HRD Antwerp
Institute of Gemmology

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D-SCREEN

The most compact **diamond screening** device in the world

The Blueprint for Quality

Antwerp - Hong Kong - Istanbul - Mumbai - Shanghai

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HRD Antwerp has developed the most compact **diamond screening** device in the world!

This device identifies natural diamonds (neither synthetic nor HPHT colour enhanced). It can be used for cut diamonds with colour range from D to J.

Diamond sector threatened by synthetic and treated stones

Up until the sixties, a colourless or nearly colourless diamond was by definition a natural stone. In the eighties the first synthetic ornamental diamonds appeared on the market. They were made using HPHT synthesis (HPHT = High Pressure High Temperature).

In 1999, the first reports of commercial HPHT treatment started to emerge. This process gained a great deal of attention, as the technique could turn some brown diamonds into colourless diamonds. It was, after all, the very first technique that could 'remove' colour from a diamond.

In 2001, the American company Apollo Diamond announced its plans to produce synthetic diamonds using CVD techniques (Chemical Vapour Deposition). It also became known that it was possible to 'remove' the brownish colour of some CVD synthetic diamonds in order to obtain colourless diamonds by using HPHT treatment.

The arrival of these new techniques brought about enormous challenges for scientists and researchers. They embarked upon an intensive search for new techniques that would allow diamond traders, jewellers and consumers to identify the true nature of a diamond: natural, treated or synthetic. These techniques were also to be user-friendly, reliable and economical.
Years of research resulted in the launch of a unique device: **the 'D-Screen'**.

The D-Screen is a practical research device developed by HRD Antwerp. It distinguishes stones that are not synthetic and have not been HPHT colour enhanced from stones that are potentially synthetic or may have had their colour improved by means of HPHT.

Is your diamond **NATURAL**, **SYNTHETIC** and/or **ENHANCED**?

What you need to know about colour

Types of diamonds

A diamond with a perfect crystal lattice made entirely of carbon would be completely colourless. In reality, however, all diamond crystals contain atomic impurities and structural imperfections. We call these 'colour centres' because they are responsible for the colour of a diamond.

The most common atomic impurity in a diamond is nitrogen. Based on the presence of this atom in the diamond lattice, one can classify diamonds into two main groups.
Type I diamonds contain a higher level of nitrogen, while **type II** diamonds contain practically no nitrogen.

Type I diamonds

Type I diamonds account for the large majority of cut diamonds (> 98%). The nitrogen atoms are organised either in 'group' (type Ia) or 'isolated' (type Ib). Because some of these nitrogen groups absorb blue light, type Ia diamonds often have a light yellow colour that can vary to brownish yellow or brown. Diamonds with isolated nitrogen atoms (type Ib) usually have a deep yellow to orange colour.

Natural type Ib diamonds are very rare, accounting for less than 0.1% of the total quantity of natural diamonds of precious stone quality. After their formation, most diamonds remain in the upper part of the earth's mantle for millions of years under high pressure and high temperature. In this environment, the nitrogen atoms present in the diamond, gradually group to become aggregates, so the diamonds change from type Ib to type Ia. Synthetic diamonds on the other hand are always very young, so they usually contain a very high relative level of isolated nitrogen.

Type II diamonds

Type II diamonds contain very negligible levels of nitrogen. Because nitrogen is usually the most prevailing impurity, type II diamonds can be considered as the purest form of diamond in terms of atoms.

Type II diamonds can be divided into two subgroups: type IIa and type IIb. The first group is very pure and can be completely colourless. These stones however often contain structural defects that can give them a brown to pink colour.

Type IIa diamonds are very rare in precious stone quality (approximately 1% to 2% of all diamonds). Some of the most famous colourless diamonds, such as the Cullinan and the Koh-I-Noor, are of this type.
Type IIb diamonds (< 0.1% of all diamonds) have substitute boron atoms in the crystal lattice. As a result, these diamonds are blue, although they can also be brown and grey to nearly colourless. All natural blue diamonds are type IIb, including the famous/infamous Blue Hope diamond.

	Type I		Type II	
	Ia	**Ib**	**IIa**	**IIb**
Colour centres	Groups of nitrogen atoms	Isolated nitrogen	No specific colour centre	Substitute boron atoms
Colour	• Colourless • Yellow	• Orange • Orange - Yellow • Brown	• Colourless • Brownish yellow • Pink • Purple	• Blue • Grey

What you must know about treatments

HPHT colour treatment

General Electric (GE) developed the high pressure (HP) - high temperature (HT) treatment in the mid-nineties with the purpose of changing the colour of 'lower quality' (read: light brown) diamonds.

During this treatment, the stone is heated to temperatures of over 2100°C. To prevent the diamond from being transformed into graphite, this takes place at a very high, stabilising pressure.
The brown colour in some types of diamonds (including type IIa) is associated with the presence of plastic deformation or

defects in the crystal lattice. HPHT treatment changes these defects in the crystal lattice. Consequently the cause of the colour disappears.
The whole process often takes only a few minutes, but the diamond must then be cut to remove the mat, corroded surface to regain its sparkle.

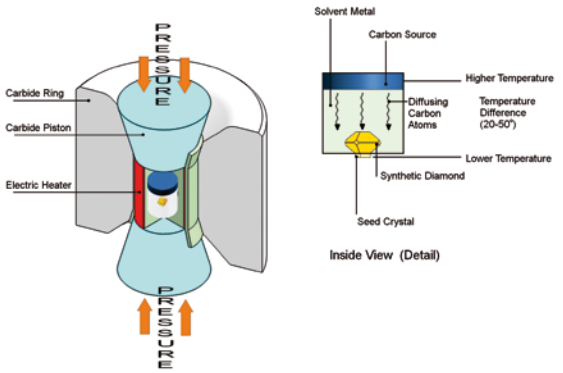
The final result of this treatment greatly depends on the initial properties of a diamond and its type. Today a brown, grey or light yellow diamond can be 'transformed' into a diamond ranging from intense yellow, to greenish yellow, pink, blue or colourless.

HPHT synthesis

The purpose of this technique is to synthetically produce a diamond by replicating the formation conditions of diamonds deep in the earth. By applying a high pressure (HP) and high temperature (HT) to a carbon source, one 'forges' a synthetic diamond. Swedish researchers at ASEA were the first ones to produce a diamond by using this method in 1953. They were soon followed by General Electric and De Beers. Since the seventies, gem quality diamonds have been produced by HPHT synthesis. Today, they are sold for about 30% of a natural diamond's price.
By keeping the conditions stable for a longer time, one can 'grow' a rough diamond up to 2 to 3 carats in just a few days.

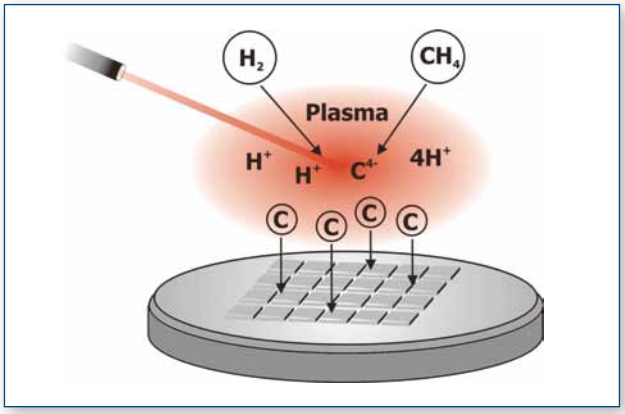
The majority of these stones are coloured bright yellow to orange due to the presence of nitrogen atoms in the crystal lattice. They are type Ib diamonds. It is also possible to grow colourless (read: nitrogen-free) diamonds, but the technical problems involved remain sizeable and such stones are practically absent from the diamond market.

Cross Section of the Ultrahigh Pressure Unit



CVD synthesis

Chemical Vapour Deposition is the process through which a diamond is produced from a (carbonaceous) gas.



The principle was already known in the nineteen thirties, but it took until the beginning of this century before one succeeded in growing larger single diamond crystals instead of polycrystalline material.

The gas (methane is usually used) is heated to a very high temperature. Atom compounds are then broken down. Then, carbon atoms can be 'precipitated' onto a surface. Under the right conditions, a single crystal is formed that becomes thicker layer by layer. A typical speed for a good quality diamond is half a millimetre a day.

CVD synthetic diamonds are - considering the complexity of the process - usually light brown, making them relatively unattractive to the average diamond trader. However, this brown colour can often be removed using HPHT treatment. As scientists are continuously defying the limits of technology, colourless diamonds are expected to become available in the future.

Compact, reliable and fast!

First, make sure that the stone is a diamond, cut (one facet is enough), colour D to J, weighing between 0.20 and 10 carat.

Then, place the diamond to be examined table downwards on the detector. Close the device. After a few seconds, the result appears on one of the indicators:

Green indicator:

the stone is not synthetic and not HPHT colour enhanced.

Orange indicator:

the stone may be synthetic or HPHT colour enhanced, the stone requires further examination in a laboratory.

Red indicator:

low battery voltage or defective device

D-Screen characteristics

Compact size:	40 x 50 x 150 mm
Use:	battery or AC (including cable)
Weight:	325 g, including battery
Power supply:	9 V DC, 250 mA
Adaptor input:	110-230 V, 50/60 Hz
Adaptor output:	9 V DC, 300 mA

The advantages of D-Screen

- **Easy check to see if your stones are not synthetic or HPHT colour enhanced using current technologies**
- **Fast and correct result**
- **Compact and user-friendly**
- **Ergonomic**
- **Mobile use (battery)**
- **Price/quality**
- **Suitable for all diamond cuts - screening of ± 200 stones/hour**

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For more information,
please contact:

HRD Antwerp
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HRD Antwerp nv
Hoveniersstraat 22, BE-2018 Antwerp, Belgium
Tel.: +32 3 222 06 23
Fax: +32 3 222 06 26
equipment@hrdantwerp.be

www.hrdantwerp.be