

Lab created white and colour diamonds – The perfect real diamonds of the future



"They are both diamonds, they have the same chemical properties, the same physical properties."

John King, Chief Quality

Officer of the Gemological Institute of America (GIA)

They (lab created diamonds) will be part of our lives in the future as diamond mines become depleted.

Ronnie Vander linden, President,

Diamond Manufacturers and Importers of America (DMIA)

Introduction –

- **Diamonds are the hardest known substances that are naturally occurring on earth. Known for their brilliance, luster and durability, these single crystals have wide applications in the jewelry industry and in the world of science and technology.**
- **In 1990's, scientists developed the technology to grow bigger diamonds of up to 3 carats and as a result, lab-cultivation of gem-quality diamonds started in Europe and USA. The newly developed HPHT presses were capable of reaching up to 60,000 bar pressures and 2,500°C temperatures, to simulate the magmatic reactions inside the earth. It takes 4-6 days to create a single crystal diamond of 2-3 carats in size, which otherwise takes millions of years in the earth's mantle.**
- **Lab-created / lab-grown / cultured / man-made diamonds are eco-friendly and conflict-free, unlike mined diamonds.**

Grown vs. mined diamonds –

- **Mined diamonds – created millions of years ago, out of carbon deposits and excavated from the earth.**
- **Grown diamonds - created inside a reactor; treated to extreme heat and pressure. They are 30-40% cheaper than natural diamonds, because they are straight from the factories.**

Similarities –

- **Both are real diamonds.**
- **Both have identical physical and chemical properties.**
- **Both are composed of pure carbon.**
- **Both are not artificial, fake or synthetic.**
- **Life of diamonds- eternity for both.**

Differences –

- Lab-grown diamonds have properties such as hardness, thermal conductivity and electron mobility that are superior to those of most naturally formed diamonds.
- Natural diamonds are still smuggled out of conflict zones in Africa and are known as ‘blood diamonds’. Diamond mining is not environmentally friendly, while lab-created diamonds are conflict-free and environmentally not polluting.
- Lab diamonds can be made with fewer inclusions, while flawless natural diamonds are very rare and expensive.
- Solitaire lab diamonds can be created in sizes of 1-3 carats, which are rarely found in the nature.

- **Lab created diamonds are ‘grown’ in a controlled laboratory environment, using technological processes that replicate the conditions under the earth’s crust. Once grown, cut and polished, these stones are identical to natural diamonds and bear the same molecular properties. They are made of pure carbon and they have identical physical, chemical and optical attributes. The HPHT process mimics the natural process of crystalizing the carbon through intense heat and pressure deep within the earth.**
- **These man-made diamonds are virtually indistinguishable from natural diamonds, either by eye or by magnifying scope. The only difference is the point of origin. They have the same hardness, refractive index, specific gravity and dispersion factors. They are polished using the same equipments and technologies. They have the same brilliance and sparkle.**

- **Lab created diamond is the hardest material on earth; and is approximately 10 times harder than sapphire and 100 times harder than cubic zirconia (American diamond). The process to grow diamonds is one of the most precise and difficult manufacturing techniques that humans have ever achieved.**

- **To uniformly grade the quality of a diamond, independent gemological laboratories developed the 4Cs of diamonds in the 1950s: *Cut, Colour, Clarity and Carat weight*. For lab-created diamonds, we can add 4 more Cs–**
 - ☐ **Conflict-free**
 - ☐ **Cost effective**
 - ☐ **Certification**
 - ☐ **Customization**

Dispelling common misconceptions-

MISCONCEPTION 1: LAB-GROWN DIAMONDS ARE CHEAPER THAN MINED DIAMONDS-

- This is the most common misconception and is completely false. De Beers' self-reported cost to mine rough diamonds was \$104 per carat in 2015. The cost to grow each diamond in a laboratory is many times the cost for De Beers and other mining operators to dig diamonds out of the earth, even if we ignore the fixed costs of the machinery required to culture diamonds in a lab. The costs to cut, polish, and grade diamonds is exactly the same, regardless of the origin: grown or mined.

MISCONCEPTION 2: LAB-GROWN DIAMONDS ARE ALL COLORLESS AND FLAWLESS-

- **The process to grow diamonds in a laboratory is very similar to the geological growth process. The same types of inclusions and imperfections present in mined diamonds can also occur in lab diamonds. There can be small inclusions of trace elements that cause the diamond to be near-colorless or slightly included. Lab diamonds are independently graded on the exact same criteria as mined diamonds, by the exact same independent gemological laboratories.**

MISCONCEPTION 3: THEY ARE GOING TO FLOOD THE MARKET-

- **There are approximately 135 million carats of diamonds that are mined, cut, and polished every year, with billions of carats more in existing mines. De Beers estimates its current diamond reserves at 480 million carats. To build production facilities to generate 3% of the current mined diamond supply, it would take billions of dollars of capital expenditure and hundreds of millions of dollars a year to run the facility. Lab diamonds are an extremely small portion of the total diamond market at present.**

MISCONCEPTION 4: THEY REDUCE THE VALUE OF MINED DIAMONDS-

- **This misconception hinges on three incorrect assumptions:**
 - 1) Diamonds are rare (see below)**
 - 2) There will be enough diamonds grown in labs around the world, to reduce that rarity (see Misconception 3)**
 - 3) It is cheaper to grow diamonds than to mine them (see Misconception 1).**
- **While mined, fancy colored diamonds and large investment grade diamonds are quite rare, there are currently over 1 billion carats of diamond gemstones owned globally. Experts estimate that the Baby Boomer Generation in the United States owns over 500 million carats of diamonds, which will be inherited or resold in the next few decades. We believe the much larger threat to the value of mined diamonds is the recycling and resale of previously mined diamonds, a space that De Beers recently entered.**

Performance comparison of Diamond and Diamond simulants

Material		Formula	Refractive Index(es) 589.3 nm	Dispersion 431-687 nm	Hardness (Mohs' scale)	Density (g/cm ³)	Thermal Conductivity
Diamond	Natural Diamond	C	2.417	0.044	10	3.52	Excellent
	Lab-created diamond	C	2.417	0.044	10	3.52	Excellent
Diamond Simulants	Cubic Zirconia (American diamond)	ZrO ₂	~2.2	~0.06	~8.3	~5.7	Poor
	Moissanite	SiC	2.648-2.691	0.104	8.5-9.25	3.2	High
	Glasses	Silica with Pb, Al or Ti	~1.6	>0.020	<6	2.4-4.2	Poor
	White Sapphire	Al ₂ O ₃	1.762-1.770	0.018	9	3.97	Poor
	Spinel	MgO.Al ₂ O ₃	1.727	0.02	8	~3.6	Poor
	Rutile	TiO ₂	2.62-2.9	0.33	~6	4.25	Poor
	Strontium titanate	SrTiO ₃	2.41	0.19	5.5	5.13	Poor
	YAG	Y ₃ Al ₅ O ₁₂	1.83	0.028	8.25	4.55-4.65	Poor
	GGG	Gd ₃ Ga ₅ O ₁₂	1.97	0.045	7	7.02	Poor

Note: As you can see from the table above, there is enormous difference between the lab diamonds and the stones known as diamond simulants. The grown diamonds are made up of carbon atoms arranged in exactly the same structure you would find in a mined diamond.

The market –

- **Diamonds are in high demand across the World and the present global market size is 135 million carats. The ‘Global diamond industry report – 2015’ by Bain and Company clearly mentioned that the rough diamond supply will reduce to around 70 million carats by 2030. It is forecasted that the diamond market will increase to 290 million carats by 2050, while the supply of mined diamonds will fall to 14 million carats; because no new diamond mines are being discovered.**
- **Natural diamonds are mined in Africa, Canada, Australia and Russia. There are civil wars in Africa for diamonds. It is estimated that diamonds change as many as 48 hands when they reach to the final customer. Natural diamonds are often mined by slaves and even by children, and the profits from them are often used to fund wars and terrorism.**

- **Lab-created gem-quality diamonds are made in white or blue colours, which are in demand from the jewelry industry. Fancy coloured diamonds in pink and yellow can also be created to get high prices. They can be certified as 'lab-grown' real diamonds by the International Gemological Institute (IGI), as per the disclosure norms in many countries. However in India, there are no such laws at present and the visual / microscopic inspection cannot distinguish between lab-grown diamonds and natural diamonds.**
- **The production of natural diamonds came down from 176 million carats in 2006 to 135 million carats in 2015. There are 54 diamond mines in the world at present and no major discoveries have been made over the last 2 decades. In the mined diamond industry, 5 large companies such as Alrosa, De Beers, Rio Tinto, Domination Diamond and Petra Diamonds collect about 85% of the total revenues. Diamond is an 80 billion global industry now.**

- **India is the third largest market for diamonds in the world; but its share in the overall sales is only 8%, compared to 42% for USA and 16% for China. In the last 10 years, the Indian diamond market tripled to Rs. 22,000 crores in 2014. About 25 lakh pieces of diamond jewelry were acquired by the Indians in 2013, as per a market survey released by De Beers in 2015. According to a published report from Tanishq, the demand for solitaire (single crystal) diamonds is increasing in India.**

The future of lab created diamonds –

- **It is estimated that lab-created diamonds will be widely accepted in the near future in the same way as cultured pearls, which is having 95% market share at present. Lab-created diamonds are perfect diamonds, and are completely different from artificial / simulated diamonds.**
- **As per a survey in Europe, 40% of the customers accept lab-grown diamonds, as these are stain-free and conflict-free. In India, such diamonds are often imported and mixed with natural diamonds, as they are 30-40% cheaper.**
- **The total world-wide availability of gem-quality lab grown diamonds does not exceed 4-5 million carats, out of which solitaire diamonds of more than 1 carat size are around 100,000 carats per year; this is not even 1% of the total market for solitaire diamonds.**

- **Looking at the future of gem and industrial diamonds, several billionaires in USA invested in diamond projects. Leonardo Dicaprio, who acted in the movie 'Blood Diamond' (2006), invested in a diamond factory in USA, which was started by a team of MIT, Stanford and Princeton engineers in 2012.**
- **Dicaprio has reportedly raised 100 million USD on this project along with 10 billionaires such as Twitter Founder Evan Williams, Zynga founder Mark Pincus, Sun Microsystems founder Andreas Bechtolsheim, Facebook co-founder Andrew Mc Collum, former eBay president Jeff Skoll and others.**
- **De Beers already started a company called 'Element Six' to produce lab created diamonds. Swarovski has recently launched an exclusive jewelry brand in USA, for lab created diamonds.**



Lab created, nearly colourless diamonds

Lab created colour diamonds –

- Labs created diamonds are also available in colours like dark red, cognac, yellow-green, pink and blue. They are priced much lower than naturally available colour diamonds, which are selling at astronomical prices.

Photos of lab-created colour diamonds





- **Naturally available coloured diamonds are 2-10 times more expensive when compared to white diamonds, and they are extremely rare in nature. For example, a fancy vivid blue diamond of 6.04 carats was sold for a massive 7.9 million USD in Hong Kong.**

- Following are the sample prices of naturally coloured diamonds-



**3.01 Carat Fancy Yellow Diamond
\$74,340**



**0.72 Carat Fancy Green Diamond
\$390,580**



**0.92 Carat Fancy Intense Purple
Pink Diamond \$231,250**



**0.95 Carat Fancy Vivid Purplish
Pink Diamond \$301,190**



**0.51 Carat Fancy Vivid Pink
Diamond \$95,860**



**0.20 Carat Fancy Blue Diamond
\$17,970**



**0.53 Carat Fancy Intense Pink
Diamond \$57,540**



**0.63 Carat Fancy Green Diamond
\$66,840**



**0.20 Carat Fancy Deep Pink
Diamond \$12,470**



**2.04 Carat Fancy Vivid Yellow
Diamond \$172,390**



**0.35 Carat Fancy Intense Purple
Pink Diamond \$17,400**



**0.38 Carat Fancy Intense Purplish
Pink Diamond \$40,270**

Coloured diamonds in jewelry





**Please send your enquiries for lab created
white and colour diamonds to -**

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