The Hologram

Since the commemorative stamp issue "50 Years Rega" is the first stamp from Swiss Postal to bear a hologram, this is truly a good reason to present more details about it and its production.

What is a hologram?

Simply stated, one could say that a hologram is the art of displaying a three-dimensional picture of an object on a two-dimensional carrier. It was in 1947 that Dennis Gabor coined the expression «hologram» by combining the Greek word «holos» (▶ whole) and «gramma» (▶ message). The expression «holography» is the combination of «holos» (▶ whole) and «graphein» (▶ writing or recording). Dennis Gabor was awarded the Nobel Prize in physics in 1971 for his theory on holography.

In general, holography is regarded as the method of picture recording and picture display which, in contrast to common photography, allows for the three-dimensional display of an object. It is considered a two-step optical method of picture object recording. The first step is the creation of the hologram through light reflection, and in the second step, the three-dimensional object image becomes visible via light waves. It is only because of this second step that it became possible for an observer to see the three-dimensional structure. Because no coherent light source was available, holography was only a theory until the invention of the LASER (**L**ight **A**mplification by **S**timulated **E**mission of **R**adiation). The LASER then supplied the necessary monochromatic (single colour) and single beam light sources which enable us to view holograms as we do today.

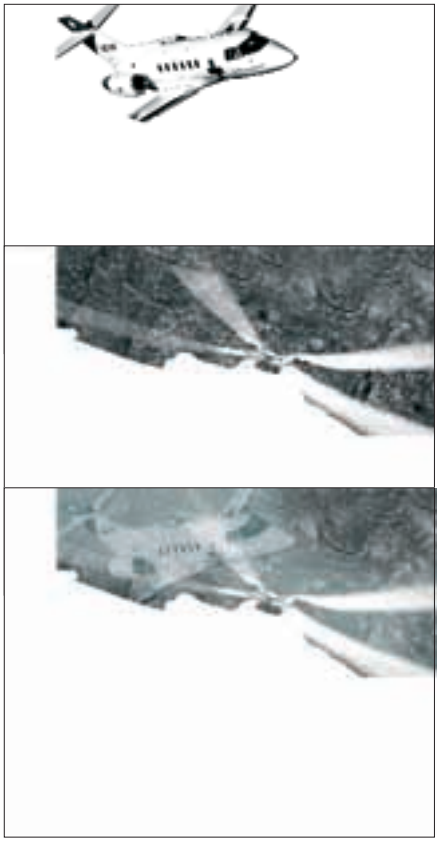

Figure 1

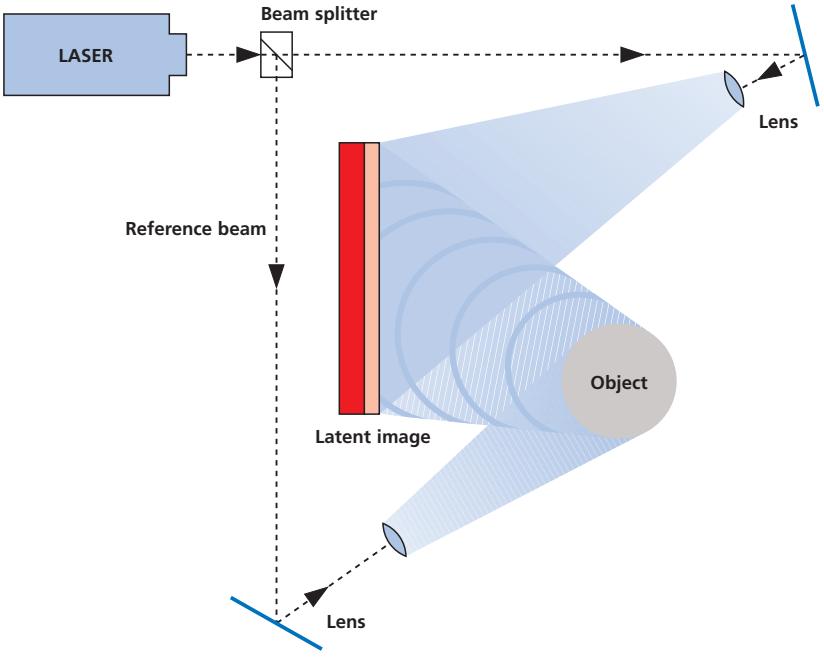

Diagram 1

How is a hologram produced?

First, a design is needed which can be a drawing, picture or carved model. The Rega issue used three components to form the actual hologram image. This is why it is referred to as a 2D/3D hologram.
The 2D hologram components (2D = two dimensional) are the photos of the:
- ambulance plane (Hawker 800 B)
- rotor of the rescue helicopter (Agusta A-109-K2)
- mountains (background in the hologram).

These three picture components have been layered to create the third dimension (which adds the 3D = third dimension) of the hologram (Figure 1).

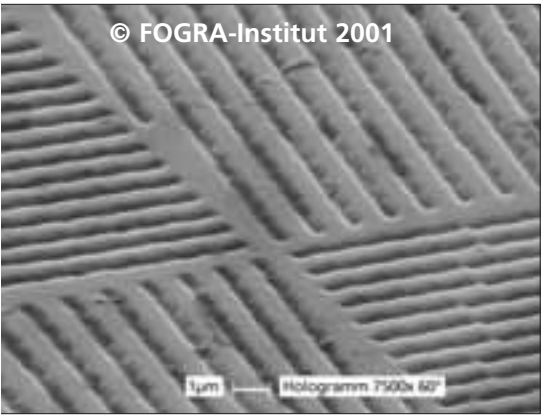

Figure 2

The three picture images were then scanned by a laser beam and the reflection inference beam was registered on a photosynthetic foil. Diagram 1 shows a laser beam which is divided into 2 half-beams (object beam + reference beam) by using a special mirror called a beam splitter. During this process, each half-beam is expanded with a lens and the object beam illuminates the object. The object beam is then reflected, and both half-beams meet again in the holographic master (film) where they create an interference image. This interference image holds the 3-dimensional information of the object (position, size and depth of the object). At this point, the hologram is only a latent image on the film. The permanent hologram image (the hologram master) is created by photochemical development. In the case of the Rega issue, three latent images were generated and recombined in order to create the hologram master. The foil surface consists of lines and notches which are as fine as the laser beam used. The surface relief structure of the Rega issue was created by use of the interferential microlithograpy method from Hologram.Industries (Figure 2 – courtesy of FOGRA Munich [2] – shows a hologram with similar capabilities at a magnification of 1:7500).

For mass production of holograms, a copy of the master hologram is made – the "photo resist" – by use of common white light. This causes the colour (called "diffraction" or "rainbow") effects to become visible to the observer. These effects appear in white light as continuous colour changes in vertical orientation. The photo resist copy, which is called a shim, is used for the mechanical process of replication. This process is usually carried out on special equipment using various methods by specialised companies. With the Rega issue, the Gyrogram® method by Hologram.Industries was

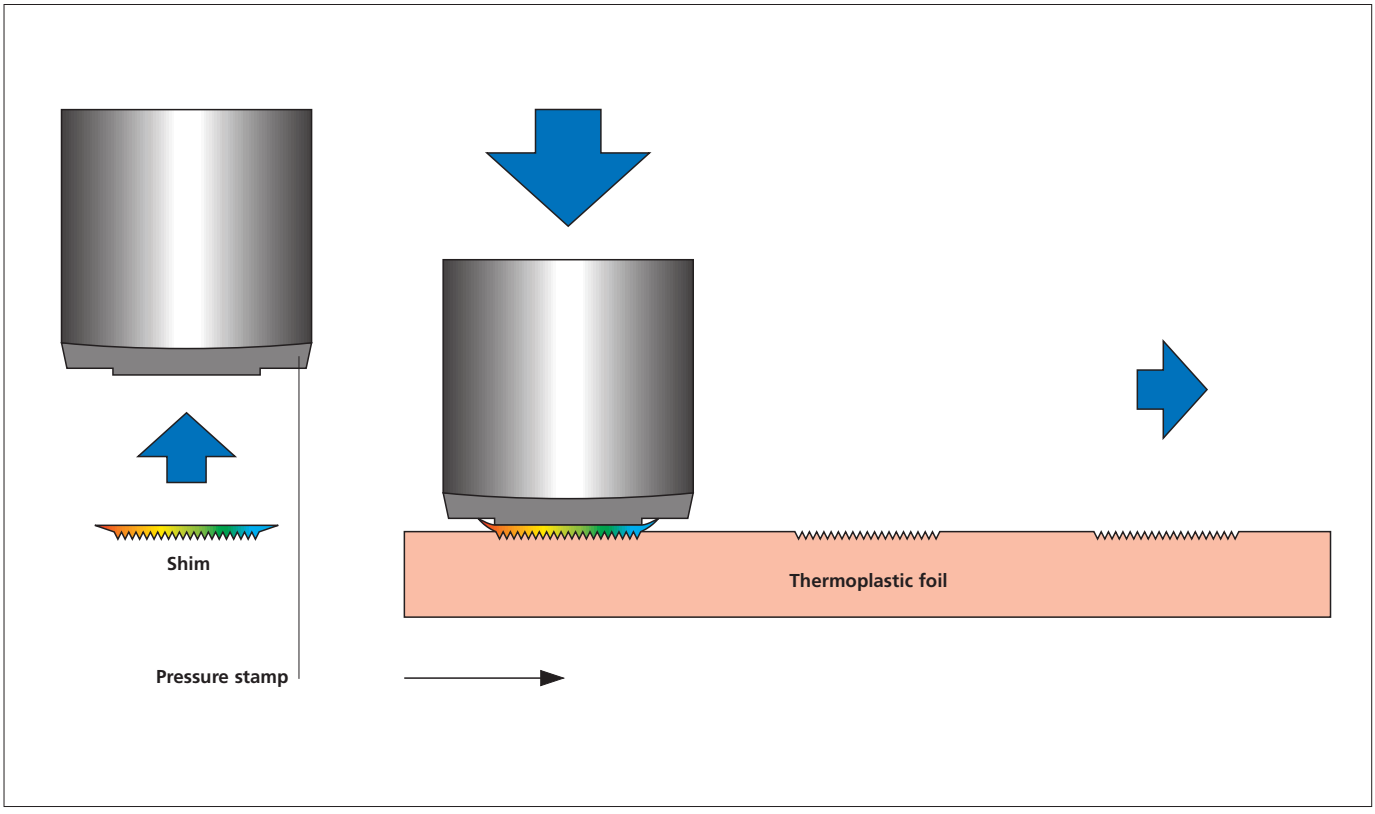

Diagram 2

utilised. In general, the surface relief structure of the shim is transferred by temperature and pressure onto a thermoplastic foil, thus creating an image resolution of 1000 lines per mm (Diagram 3).

After adding a micro thin aluminium layer and an electron beam curing process, the hologram is permanent. A protective layer is applied in the final process step and the hologram is ready for use. Quite often, only a hot melt layer is applied to the hologram for embossing. Figure 3 (courtesy of FOGRA Research Institute Munich [2]) shows a vertical cut through a stamp with an embossed hologram, revealing the protective layer and the micro thin aluminium layer with the thermoplastic foil together with the hot melt layer beneath it. The difference in surface structure between the paper and the hologram can be observed on the border of the contact area.

How is a stamp issue with an applied hologram produced?

The Rega commemorative issue is printed on a 5-colour offset printing machine. In an additional process step, the roll of hologram foil, which contains many thousands of individual holograms, is applied on the printed sheets by hot foil embossing (like commonly used gold foils). This is done by application of heat and pressure via a polished metal plate. The heated metal plate on the counter print cylinder glues the so-called "hot melt layer" of the hologram onto the printed stamp. For exact register (to ensure that the hologram has no shift in its position on the stamp), a glass fibre is placed on the heated metal plate. This serves as a registration mark which is electronically controlled to secure the highest precision. Even in a highly automated print process, a printer is still required in order to maintain optimum levels of the various printing condition parameters. The most important parameters including applied pressure, speed and the temperature of the embossing plate are checked continuously. Furthermore, the slightest variation in thickness of the hologram foil or printed paper needs to be adjusted as well. In the final post press step, the printed sheets are perforated and cut to stamp sheet size.

"Holograms on stamps" is a new and exciting area of philately which has already attracted many collectors. It is not surprising that specialised literature, topical collectors groups and renowned experts already exist in this area. With the Rega commemorative stamp, Swiss Post has added yet another exciting and valuable philatelic and holographic issue to this expanding field.

Figure 3

1 Printing paper
2 Aluminium layer
3 Protective layer
4 Hot melt layer

For the creation of the stamp issue, its production and additional information for this article, we would like to thank:

Gilles Le Baud, Direktor of Cartor Security Printing, Chartres near Paris. The mailing address of "La Loupe*" and stamp print production is coincidental. Cartor is located at Avenue Rowland Hill, in the industrial zone Gutenberg in 28240 La Loupe. Cartor has been in stamp production for 25 years and has 120 postal services, on all continents, as its clients.

Marie-Laure Maquaire, Head of Marketing for Hologram.Industries at Avenue de l'Europe 22 in 77607 Marne la Vallée, Cedex 3; France, an enterprise which is specialised in production of holograms of all sorts and in all areas of security printing.

Ulrich Schmitt, Editor and Vice Chairman of HIT e.V. (Topical Stamps Workgroup for Trades-Industry-Technology e.V), renowned collector and author on the topic of holograms. For many years he has also worked as a Senior Researcher with the FOGRA Institute, Munich where he has worked on, and led research projects in all aspects of quality assurance and innovative methods for pre-press, as well as print production.

* the french-language version of Focus

Tips for collectors:

Cancellation:

While holograms do accept the ink of cancellors used by post offices and philatelic outlets in Switzerland, it is worthy of note that the ink does not dry to an acceptable degree (even after a considerable time). Consequently, the ink on the hologram can easily be smudged or smeared at any time. The ink used for cancellation will not be replaced to get better results with this stamp issue. In the best interest of collectors, a special cancellation service for the Rega stamp issue items, will be available in Berne. A special cancellation machine, with specially made ink that has appropriate drying qualities on hologram foils, will be used to ensure the best results for collectors.

The following cancellations (see figures) are only available at:
Swiss Post
Stamps and Philately
Cancellation Service
Ostermundigenstrasse 91
CH-3030 Berne

First-day cancellation:
8058 Zurich (Date 12.3.2002)

Place cancellation:
2513 Twann (Date 12.3.2002)
Twann is where Rega was founded

Day cancellation:
3000 Bern 1, Schanzenpost
(Date 12.3.2002)

Attention: Cancellations on the printed, non-holographic section of the Rega commemorative issue can be obtained at all regular post offices and philatelic outlets.

Use of steam or water for removing hologram stamps from envelopes

Collectors who wish to remove used hologram stamps from envelopes are advised to keep the steam or water contact as short as possible. Research on hologram stamp issues from other countries has shown that extensive steam or water contact has resulted in micro cracks of the holograms. Figure 4 (courtesy of FOGRA Munich) shows the typical microscopic cracks on the hologram surface. These cracks create undesirable visual impacts such as cloudiness over the images, roughening and, in some cases, clearly visible cracks of the hologram surface. These are all caused by differences in the elongation properties of the two materials which create structural changes in the bonded structure of hologram and paper.

Wet hologram stamps should be placed in a drying book and any surface wetness should be wiped off gently. Extensive pressure on the closed drying book or on the hologram stamp should be avoided since this can create additional strain on the bond structure of paper and hologram. This could result in increased structural damages.

Storage of philatelic items with holograms:

Holograms should be treated like all valuable philatelic items and stored accordingly. Use only plastic protective covers which are free of solvents or softening agents. Storage temperatures should be between 10 °C and 20 °C. In general, it is advisable to use vertical storage since it does not increase force on the philatelic items (as could happen if pile storage is used). Increased temperatures, constant high levels of humidity and increased pressure can create conditions where valuable items become damaged or even destroyed (due to additional impressions or secondary bonding).

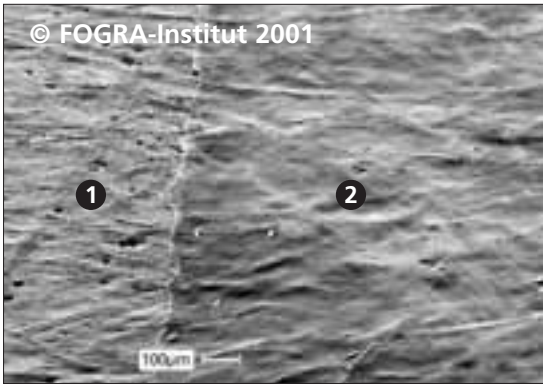

Figure 4
❶ Printing paper
❷ Hologram foil damaged by water

Additional literature:

Schmitt, U.: Holograms on Stamps. Edition 2000 (in German and English)
can be ordered from: Motiv-Arbeitsgemeinschaft Handwerk-Industrie-Technik e.V. (Topical Stamps Workgroup for Trades-Industry-Technology e.V.) – H. Meyer – Von Manderscheidtstr. 4 – 48691 Vreden – Germany

Techno-Thema
German-language members' magazine of the Topical Stamps Workgroup for Trades-Industry-Technology e.V. – H. Meyer – Von Manderscheidtstr. 4 – 48691 Vreden – Germany (Includes the German Hologram Stamp Interest Group and is also open to international members)