pearl sac of the molluscs by inserting a piece (or pieces) of epithelial tissue and a bead (or beads) made of shell. Bead (or beads) are entirely covered with nacre secreted by molluscs.

Non-beaded cultured pearls
Cultured pearls formed in a pearl sac in molluscs by inserting a piece (or pieces) of epithelial tissue. They are entirely composed of nacre secreted by molluscs.

Cultured blister pearls
Cultured pearls formed on the inner surface of mollusc shell with the assistance of man. They form as whole-round cultured pearls in a pearl sac; they then break from the pearl sac to attach to the surface of the shell, where the host mollusc covers their surface with nacre.

Cultured blister (Hankei cultured pearls)
Pearls formed on the inner surface of the shell of molluscs by attaching hemispherical (including three-quarter) object (or objects). The entire surface of the object (or objects) is covered with nacre secreted by molluscs.

Imitation pearls
Imitation pearls are artificial products not formed in molluscs but manufactured by man to imitate the appearance, colour and other features of natural or cultured pearls.

A microradiograph (left) of a beaded cultured pearl strung as part of a necklace shows the bead inserted and the nacreous layers formed during the growth period. A cross-section of a beaded cultured pearl (right) showing the layered structure of the shell bead and the concentric nacreous overgrowth.

Cross section of a non-beaded freshwater cultured pearl; showing that it has no bead at its centre and that it is composed entirely of nacre.
Natural pearls

History

Many historical documents show that mankind has used natural pearls as ornaments since long before the beginning of the Christian era. In about 4,000 BC, the Indian Ocean, the Red Sea and the Gulf were famous for being a rich source of natural pearls. In addition, many European countries produced freshwater natural pearls.

In the New World, after the discovery of America by Columbus, numerous salt-water natural pearls were fished, especially in Mexico. From the 1930s the nacreous natural pearl market contracted, largely due to the discovery of oil in the Arabian Gulf and the appearance of cultured pearls.

Natural pearls today

Currently, most pearls sold are cultured, but natural pearls are still available in specialist markets, particularly in the Middle East and India. In addition, they can often be found in major auction sales.

Conch pearl

Conch pearls are produced by a gastropod commonly known as the “Queen” or “Giant conch” (Strombus gigas) that inhabits Caribbean waters. Conch pearls differ from ordinary pearls by having a tough crossed lamellar micro-architecture that manifests itself as a flame-like structure that appears to move as “watered-silk” when the pearl is moved under light. Conch pearls are not cultured, they are natural and come in a variety of colours. However, some imitations are attempted by cutting the thick shell into beads.

Horse conch

The Horse conch pearl is a natural pearl produced by Horse conch (Pleuroloca gigantea), a very large gastropod inhabiting Indo-Pacific waters. It has a orange to reddish brown colour, and possesses a unique surface pattern.

Natural conch pearls of various colours.

On the left a 111.59ct example of a natural pearl from Cassis Madagascarensis (the Queen Helmet); the remainder are all natural pearls from Pleuroloca gigantea (the Horse Conch) and weigh 198.26ct (top left) 112.03ct (top centre) 74.80ct (top right) and left to right in the bottom row 16.02ct, 11.16ct, 7.43ct, and 16.36ct.

The pearling fleet returns home after months at sea.
Natural pearls

**Melo pearl**

Melo pearls are produced by the large volute with the genus Melo, inhabiting the South China Sea, the waters around the Philippines, the eastern coast of Indonesia and the Andaman Sea. In Taiwan, Malaysia, Indonesia China and Vietnam they are caught for food.

Melo pearls are usually spherical and quite large but can also be baroque, they have a yellowish brown to orange and reddish brown colour. Like the Conch pearl and Horse conch pearl, Melo pearls do not have a nacreous structure but instead a crossed lamellar micro-architecture. The species known to have produced natural pearls are *Melo broderipii*, *Melo Amphora* and *Melo melo.*
Natural pearls

Natural freshwater pearls

Most of the natural freshwater pearls on sale today are from the United States, they are obtained as a by-product of mussels collected as material for pearl culturing beads. Among pearls gathered, those with interesting shapes such as “Wing” and “Rose bud” and exceptional colours are preferred.

In addition, natural freshwater pearls are found in rivers throughout Europe, the UK and Ireland.

Abalone pearl

Abalone is a gastropod widely inhabiting Pacific, Atlantic and Indian Oceans. The population is particularly rich along the coastal areas of Japan, North America and Australia. Though abalone pearls are popular, round examples are very rare, as many are horn-shaped.

Fishing for natural freshwater pearls in a fast flowing river in Scotland

An important single white natural freshwater pearl and necklace from the United States (top left) and a lilac coloured natural freshwater pearl in the mussel shell in which it was found (bottom left).

A large horn-shaped natural abalone pearl along with a very rare near-round natural abalone pearl (top right) and the interior of an abalone shell (bottom right).
Cultured pearls

History
The modern cultured pearl industry started with Mikimoto’s hemispherical cultured pearl in 1893. In 1907 the technique of spherical or whole pearl culturing was invented. Since then, the cultured pearl industry has developed significantly. Pearl culturing areas have been extended, and in addition to the Akoya oyster other species such as Silver/Gold lipped oyster, Black lipped oyster, the abalone and (in freshwater) the Triangle mussel are used.

Pearl culturing methods
At present three culturing techniques are used to produce cultured pearls; beaded pearl culturing, non-beaded pearl culturing and hemispherical “Hankei” cultured pearl.

Beaded cultured pearl
Based on Nishikawa’s “Piece method”, a bead (or beads) and piece (or pieces) of mantle tissue are inserted into an oyster body. Most salt-water cultured pearls are beaded.

Non-beaded Hankei cultured pearl
A piece (or pieces) of mantle tissue is inserted into a pocket (or pockets) in the mantle of a mussel. Most of freshwater cultured pearls are non-beaded.

Cultured blister (Hankei cultured pearl)
A hemispherical object (including three-quarter) is placed on the inner surface of the shell and over time this is covered with nacre. The pearls produced by using the Mabé oyster are the best known, as a result Hankei cultured pearls are also called Mabé cultured pearls.
Pearl culturing and the molluscs

Akoya pearl culturing
Pearl culturing using the Akoya pearl oyster is carried out in Japan, China and Vietnam. Recently culturing has also started in Dubai. Compared with other pearl oysters the Akoya oyster is rather small, the size of the pearl is less than 10mm. Most popular sizes are 6 and 7mm.

Silver/Gold-lipped pearl culturing
The main culturing areas for the Silver and Gold-lipped pearl oysters are Australia and Indonesia, followed by the Philippines. Though the oyster species is the same – *Pinctada maxima* – there are differences between pearl culturing in Australia, Indonesia and the Philippines. In Australia large sized and high quality pearls over 10mm are cultured using the Silver-lipped oyster, while in Indonesia many smaller sized cultured pearls of below 10mm are cultured. In the Philippines many golden pearls are cultured using Gold-lipped oyster.
Pearl culturing and the molluscs

**Black-lipped pearl culturing**

French Polynesia is the main country for producing black cultured pearls using the Black-lipped pearl oyster. However, culturing areas are expanding to Fiji, New Caledonia, and the Cook Islands. Recently smaller-sized black cultured pearls of below 10mm are on the increase.

**Freshwater pearl culturing**

Modern freshwater pearl culturing began in 1924 in Lake Biwa, Japan. Though pearl culturing was forced to stop because of World War II, the production volume increased thereafter. Production began to decrease from 1980, and today has reduced to almost zero.

Chinese freshwater pearl culturing, started in 1981 with the export of 600g pearls to Japan. At present, annual Chinese freshwater cultured pearl production exceeds 1,500 tons. By the improvement of culturing techniques, large, round and smooth-surfaced pearls are able to be produced. However, large volumes of middle to low quality pearls are appearing on the world markets.
Quality of the cultured pearl

Quality elements

Size
The popular size of cultured pearl ranges from 2 - 13mm. The size range is dependent upon the oyster species used; Akoya cultured pearls range from 2 - 10mm, Silver/Gold-lipped and Black-lipped cultured pearls range from 8 - 13mm or larger, freshwater cultured pearls range from 2 - 13mm. The size of cultured pearls is measured in millimeters (mm).

Shape
A perfectly round cultured pearl is worth the highest value. However, a beautiful symmetrical drop shape is also highly valued. Shape is divided into the following: round, semi-round, oval, drop, button, semi-baroque, baroque and circled.

Nacre thickness
Nacre thickness is closely related to the culturing period and may have some impact on the colour, lustre and durability of the pearl. It is one of the most important elements of pearl quality. X-rays are used to measure nacre thickness and to assist in observing nacre quality.

Surface
The surface of a cultured pearl is examined in terms of the number, size, kind and location of the imperfection. In evaluating the imperfection, first, the number of imperfections is taken into account – whether a pearl has a clean surface, one spot or many spots. Then the kind of imperfection is examined whether it is a dent or a bump on the surface; imperfections are subdivided into pits, holes, pinpoints, bumps and wells. Even if the imperfection seems insignificant, if it is visible to the eye, it lowers the value of the pearl.

A microradiograph indicating the measurement of nacre thickness.
Quality of the cultured pearl

**Lustre**
Pearl lustre is defined by the quality of the reflected light. A lustrous pearl has a strong bright and sharp reflection. A low lustre pearl on the other hand is not bright and its reflection is dull. The lustre of a pearl may be closely related to the homogeneity, light transmittance and thickness of the nacre. Recently, as cultured pearl dealers prefer a high lustre, many pearls are heavily polished.

**Colour**
There are three main causes of pearl colour; light phenomena, especially interference of the light, pigments contained in conchiolin and organic matter formed in the clearance between the inner surface of the nacre and outer surface of the bead. Colour characteristics differ according to a mother oyster species.

An illustration of high surface lustre in Akoya cultured pearls.

An illustration of variously coloured cultured pearls.
Quality characteristics of cultured pearls as they relate to the producing mollusc

Akoya cultured pearl
Size: 2 - 10mm. 6 and 7mm are the most popular.
Shape: Round, semi-round, oval, button, drop, semi-baroque, baroque and circle.
Nacre thickness: Minimum is around 0.3mm.
Colour: Pink, green pink, silver pink, cream pink, white, green, cream, gold.

Silver/Gold-lipped cultured pearl
Size: Over 10mm is the most popular. Recently smaller sizes (8, 9mm) have appeared.
Shape: Same as Akoya cultured pearl.
Nacre thickness: Thick nacre
Colour: Black, green, brown, blue, grey, peacock, red

Black-lipped cultured pearl
Size: Over 10mm is the most popular. Recently smaller sizes (8, 9mm) have appeared.
Shape: Same as Akoya cultured pearl.
Nacre thickness: Thick nacre
Colour: Black, green, brown, blue, grey, peacock, red

Freshwater cultured pearl
Size: 3 to over 10mm
Shape: Round, semi-round, oval, rice, button, drop, baroque
Colour: Three basic colours (orange, purple and white)
Treatment is any action by man (other than polishing, cleaning, buffing and peeling) that alters the appearance of a pearl or cultured pearl. The following treatments must be declared at the point of sale.

**Bleaching:** to remove, lighten or alter colour by means of chemical and/or physical agents or light.

**Coating:** an artificial layer of any natural or artificial substance spread over the surface, of pearls for protection, colouration, increased lustre and other optical phenomena, decoration or to change appearance; a covering layer.

**Dyeing:** any colour caused artificially by the application of a dye to pearls.

**Filling:** a substance that occupies a whole or part of a void in a pearl.

**Irradiation:** exposing pearls or cultured pearls to radiation.

**Lustre enhancement:** Any treatment or process applied to enhance the lustre of a natural or cultured pearl

**Oiling:** a process sometimes applied to natural and cultured pearls, whereby the surface of pearls are soaked in warm oil; to diminish the appearance of cracks.

**Tinting:** a treatment which causes a subtle change in colour and/or appearance.

**Waxing:** the application of a colourless wax or similar products to, or near, the surface of a pearl.

**Working:** significantly remove layers of nacreous or non-nacreous material from a pearl, usually to remove blemishes and/or to reshape a pearl, especially blister pearls.

For more information about CIBJO standards and rules regarding treatments, please download a free pdf copy of the CIBJO Pearl Bluebook: [www.cibjo.org](http://www.cibjo.org)
Contents: Precious metals

3 Introduction
4 Common Control Mark
5 Gold
8 Silver
9 Platinum
10 Palladium

The information in the following chapter was provided by the CIBJO Precious Metal Commission with images provided by the World Gold Council and the Platinum Guild International.
A precious metal is a rare metallic chemical element which is of high economic value. The precious metals are gold, silver, platinum and palladium in their pure state.

When discussing precious metals, an alloy is a mixture of metals. So for example, red gold is an alloy of gold and copper, which gives the gold its red hue. A precious metal alloy is a solid solution containing at least one precious metal.

**Marking and Hallmarking**

Because precious metals are extremely expensive, it is very important for members of the public and all those involved in the jewellery supply chain to know how much precious metal is contained in any precious metal alloy used for making jewellery.

It is impossible for anyone to know how much precious metal there is in a piece of jewellery simply by looking at it or touching it. The precious metal content must be declared in some meaningful way.

All jewellery should therefore be marked or hallmarked with a stamp so that the consumer knows what they are buying.

**Marking**

The CIBJO Precious Metals Blue Book stipulates that as an absolute minimum, all items of jewellery should be stamped with a ‘finess mark’ declaring the content of precious metal in the alloy, and a registered ‘responsibility mark’ indicating the name of the trader who has first placed that piece of jewellery on the market.

This mark is not an independent third party guarantee of the content of the precious metal.

**Hallmarking**

Some countries have independent third party Assay Offices who test precious metal jewellery and then strike a ‘Hallmark’ on the article to guarantee its’ fineness.

A hallmark, is a mark or series of marks struck on items made of precious metals – platinum, gold, silver and, in some nations, palladium. Hallmarks are applied by an assay office and they guarantee a certain purity or fineness of the metal.

As a pre-requisite to official hallmarking, the maker or sponsor of a piece of jewellery must usually mark a responsibility mark and lodge a claim of fineness. The hallmarking by an assay office is to confirm this claim. “Assaying” is the term used to describe the testing and measurement of the precious metal content in an item such as jewellery.

Hallmarking systems differ from country to country. The Vienna Convention of 1973 was an attempt to standardise the legislation on the inspection of precious metals and to facilitate international trade. It is a good example to illustrate how an independent third party hallmarking system works.

Articles which are assayed and found to be in conformity by the qualifying office of a signatory country receive a hallmark, known as the Common Control Mark.
Common Control Mark

The Common Control Mark is a balance scales symbol superimposed on:

- **Gold:** Two intersecting circles
- **Silver:** The letter “M”
- **Platinum:** A diamond shape

The countries that have signed up to the Vienna Convention have done so to facilitate international trade in precious metals. It does not mean they have compulsory hallmarking in their domestic market. Some have compulsory hallmarking, such as the Czech Republic, Ireland, Netherlands, Poland, Switzerland and UK, while others have a voluntary system allowing jewellery to be sold either with or without hallmarks, for example Austria, Denmark, Finland and Sweden.
Gold

Gold is a rare metallic element. Its chemical symbol, Au, is short for the Latin word for gold, “Aurum”, which literally means “Glowing Dawn”. It has several properties that have made it very useful to mankind over the years:

- Pure gold does not rust, tarnish or corrode.
- Gold can be melted or shaped into almost any design.
- Pure gold has a naturally warm yellow colour and is one of only two coloured metal elements, the other being copper. All other metals are silver or grey.
- Gold can be alloyed with a number of other metals to increase its strength and create different colours.

Caratage

Gold jewellery is usually described in terms of “caratage” ("karatage" in the U.S.) to indicate its gold content. This can also be described as fineness which refers to the parts of gold per thousand. 750 fineness, the measure for 18K gold, indicates that there are 750 parts of gold per thousand. 24K gold, which is described as “pure gold”, “fine gold” or “Chuk Kam” in Chinese, must contain a minimum of 99.0% gold.

A caratage value below 24K will indicate how much gold there is in the gold jewellery alloy. For instance, 18K is 18/24ths of 100% gold or 75% gold. Many countries only allow certain caratages of gold jewellery to be sold. For example, in the United Kingdom one can make and sell 9, 14, 18 and 22 carat gold jewellery, but not 12 carat gold. In some countries, jewellery lower than 12 carats (50% gold or 500 fineness) cannot be described as gold. The price of gold jewellery is based, in part, on its gold content. Consequently, most gold jewellery worldwide is marked with its caratage or fineness, often as part of the hallmark.
The following table shows some of the various caratages with their equivalent gold content in percentage and fineness terms, as recognised by law in some countries.

The CIBJO fineness standards recognised in the Precious Metals Blue Book are 999; 986; 916; 750; 585; 416; 375; 333.

Negative tolerances are not recognised by CIBJO.

<table>
<thead>
<tr>
<th>Carats / Karats</th>
<th>Fineness</th>
<th>Gold content (%)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>999</td>
<td>99.9</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>990</td>
<td>99.0</td>
<td>Minimum allowed for 24K gold</td>
</tr>
<tr>
<td>22</td>
<td>916</td>
<td>91.6</td>
<td>Indian subcontent</td>
</tr>
<tr>
<td>21</td>
<td>875</td>
<td>87.5</td>
<td>Arabic countries</td>
</tr>
<tr>
<td>19.2</td>
<td>800</td>
<td>80.0</td>
<td>Standard in Portugal</td>
</tr>
<tr>
<td>18</td>
<td>750</td>
<td>75.0</td>
<td>Standard caratage</td>
</tr>
<tr>
<td>14</td>
<td>585</td>
<td>58.5</td>
<td>583/58.3% in USA</td>
</tr>
<tr>
<td>10</td>
<td>417</td>
<td>41.7</td>
<td>Minimum in USA</td>
</tr>
<tr>
<td>9</td>
<td>375</td>
<td>37.5</td>
<td>UK standard</td>
</tr>
<tr>
<td>8</td>
<td>333</td>
<td>33.3</td>
<td>Minimum in Germany</td>
</tr>
</tbody>
</table>
Gold

Colour and finish

Gold jewellery can be produced in a range of colours – ranging from white, yellow and red, through to blue, black and purple. These variations are achieved by mixing (alloying) pure gold with other metals to obtain different hues.

White gold is produced by alloying pure gold with a family of white metals, most commonly nickel, palladium and zinc. Nickel however has properties that cause sensitivity and allergies, and needs to be used with great care. In the EU there are health laws relating to nickel release from jewellery. Rose gold is produced by raising the ratio of copper to silver while green gold is made by adding a combination of silver, palladium and copper to the pure gold. Variations in colour affect other properties of gold such as its hardness and strength.

In addition to different colours, gold jewellery is available in a range of different finishes:

• Highly polished
• Satin-finished or “brushed”
• Matte-finish
• Hammered-finish
• Diamond-cut (featuring tiny, reflective facets)
• Diamond-laser (which adds extra brightness)
• Filigree (a traditional, intricate appearance)

Assaying

There are numerous methods for measuring gold content and the choice of method will depend on a number of factors including the accuracy of measurement needed and the speed and ease of measurement. The cost of the equipment (instrument) will also influence the decision. However, the referee method is a process known as cupellation.

A sample will be scraped from the item to be tested of less than a quarter of a milligram. Highly-sensitive balances are used to measure the weight of the sample, which is then bound in lead foil with some silver. This helps to separate out the base metals in the firing stage.

For this stage, the samples are placed on special blocks known as “cupels”. When heated in a furnace, the cupels absorb all of the base metals and the sample is left as just silver and gold. Nitric acid is then used to dissolve away the silver and the result is a sample of pure gold. This is then measured and compared to the original weight of the sample. The purity can then be determined from these two measurements.
Silver has long been valued as a precious metal and used in currency, ornaments and jewellery, as well as flatware and hollow-ware. It is a soft, white, lustrous transition metal and it has the highest electrical and thermal conductivity for a metal.

**Sterling silver** is an alloy of silver containing 92.5% pure silver and 7.5% other metals, usually copper.

**Britannia silver** is an alternative hallmark-quality standard containing 95.8% silver, often used to make silver tableware and wrought plate.

Hippocrates, the father of modern medicine, wrote that silver had beneficial healing and anti-disease properties, and the Phoenicians used to store water, wine, and vinegar in silver bottles to prevent spoiling.

**Assaying**

Unlike gold, silver is assayed using a process known as “potentiometric titration”. A sample will be scraped from the item to be assayed which weighs between 50 and 250 milligrams. The sample is then weighed using a highly accurate balance and dissolved in nitric acid.

In order to determine the silver content, potassium chloride is added to the sample and the electrical conductivity of the solution is tested until the point that the “titration” is complete and all of the silver has become silver chloride. The amount of potassium chloride needed to get to this point indicates the amount of silver that was in the original sample.
Platinum

Found in only a few places in the world, principally South Africa and Russia, platinum is very rare. It possesses a unique portfolio of properties, amongst others being both ductile and durable, that give the craftsman more scope for creating intricate and lasting jewellery.

Platinum has a naturally white lustre that never fades. Its high purity levels give it a high tensile strength, making it the perfect setting for precious stones. A further attribute of platinum is that it is hypoallergenic, so it will not cause an allergic reaction when used as jewellery.

To create hard-wearing jewellery, platinum needs to be alloyed with other metals. There are stringent standards governing the amount of platinum in an alloy, with typical levels being 95% pure metal. This is known as Pt 950. In most countries in order to be called platinum, the jewellery must be at least 85% pure platinum content.

All precious metals scratch and platinum is no exception. However when scratched the metal is merely displaced, rather than removed meaning a platinum ring will weigh virtually the same with 30 years of wear as when it was first put on.

Platinum has a number of other properties that make it an excellent catalyst and extremely resistant to corrosion from most chemicals, which means that platinum is the only metal suitable for a number of industrial and medical applications ranging from catalytic converters to pacemakers. It is so ductile that one ounce of platinum can produce a wire over a mile long.

The platinum group

The platinum group comprises six metallic elements clustered together in the periodic table: ruthenium, rhodium, palladium, osmium, iridium and platinum.

They are grouped together because they have similar chemical properties. For example, they all have catalytic properties however their mechanical properties differ greatly. These metals tend to occur together in the same mineral deposits.

Assaying

Platinum is assayed using a process known as inductively coupled plasma-optical emission spectrometry. A sample of platinum weighing about 10mg is removed from the item to be tested. This is then weighed on highly sensitive balances. The next step is to dissolve the sample in aqua regia, which is a mixture of 75% concentrated hydrochloric acid and 25% concentrated nitric acid.

This solution is then passed through the spectrometer, which determines the amount of platinum present in the solution as compared to the mass of the original sample taken.

Once the purity of the platinum is determined, the item will be stamped with a hallmark to certify this.
Palladium

Palladium is one of the platinum group metals but is considered a precious metal in its own right. Palladium is naturally white which means that there is no need for rhodium plating.

Palladium is more precious than silver. It is less dense than platinum, being nearly half the weight, so larger necklaces and bracelets can be made, capable of bearing larger gemstones with minimal gain in overall weight. For the same reason, palladium is considered to be a good choice for earrings although unlike platinum it is not hypoallergenic. It is often recommended as a good alternative to 9Kt white gold for male bridal consumers due to it never needing re-plating.