



Diamonds

Retailers' Reference Guide



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Introduction to diamonds



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 civilizations, 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

Formed in the earth's upper mantle 150-200 kilometers below the earth's surface and under tremendous heat and pressure, diamonds were carried to the planet's surface by volcanic forces so violent that very little is known today, except that they 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 rocks but are merely transported to the surface by 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 kilometers from their original source to Namibia's coast.

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 and West Africa, Canada and Australia.

Diamond mining methods include open-cast mining, alluvial, underground mining, coastal 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 diamond deposit in the world produces different qualities and quantities but generally even a profitable mine removes over one ton of host rock to produce one carat of gem quality diamonds.



Diamond and nomenclature

In 2015, the international standard 'ISO 18323 – Consumer Confidence in the Diamond Industry' was accepted by international voting cast.

This standard clearly defines the word 'diamond' and states that "diamond" without further specification always implies "natural diamond". Further this international standard insists on the fact that the two terms "diamond" and "natural diamond" are equivalent and carry the same meaning.



Properties of diamond

Diamond is a unique mineral. It possesses a rare combination of physical and optical properties that make it special not only in jewellery but also for technological and industrial applications. It is a crystalline material composed of pure carbon that crystallizes in the cubic crystal system, the highest symmetry crystallographic group, with a refractive index of 2.417, adamantine luster, specific gravity of 3.52, a high dispersion of 0.044, hardness of 10 on the Mohs scale (see right), has extremely high thermal conductivity and is chemically inert.

Durability

Durability is a stone's ability to withstand wear, heat, impact and chemicals. Durability may be broken down into three categories hardness, toughness and stability.

Hardness: expresses the resistance to scratching and penetration or the response to a sharp point being dragged across its surface being commonly represented in the Mohs scale. Diamond is generally recognized as the hardest substance known to man. The hardness of a diamond varies slightly in different directions. Polishers cleverly rely on diamond's directional hardness in order to use diamond to polish a diamond.

Toughness: As many hard materials, a diamond is not tough. 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 cleavages on a diamond will occur around girdles or edges. Jade is actually a lot tougher than diamond but not anywhere near as hard.

Stability: Diamond will burn at around 750oC which can be reached with a jeweler'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. Beware of thermal shock or the sudden change in extreme temperatures. Diamond may fracture or have inclusions extended from thermal shock. It is, however, chemically inert.

The Mohs scale was developed in 1822 by Friedrich Mohs, and has been used to assess relative hardness for over 150 years. There are ten minerals in this series. Diamond is the hardest mineral and 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 absolute hardness between talc and gypsum, but an enormous difference between corundum (ruby and sapphire) and diamond.

Mohs scale

Diamond	10
Corundum	9
Topaz	8
Quartz	7
Orthoclase feldspar	6
Apatite	5
Fluorite	4
Calcite	3
Gypsum	2
Talc	1

Classifying diamonds into types

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

Aside carbon – the main diamond forming chemical element – two other chemical elements may be present as trace chemical elements (in the order of parts per million), namely nitrogen and boron. Based on the presence or the absence of these two chemical trace elements, diamonds are classified into Type I and Type II.

Type I diamonds contain appreciable levels of nitrogen within the diamond's structure.

Type II diamonds contain virtually no nitrogen (less than 1 nitrogen atom per million of carbon atoms). Brown to brownish diamonds of type II can typically be treated by HPHT to change their body color to colorless, blue or pink and therefore colorless, blue and pink diamonds of type II need to be checked by a well-equipped and reputed diamond grading institution.”



From rough to polished

When extracted from the ground, diamonds often display characteristic crystal surfaces with high luster 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 as mined.

In trying to get the best quality and largest 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** – this planning stage 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 outline of the rough crystal and to prepare the girdle.
- **Blocking and brilliantteering** – faceting of the rough diamond. Blocking is the initial step in faceting. It determines the shape, weight and symmetry. Brilliantteering 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.



Marking a rough diamond



Cleaving a rough diamond



Bruting a diamond



Polishing a diamond

The 4 Cs

Around the world customers, diamantaires 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 usually based on the combination of all of the 4 Cs. Each of these criteria 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 4 Cs will yield the highest value in a 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 the customer will then 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 unit of weight. It is abbreviated as "ct". One carat (equivalent to 200 milligrams) has also been divided into 100 "points" by diamantaires. The "points" do not refer to facet junctions, only to a diamond's total weight. A 0.75 ct diamond may also be described as a $\frac{3}{4}$ carat diamond, 75 points or a 75 pointer. The term "point" or "pointers" is only used for diamonds weighing less than 1 carat. The weight of a diamond shall be stated in carats to at least two decimal places.

Diamond trade rules specify that for the weight of a diamond only rounding up to the next carat is permitted when the possible last thousandth decimal place is a 9, then only a 1.299 ct could be rounded up to 1.30 ct, a 1.298 ct would be rounded to 1.29 ct.

Although related in the origin, carat weight is different than gold karat. Carat is indeed a metric weight unit for gemstones, while karat is a measure of the purity or fineness of precious metal alloys. (See Precious Metals section of this *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 $\frac{1}{2}$ carat diamonds of equal color, clarity and cut.

							
2 CT	1.5 CT	1.25 CT	1 CT	0.75 CT 75 points	0.50 CT 50 points	0.25 CT 25 points	0.10 CT 10 points

Guide to approximate carat size

Cut

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 seen in the face-up position – 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" is an optical effect made of coloured flashes. Scintillation is the sparkle or flashes of light you see as the diamond or light source moves.

Diamond's fires

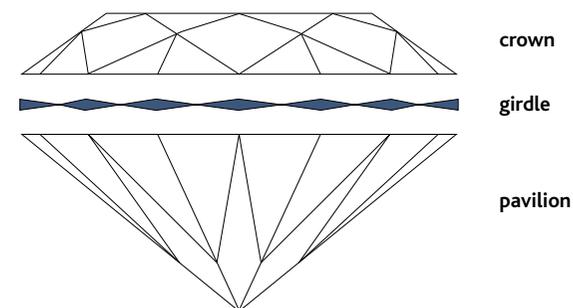
When white light reaches a diamond, part of the ray is reflected back from its surface (external reflection). Another part of the white light penetrates into the diamond.

White light is composed by all the colours of the rainbow and when it enters a diamond bended (refraction) and separated in purple, blue, green, yellow, orange and red rays, that are returned back to the observed as isolated rays (dispersion). This singular and spectacular optical phenomenon can be observed when light exits the diamond after multiple internal reflections inside the diamond.

The art of a diamond cutter consists in shaping and polishing the diamond so that all the light entering inside the diamond exits the stone from its top. This will magnify the play-of-light with diamond also named 'fires'. For an ideally cut diamond, the larger it is, the more impressive are the 'diamond's fires'.

Shapes

The most common shapes in the market today are *round, cushion, octagonal, heart, marquise, pear, square, oval, and trillion* (see following pages). There are also many modified shapes and novelty cuts, such as a princess cut, 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.



Parts of a cut diamond

Cut

COMMON CUTTING STYLES

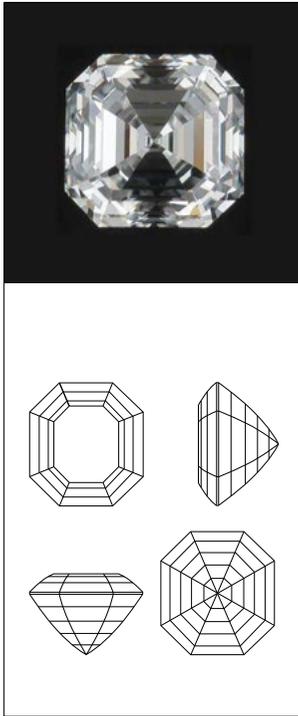
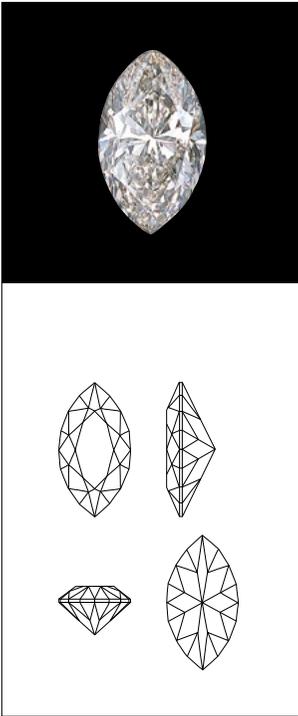
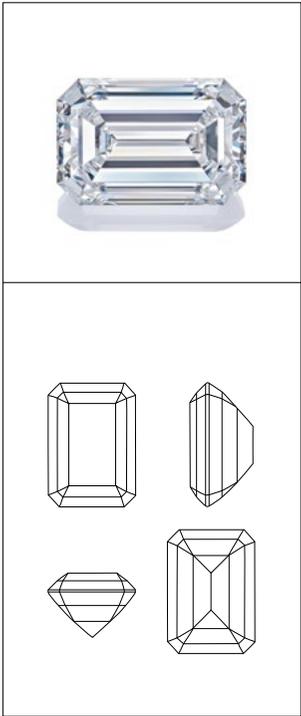
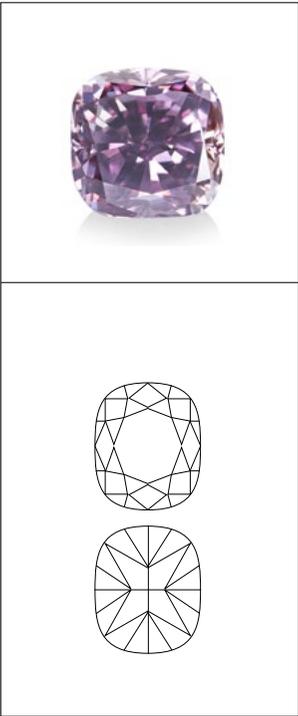
Cushion

Emerald

Heart

Marquise

Octagonal



Cut

COMMON CUTTING STYLES

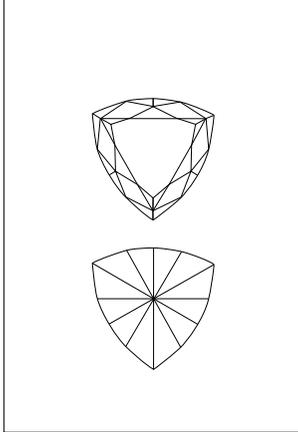
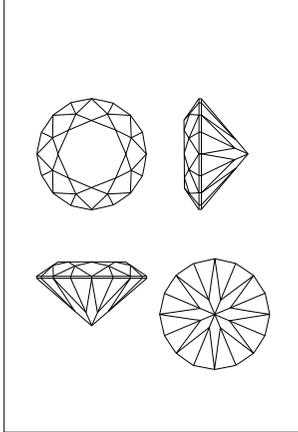
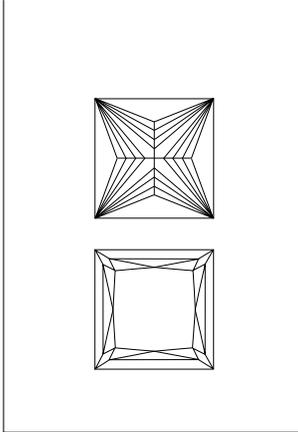
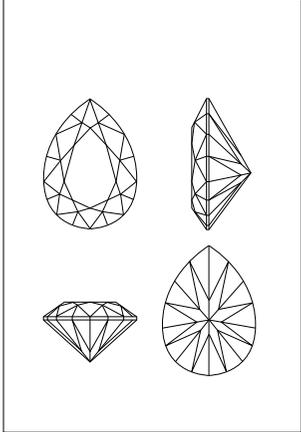
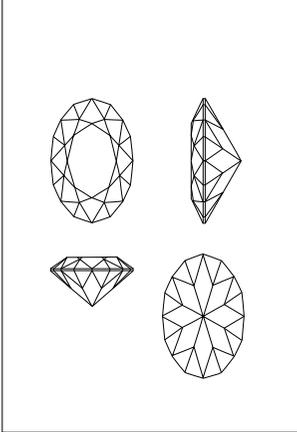
Oval

Pear

Princess

Round

Trilliant



Cut

STYLES OF FACETING

The cut of a diamond at the most basic level refers to a diamond's shape, see above. It can also refer to a cutting style such as a round brilliant, step cut oval, princess cut square or mixed cut.

A brilliant cut is a general term used for round 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 in eight-fold symmetry towards the edge or girdle. The most popular of all the diamonds is a round brilliant with 57 (sometimes with 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. For round brilliant cut diamonds, the "cut grade" depends on the quality of, polish, symmetry and proportions.

A step cut is a term used for a diamond with long narrow trapezoidal facets usually arranged in three rows, as steps, parallel to the girdle. A good example of this is the emerald cut diamond with a rectangular shape outline and beveled corners.

Proportions, symmetry and polish

Proportions – refer to the relative dimensions of a part of the diamond. When a proportion is expressed in percentage, the given value is relative to the mean size of the diamond's diameter for a round shape or to its width for other shapes (i.e. table size: 60%). When expressed in degrees, the given angle is relative to the girdle plan.

Symmetry – is the precision of the shape of a cut and the symmetrical arrangement and regular or even placement of the facets.

Polish – is the surface condition of the polished facets.

The term Finish is sometimes referred to as the quality of the symmetry and the polish of a diamond.



Colour

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 very rarely – in red, blue, green and all other colors 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 may be considered a range from colourless mostly to light yellow or brown.

Today, the most prevalent systems in use are those of GIA – Gemmological Institute of America and of CIBJO.



Colour

COLOUR GRADING SCALES

	CIBJO	GIA
Colourless	Exceptional White+ (D)	D
	Exceptional White (E)	E
	Rare White+ (F)	F
Near colourless	Rare White (G)	G
	White (H)	H
	Slightly Tinted White (I/J)	I
J		
Faint yellow	Tinted White (K/L)	K
		L
Very light yellow	Tinted	M
		N
		O
		P
		Q
Light yellow		R
		S
		T
		U
		V
	W	
	X	
	Y	
	Z	



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.



Colour

FANCY COLOURS

The D-Z grades mainly apply to yellow, grey and brown-tinged stones. If these colours are more intense than the Z master stone or standard in a diamond, they are referred to as "Fancy-coloured". Other colours such as blue, pink, red, green, purple, orange, etc., are really rare and highly prized.



Colour

Ultraviolet fluorescence

When observed under a long wave ultraviolet light source (365 nm), diamonds often emit visible light (fluorescence). Diamonds may fluoresce many colours (blue, yellow, orange, etc.) in varying intensities.



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. 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 grading is the highly skilled task of assessing the visibility and effects of a diamond's blemishes and inclusions. A professional will view each diamond for clarity grading with simple words in his mind, size, visibility, nature, location and number.

Clarity characteristics include a wide range of features but they are generally broken down into two basic categories, external features and internal features on the plotting diagram of a diamond grading report, external features will be marked in green and internal features will appear in red.



Clarity

GRADING SCALES

Flawless (FL)	Internally Flawless (IF)	Loupe Clean (LC)	Very Very Slightly Included/Very Very Small Inclusions (VVS)	Very Slightly Included/Very Small Inclusions (VS)
<p>FL diamonds shall be free from internal characteristics / inclusions and external characteristics / blemishes when examined under 10 x magnifications.</p> <p>NOTE – The following do not disqualify a diamond from the Flawless grade:</p> <ul style="list-style-type: none"> • An extra facet on the pavilion which cannot be seen face up; • Naturals totally confined to the girdle, which neither thicken the girdle nor distort its outline; • Internal graining which is not reflective, white or coloured and does not significantly affect transparency 	<p>IF diamonds shall be free from internal characteristics / inclusions and shall only possess external characteristics / blemishes when examined under 10 x magnifications.</p> <p>NOTE – The following does not disqualify a diamond from the Internally Flawless grade:</p> <ul style="list-style-type: none"> • Internal graining which is not reflective, white or coloured and does not significantly affect transparency. 	<p>LC diamonds shall be free from internal characteristics / inclusions when examined under 10 x magnifications.</p> <p>NOTE – The following does not disqualify a diamond from the Loupe Clean grade:</p> <ul style="list-style-type: none"> • Internal graining which is not reflective, white or coloured and does not significantly affect transparency. 	<p>VVS diamonds shall contain minute internal characteristics/ inclusions when examined under 10 x magnification.</p> <p>VVS1 diamonds shall contain minute internal characteristics/inclusions which shall be extremely difficult to observe when examined under 10 x magnification.</p> <p>VVS2 diamonds shall contain minute internal characteristics/ inclusions which shall be very difficult to observe when examined under 10 x magnification</p>	<p>VS diamonds shall contain minor internal characteristics/ inclusions when examined under 10 x magnification.</p> <p>VS1 diamonds shall contain minor internal characteristics/ inclusions which shall be difficult to observe when examined under 10 x magnification.</p> <p>VS2 diamonds shall contain minor internal characteristics/inclusions which shall be somewhat easy to observe when examined under 10 x magnification</p>

Clarity

GRADING SCALES

Slightly Included/Small Inclusions (SI)	Included 1 or Pique 1 (I1/P1)	Included 2 or Pique 2 (I2/P2)	Included 3 or Pique 3 (I3/P3)
<p>SI diamonds shall contain noticeable internal characteristics/inclusions when examined under 10 x magnification.</p> <p>SI1 diamonds shall contain noticeable internal characteristics/inclusions which shall be easy to observe when examined under 10 x magnification.</p> <p>SI2 diamonds shall contain noticeable internal characteristics/inclusions which shall be very easy to observe when examined under 10 x magnification.</p>	<p>I1/P1 diamonds shall contain internal characteristics/inclusions which are prominent when examined under 10 x magnification. They shall also be visible face up to the naked eye.</p> <p>NOTE – Internal characteristics / inclusions may also be visible face up to the naked eye in higher grades.</p>	<p>I2/P2 diamonds shall contain internal characteristics/inclusions which are very prominent when examined under 10 x magnification. They shall also be easily visible face up to the naked eye, slightly reducing the brilliancy of the diamond.</p>	<p>I3/P3 diamonds shall contain internal characteristics/inclusions which are extremely prominent when examined under 10 x magnification. They shall also be very easily visible face up to the naked eye, reducing the brilliancy of the diamond.</p>

Diamond Grading Report

A diamond grading report will contain three different assessments:

1. It will establish the natural origin of the diamond.
2. It will report the diamond's quality (based on the 4C's rule).
3. and, finally, by providing the unique combination of carat weight, colour grade, clarity grade, measurements, proportions, fluorescence, positioning of inclusions etc. (on the plotting diagram), it will establish the unique identity of your diamond.

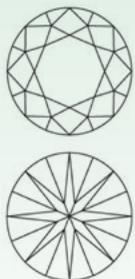
A Diamond grading report shall contain at least the following information:

- Diamond Grading Report (as a title)
- Unique reference number (not shown on the sample report)
- Name and address of the institution issuing the report (not shown on the sample report)

- Reference to the standard* used
- Mass
- Colour grade
- Clarity grade
- Shape and cut
- Measurements
- Symmetry
- Polish
- Proportions
- Nature and thickness of the girdle
- Nature and size of the culet
- Fluorescence
- Diagrams showing the positions of internal and external features
- Date (not shown on the sample report)
- A method to show the authenticity of the document (not shown on the sample report).

* For diamond grading, the CIBJO standard is: ISO 24016 – Jewellery and precious metals – Grading polished diamonds – Terminology, classification and test methods.

DIAMOND GRADING REPORT No.	
Carat weight / Mass	1.05 carat
Colour	exceptional white + (D)
Clarity	loupe clean (flawless)
Shape and cut	round, brilliant
Measurements	6.62 – 6.65 x 3.98 mm
Symmetry	excellent
Polish	excellent
Proportions	total depth: 60.0 % table: 61.0 %
Girdle	faceted, medium
Culet	polished, small
Fluorescence	faint, blue



Comment: Grading compliant with standard ISO 24016

Date:

A sample diamond grading report

Treatments

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 original clarity or colour.

Clarity treatments

Clarity treatments were developed after 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 inclusion and the surface of the stone. Any part of the inclusion not vaporized by the laser is then “bleached” with acid. Laser drilling, known since the 1970s, is a permanent and irreversible technique which shall be disclosed as a “treated diamond”.

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 (or bismuth)-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 lose its transparency with age or leak from the stone when being heated during jewellery repair. Therefore, a fracture-filled diamond shall be disclosed as a ‘treated diamond’ and shall not be graded.

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 the alteration of the body colour of a diamond. Colour treatment is the oldest form of treatment, dating back to before the 16th century, it has normally, but not always, been used to make a poor stone more desirable.

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’ or ‘varnishing’ the pavilion or the girdle area of the stone. Felt pen, nail varnish and many other substances have been used.

To the trained eye, treated diamonds coloured with artificial coating processes often “don’t look right”, because they have an unnatural-looking colour.

Body treatment: irradiation – To actually change the colour of a diamond, new -causing optical defects can be created artificially. A stone can be bombarded by neutrons or other sub-atomic particles or irradiated with electrons; this modifies the diamond’s internal structure by creating carbon vacancies, which absorb the red color of white light, thus changing the diamond’s color to blue, green or greenish-blue.

Longer exposure to irradiation causes the colour to become more intense. The colour can be further changed by heat treatment which anneals the red absorption. By heat

treating the irradiated stone, fancy yellow, orange or pink diamonds, for example, can be created. The final colour depends on the type of the diamond (see classifying diamonds into types). A diamond modified by this treatment shall be clearly disclosed as a “treated diamond”.

Body treatment: High Pressure, High Temperature

– The most recent and sophisticated development in diamond 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 used to produce synthetics. These treatments are irreversible and permanent. Their detection is impossible with simple visual inspection and must be tested by advanced gemmological laboratory equipment to reveal the HPHT treatment. A diamond modified by a HPHT treatment shall be clearly disclosed as a “treated diamond”. A combination of the two last described treatments (irradiation and HPHT) is also possible.

