Travel Documents
Security Features, Production Technologies and Examination

Textbook for state officials of the Republic of Azerbaijan

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The textbook was prepared by the team of experts from the Lithuanian State Border Guard Service and the Royal Netherlands Marechaussee, coordinated by Ms. Monika Weber (ICMPD), in close cooperation with the working group on document security represented by the State Border and State Migration Services of the Republic of Azerbaijan, led by Ms. Saltanat Mammadova (ICMPD National Project Officer). The development of the manual was reinforced by several international experts; from Lithuania: Mr. Artūras Gedminas, Mr. Vitalijus Mučinis, and Mr. Pavelas Staškevičius; from the Netherlands: Mr. Gerton Bomhof and Mr. Jody Schuurman; and ICMPD Project Manager Ms. Monika Weber.

The material related to the specifics of document security in the Republic of Azerbaijan used in the preparation of the textbook has been drawn from presentations from the partner state EU experts, and knowledge and experience gained during study visits to Bulgaria, Czech Republic, Latvia, Lithuania, the Netherlands and Slovak Republic.

This textbook provides descriptions of the main security features of travel documents, and examples of counterfeiting and the methods of detecting them, both during quick document checks and detailed checks using the different detection equipment. The textbook is aimed at a wide range of readers, and should be of particular importance to the staff of the State Border Service and the State Migration Service of the Republic of Azerbaijan, and other governmental agencies dealing with the issue of document check and/or document security.

This textbook is a standalone, independent tool to be used for daily reference, professional teaching at border/migration training centres, including advanced and qualification raising trainings, or self-learning. However, for an even better performance with regard to document security, it is recommended to use this manual in combination with the distance learning e-tool which has been produced in the framework of the MOBILAZE project.

ICMPD and the project partners wish the best of success to the national trainers in Azerbaijan, whom have been trained in the framework of this project by international EU partner trainers through knowledge sharing, training of trainers, workshops, supported pilot trainings, national trainings, study visits to European Union Members States (EU MSs) and other project activities.

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List of abbreviations, acronyms and definitions

1-D ..........One-Dimensional
2-D ..........Two-Dimensional
3-D ..........Three-Dimensional
AA ..........Active Authentication
ABS ........Acrylonitrile Butadiene Styrene
BAC ........Basic Access Control
BCP ........Border Crossing Point
BG ..........Border Guard
CLI® ........Changeable Laser Image
CSCA ......Country Signing Certification Authority
CMYK .....Cyan, Magenta, Yellow, Black
EAC ........Extended Access Control
EU .........European Union
EU MS ....European Union Member States
ICAO ......Canada/Montreal based UN organisation that codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth.
ICMPD ....International Centre for Migration Policy Development
ID .........Identity Document
IDNP ......Identification Number of Person
IR ..........Infrared
ICAO ......International Civil Aviation Organization
ISO .......International Organization for Standardization
IPI .......Invisible Personal Information
MM ........Millimetre
MRD ..........Machine-Readable Document
MRP ..........Machine-Readable Passport
MRZ ..........Machine-Readable Zone
MOBILAZE ..Support to the Implementation of Mobility Partnership with Azerbaijan (project funded by the European Union and implemented by ICMPD)
MLI® .........Multiple Laser Image
NM ........Nanometre
OCR ..........Optical Character Recognition
OVI ........Optically Variable Ink
OVMI ........Optically Variable Magnetic Ink
PA ..........Passive Authentication
PC ...............Polycarbonate
PEAK® ..........Printed and Embossed Anti-Copy Key
PET ..........Polyester
PP ........Polypropylene
PVC ........Polyvinylchloride
RF ..........Radio Frequency
RFID ..........Radio Frequency Identification
RGB ........Red, Green, Blue
SAM ........Screen Angle Modulation
SBS ..........State Border Service (of the Republic of Azerbaijan)
SMS ..........State Migration Service (of the Republic of Azerbaijan)
UV ..........Ultraviolet
VIZ ..........Visual Inspection Zone
Greater mobility brings both opportunities and challenges. Migration is becoming more important and essential for daily human life in our globalised world and, as a consequence, the importance of travel documents is increasing. Passports, residence permits or visas are used for travel purposes as proof of a traveller’s identity. It is well known that, unfortunately, not all travellers have bona fide purposes; therefore, ensuring the security of travel documents becomes essential.

Seeking to adequately respond to growing challenges related to the international community’s efforts to control people’s movement over international borders, the producers of travel documents continuously introduce the newest and most modern security features to the travel documents of different countries. On the one hand such a steady process of modernisation supports secure border mechanisms, on the other it may slow down border crossing and other migration-related procedures if state officials are not fully informed and trained on documents security issues. In this regard, this textbook provides a necessary basis to get familiar with the current aspects of document security.

Moreover, different to many other manuals, handbooks and guides on document detection and recognition of forged and falsified travel documents, this textbook is tailor-made for the purposes of the law enforcement agencies of the Republic of Azerbaijan, which makes it of most relevant use in that country. Such adjustment of the textbook in line with the specific needs of the Republic of Azerbaijan was possible due to the significant contribution to the elaboration of this manual, and support from the State Border Service and the State Migration Service. In the second part of this introduction, some short information about both these services is provided.

There are a number of methods and ways of falsifying documents and these methods are changing all the time and go hand in hand with the new security features being used in the genuine documents. That is why it is often more important to learn and focus on original document production instead of ways of falsification. This textbook takes such an approach and describes in detail the technology used in the production of secure documents. However, despite the importance of knowledge on document production technologies, in order to run an efficient document check, the representatives of the competent authorities must have a solid knowledge not only regarding document security features but also the basic methods of their falsification and indicators of falsification. In response to this, the textbook also focuses on the most common falsification processes, technical knowledge and possible opportunities for falsification, etc.
Following this introductory part, the present textbook covers the following main aspects of document security:

**Part I – Travel Document Printing Steps**
Covers such actions in document production as prepress, press and after press, particularly focusing on printing technologies and practical examples of these.

**Part II – Travel Documents**
Introduces the main features of travel documents currently being used by the majority of states, including the specifics of machine-readable and electronic (biometric) documents.

**Part III – Document Examination**
Provides an overview of the most widespread document falsification methods, as well as lists important tips for state officials on how to recognise a falsification during the document check, thus improving the efficiency of border control and other migration-related procedures.

**Part IV – Glossary**
Designed to explain the main terminology related to the production of secure documents.

The steps, procedures, methods and techniques presented in each of the parts are all illustrated by pictures based on the European and Azerbaijani experience in production of secure documents and the specifics for their examination.

Identification of the security features and printing methods used in the production of documents is a compulsory stage of any document examination. The information provided in this textbook will facilitate the work performed by specialists when assessing the authenticity of travel documents, and the training given to personnel of border/migration control subdivisions and other experts on identifying the security features and printing methods of travel documents. As well as this, it will also be useful in enhancing professional development and training in the area of identification of forged or counterfeited documents.

The EU-funded MOBILAZE project team consisting of ICMPD, EU MS and Azerbaijani experts hopes this textbook will be a useful tool for state officials working in the border and migration fields in Azerbaijan and that it will contribute to the further development of a modern, secure and transparent migration and mobility area.
The State Border Service of the Republic of Azerbaijan

In the early twentieth century, the formation of the Azerbaijan border security forces was linked to the first democratic republic established in the East of the country. On 18 August 1919, the Azerbaijani National Parliament adopted the Law on the Establishment of Border Protection of the Republic of Azerbaijan. The implementation of this Law stipulating the establishment of 99 security posts along the border remained unfinished due to the collapse of the Azerbaijani Democratic Republic as a result of the expansionist policy of foreign forces. Nonetheless, the concept of “border” and “border guard” was engraved in the minds of officials as an important attribute of independence. In 1991, after the restoration of the independence of the Republic of Azerbaijan, the establishment of the state border protection system resumed.

The work done in the field of ensuring the security of the state border and the decisions made by Heydar Aliyev, former President of the Republic of Azerbaijan, has shaped national border policy and defined the concept of border security. Currently, tasks in the field of border security are being successfully carried out as a result of the great attention and care of the President of the Republic of Azerbaijan, and Supreme Commander-in-Chief of the Armed Forces, Ilham Aliyev. Founded in 2002, the State Border Service (SBS) is a central executive authority directly subordinate to the President. According to the current legislation the main functions of the SBS are to ensure border security and inviolability, counter international terrorism, combat illegal migration, drug trafficking and smuggling of weapons or ammunition, prevent proliferation of weapons of mass destruction and their components, and assure the safety of hydrocarbon deposits and oil and gas infrastructure.

Combining search operations, investigation and military competences, the State Border Service consists of a border division, border detachments, border control units, the Coast Guard, the Aviation Detachment, a training academy and training centres, as well as logistic units. The SBS is the main governmental body dealing with travel document checks and profiling of persons, as they are, among others, responsible for the first-line check of travellers at border crossing points (BCPs).

The State Migration Service of the Republic of Azerbaijan

Rapid development and creative works, socio-political and economic stability in the Republic of Azerbaijan have led to rise in number of people migrating to this country from all parts of the world, thus increasing dynamics of migration processes in the country.

Over the past period the legislative framework has been updated in order to regulate migration flows in the Republic of Azerbaijan, to enhance control in this area and to adjust the migration policy in line with political and economic interests of the country. Thus, the adoption of the State Migration Management Policy Concept of the Republic of Azerbaijan on July 13, 2004 and the State Migration Program of the Republic of Azerbaijan (2006-2008) on July 25, 2006 is the most important step made in this direction.
As a logical continuation of the work being done so far the State Migration Service was established on March 19, 2007 under the Decree No560 signed by the President of the Republic of Azerbaijan for introduction of the most sophisticated migration system in the Republic of Azerbaijan.

The State Migration Service is a central executive body that obtained the law enforcement status with the Decree No76, dated April 8, 2009, signed by the the President of the Republic of Azerbaijan and implements the state policy in the migration sphere, manages and regulates migration processes as defined by legislation of the Republic of Azerbaijan. The spheres of activity of the State Migration Service include registration of foreigners and stateless persons at places of their staying in the Republic of Azerbaijan, issuance of permits for temporary staying, temporary and permanent residence as well as of work permits and extension of their periods, determination of the refugee status, participation in citizenship and readmission issues and prevention of irregular migration.

Since the first day of its establishment this Service implements its duties following the principles of respect to human rights and freedoms, legality and humanism.

The overall system of the State Migration Service of the Republic of Azerbaijan consists from its Apparatus, Regional Departments in Baku, Ganja, Khachmaz, Aghsu, Lankaran, Shaki, Shirvan and Yevlakh cities, Irregular Migrants Detention Centers in Baku and Yevlaks cities, Training Center, Medical Institution and State Migration Service of the Nakhchivan Autonomous Republic.

In order to regulate migration processes through single and prompt procedures and facilitate their documentation, the Decree No69 on “Application of “one-stop-shop” principle in the Management of Migration Processes” dated March 4, 2009 was signed by Mr. Ilham Aliyev, President of the Republic of Azerbaijan. In accordance with the Decree, the “one-stop-shop” principle began to be applied in the management of migration processes from 1 July 2009 and the competences of a unified state authority on this principle were entrusted to the State Migration Service of the Republic of Azerbaijan.

The Unified Migration Information System (UMIS) was established in 2009 to keep records on foreigners and stateless persons residing, working and staying temporary in the Republic of Azerbaijan and to improve e-services provided in this sphere. UMIS enables to have full idea about dynamic of migration processes taking place in the country and creates good opportunity for providing necessary information to the relevant stakeholders. Nowadays whereabouts and activities of any foreigner and stateless persons after entering territory of the country is observed and kept under strict control through UMIS.

Last years a number of successful steps have been made to adjust the migration legislation in line with modern requirements. From this prospective adoption of the Migration Code of the Republic of Azerbaijan on July 2, 2013 taking into consideration international experience was the most important measure among other ones that have been undertaken so far. Other countries show very big interest to the Migration Code adopted in the country first time.
I. Travel Document Printing Steps

Traditionally, document printing has included several steps which need to be discussed separately and in detail. These steps include:

- **Prepress** - all the procedures and processes directed towards selection of materials and the design and adjustment of text and images which take place before the actual printing of the documents.
- **Press** - the actual production of the document.
- **After press** - actions directed towards finalising the printed document before it goes into use, such as perforation, lamination, laser engraving, etc.

1.1. Prepress

The first step in printing documents is called “prepress”. In prepress, the design is transformed into printable images and text and special security features are added. In a modern prepress you will find a lot of high-tech hardware and software specially designed for security printing. Images and text are mixed by means of advanced computer systems. Output and input are generated in very high resolution. Depending on the printing technique, prepress produces specific printing plates for printing the document.

For a secured document, usually, multiple printing techniques are used. Printing works engaged in security printing have at their disposal a range of mechanical means of protecting printed matter against fraud and counterfeiting. However, the security provided by printing technology does not suffice for producing this type of secured document. Clients require further protection for their documents and printers and therefore use security paper. Security features make it particularly difficult for counterfeiters and forgers to copy documents.

Substrates are categorised in prepress. This is because the printing process starts with a blank substrate. The substrate is the basic material of any secured document. There is a wide variety of secured papers available. There are two main substrates used in the production of security documents:

- paper
- plastic

The subchapters further describe each of the substrates in detail.
1.1.1. Paper

The oldest known archaeological fragments of the immediate precursor to modern paper, date to the 2nd century BCE in China. The pulp papermaking process is accredited to Cai Lun - a Han dynasty official. His knowledge and experience later spread from China through the Middle East, coming to Europe in the 13th century, where the first water-powered paper mills were built.

The papermaking process

- Early paper production methods:

  Handmade: 

  First paper production machine:

- Paper production - nowadays:

  Just as in its earlier incarnations, paper today is made from different raw materials, such as wood, wastepaper, textiles and rags, and cotton.
Wood is the most common source material for paper and is a main constituent of passport paper. The term “wood” is used in connection with approximately 25,000 different plants with lignified stems. Mostly coniferous woods are used for making paper. A mixture of hardwood and softwood fibres are used. The bark must first be stripped from the logs.

There are two further processes:

- **Mechanical processing**
  - the wood is split into fibres by grinding it with a fast-rotating stone under running water. The result is “ground wood pulp” (cellulose containing wood). The paper turns yellow over time and is not durable.

- **Chemical processing**
  - the woodchips are boiled in a chemical solution. In this process pure fibre is extracted, i.e. the lignin is eliminated, too. Lignin is the most important component of wood. It causes lignification of the plant cells; the result - cellulose. In this case the paper will not turn yellow and is durable.

As cellulose is either brown or brownish, it has to be bleached to obtain the whiteness needed for white paper. Bleaching agents such as chlorine or chlorine compounds, or ozone or oxygen compounds are used.

Chemical processing - the woodchips are boiled in a chemical solution. In this process pure fibre is extracted, i.e. the lignin is eliminated, too. Lignin is the most important component of wood. It causes lignification of the plant cells; the result - cellulose. In this case the paper will not turn yellow and is durable.

In addition to wood, **cotton** has a special role in document production. In the paper manufacturing process cotton may be used as feed stock for the cylinder machine. Such paper is used for various purposes or as special long-storage paper. During the manufacturing process it can be given mechanical security features. Cotton feedstock comes in two forms: bleached or unbleached.

Cotton is used mainly to make security paper, therefore, most passports and other travel documents will contain some cotton. Cotton consists almost completely of pure cellulose (approx. 95%). The cotton fibres are bleached and turned into fibre pulp. The paper does not turn yellow and is very durable.
The cotton fibre is processed into the right condition by cooking and treatment with chemicals and is then broken down into tiny fibres. A beater is used to process the fibre. The fibre can now be mixed with seizing agents and other additives at the input end of the paper machine. At this stage, it is already possible to incorporate some security features into the pulp, such as fibres that show up in different colours when exposed to ultraviolet (UV) light, iridescent planchettes.

Security paper used for printing secured documents is 99% optically dull. This characteristic is achieved by leaving out some compounds that whiten commercial paper. Security paper exposed to UV light should not reflect the UV light.

The fibres are mixed with various processed materials in the proportioning system. The resulting mash is called the “suspension”.

Various different types of fillers are used for various purposes, such as:
- making the paper more opaque
- sealing the surface
- making the paper softer and more pliable
- improving ageing stability, etc.

Fillers include Kaolin, Calcium carbonate (chalk), etc.

**Treatment of printing surface**

Depending on the customer’s requirements, the paper can be subjected to a special surface treatment. Starch is applied for surface bonding. A paper-coating layer of pigments, binding agents and auxiliary substances is applied onto the base paper. Glossiness, smoothness and optical features, such as whiteness and colouring, can then be improved.
**Security paper** does not contain optical brighteners and so remains relatively dull when exposed to ultraviolet light. This is commonly referred to as “low base fluorescence”.

The fluorescence of paper viewed under UV light:

<table>
<thead>
<tr>
<th>Commercial paper:</th>
<th>Recycled paper:</th>
<th>Secure paper:</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Blue Commercial" /></td>
<td><img src="image2" alt="Blue Recycled" /></td>
<td><img src="image3" alt="Purple Secure" /></td>
</tr>
</tbody>
</table>

For secure document production, synthetic paper (material produced from polymers) is also used. Synthetic paper is resistant to temperature flows, resistant to water and chemicals, and has optical and electrical insulation properties.

It is produced from polymers or by mixing polymers with natural fibres, usually by means of traditional paper production technology.

The whole document, or just some parts of it, can be made of synthetic paper. There are several types of synthetic paper used in document production. Some of the advantages of synthetic papers are that they are more durable, hardwearing and water-resistant.

**Teslin®** - a synthetic printing medium, made of glass dust mixed with polyethylene foam, of a specific microporous structure (65% air) that is strong and water-resistant.

Teslin® possesses the printing properties of special paper together with the properties of the polymer materials. Images printed on Teslin® are of high quality and are prominent. The porous structure of Teslin® ensures strong adherence to the surface of the laminate. The level of adherence is six times higher than that of other polymers or paper types. For example, the warranty period for cards made from Teslin® is ten years.

The synthetic paper **Neobond™** consists of cellulose, polyamide and polyester fibres, special bonding agents, and pigmentation on both sides. Neobond™ is a very strong material that is difficult to disjoint, and resistant to temperature flows (up to 100°C).
**Security features in paper**

The security features that can be incorporated into paper and synthetic paper are:

- watermarks
- security fibres
- planchettes
- security threads
- fluorescent hi-lites
- chemical reagents

**Watermarks** - an integral part of the paper, rather than being incorporated into the material at a later stage. They are formed in the paper fibre whilst it is being produced on the paper machine (incorporation takes place whilst the paper is in a wet state) and can only be produced by means of complicated preparation techniques involving expensive equipment and a high degree of skills on the part of the mesh-makers.

They are thin or thick areas of the paper consisting of an image and/or text created during the paper production process by varying the density of the paper. Because of the varying transparency, watermarks can easily be recognised by the public without any special equipment (as they are visible when held up to the light). A watermark should never react under UV light. Watermarks can be repeated or not repeated. They can also be intentionally positioned (always in the same place on each page) or placed at random:

Randomly positioned watermarks:
Types of watermarks:

- shadow (or multitonned)
- line
- electrotype

Applying a shadow watermark pattern to the mesh requires both technical and artistic skills. Making a stamping die from a design for a shadow watermark image involves highly specialised artistic techniques and several intermediate stages and engraving techniques. The die with the relief pattern is used to give the mesh cloth or gauze of the paper machine cylinder a relief impression where the localised or positioned shadow watermark will be placed in the paper web.

When the cylinder rotates through the pulp, taking with it cotton fibres, the recessed areas in the mesh (valleys) will contain more fibres, and the raised areas (hills) fewer fibres, than the surroundings areas. When held up to the light, the recessed areas (containing more fibres) will look darker as they will let through less light. The normal areas will have the same thickness as the paper as a whole and will appear to have a normal degree of transparency. There will be tonal variation compared to the dark shades.

The raised areas of a shadow watermark contain fewer fibres and will appear lighter when held up to the light. This is how we get light, dark and medium tones of paper thickness in the image, hence the name shadow watermark.

The line watermark is a traditional watermark - a picture, text or character design which is produced by pressure on the substrate during manufacture, leading to paper that varies in thickness. The cylinder (Dandy Roll) has raised areas soldered onto it that press the paper fibres to the side.
The **electrotype watermark** (mould-made watermark) is a modern design of a negative line watermark made using a cylinder mould machine. It is very light because it is very thin and very clear due to the sharp edges that can be created during the process. Electrotype watermarks are usually used to indicate the page number.

**Security fibres** - embedded in the paper at random and at varying depths, and are usually different on each page. Their colour makes the fibres stand out clearly against the paper substrate. Normally, these are mixed with the suspension and this is then fed into the paper machine. This causes the fibres and planchettes to be randomly distributed. They can easily be seen with the naked eye, but can be more clearly viewed by using a magnifying glass.

**Planchettes** - small coloured discs incorporated (scattered) into the paper substrate during manufacture. They are incorporated in a similar way to security fibres, into the paper pulp, and can be distributed within the paper at random.
Security fibres and planchettes can be:

- visibly coloured - produced from a variety of raw materials, they are available in visible colours. They merge into each other in all the colours of the rainbow or spectrum

- fluorescent - responsive to UV light, only show up under UV light

- visible and fluorescent coloured - are often made of plastic coloured using ordinary colours but with fluorescent pigment which causes them to show up in certain colours when exposed to UV light

- thermochromic planchettes - a special type of planchette that changes colour in a reversible way at different temperatures

- multi-coloured fibres - made from a few different colours
Security thread - a synthetic or metallic strip added to the paper during the production process. Looking at the page against the light, you will see it as a dark line. The thread forms a middle layer in the paper. Some security threads contain text while others fluoresce when exposed to UV light. The thread is actually integrated into the paper, and there are many ways to do this. Microprinting may also be incorporated, as an additional security feature. A broad range of different security threads exists, from polymer to metal-coated, coloured and microprinted laminate strips, to highly complex threads.

Fluorescent hi-lites - very small fluorescent particles in the substrate, mixed into the paper pulp during the substrate manufacturing process to serve as a security feature. They become visible under UV light.

Chemical reagents – substances that make treatment with erasing agents impossible. Security paper may contain dye particles that dissolve when they come into contact with solvents commonly used in falsification processes. Chemical erasures cause the particles to bleed and become visible to the naked eye under normal light conditions.
1.1.2. Plastic (Polymers)

**Synthetic polymeric materials**, also called “polymer” or “plastic”, are materials made in an artificial way, by the chemical reaction of components derived from crude oil. A chemical reaction is a clustering of atoms. The word “polymer” implies that they are constructed from pieces (monomers) that can be easily connected into long chains (polymer). They are also used in the production of some banknotes and other security documents. Polymers used for the production of secure documents should be thermoelastic.

**Types of polymers:**

**Polyvinylchloride (PVC)** is mostly used for domestic products such as pipes, tables and chairs. PVC is also used as insulation for electric wires in homes and cars. It is also widely used in the plastic card industry. It is quite safe until it burns, since the fumes emitted interact with water in the lungs or mouth. PVC is easy to process, cheap, resistant to wear, and its deformation temperature is about 65-70°C.

It comes in two basic forms: rigid and flexible. The rigid form is used in construction of pipes and in openings such as doors and windows. It is also used for cards (such as bank or membership cards). It can be made softer and more flexible by the addition of plasticisers. In this form, it is also used in plumbing, electrical cable insulation, imitation leather, signs, inflatable products, and many applications where it replaces rubber.

**Polypropylene (PP)** is a thermoplastic polymer used in a wide variety of applications including packaging and labelling, textiles (ropes, thermal underwear and carpets), stationery, plastic parts and reusable containers of various types, laboratory equipment, loudspeakers, automotive components, and polymer banknotes. An addition polymer made from monomer propylene, it is rugged and unusually resistant to many chemical solvents, bases and acids. Polypropylene has a relatively slippery “low-energy surface”, which means many common glues cannot be used with it (they will not be able to form adequate joints).
**Polyester (PET)** is the most common plastic in general use. Polyester is used to make holograms and laminate for documents. It is also used for bottles, buckets, jugs, containers, toys, even synthetic wood, and many other things. It is also used quite widely in the production of clothing. Depending on the chemical structure, polyester can be thermoplastic or thermoset.

**Acrylonitrile butadiene styrene (ABS)** - is a common thermoplastic polymer. It is amorphous, and therefore has no true melting point, and thermoresistant. ABS is also quite expensive, and its deformation temperature is about 85-90°C. Its most important mechanical properties are impact resistance and toughness. A variety of modifications can be made to improve impact resistance, toughness, and heat resistance. ABS can be prepared in different grades. Generally, it has useful characteristics within a temperature range of −20°C to +80°C.

**Polycarbonate (PC)** is an amorphous thermoplastic that was developed in 1957. It is characterised by excellent impact strength (excellent clarity, excellent toughness, good heat resistance, excellent electrical insulation properties), glasslike transparency, and high dimensional stability up to just below its deformation temperature of about 150°C. It is extremely strong - over 250 times stronger than glass and 30 times stronger than acrylic. Modifying PC overcomes some of its limitations, expanding its use significantly. Principal modifications include copolymerisation, variation of chain stoppers, branching, blending, and the use of performance additives and fillers.

Polycarbonate is mostly used for the production of secure documents.
Documents containing polymers always have several layers. The individual layers are placed over each other in register and according to the required construction, and are fabricated from different types of polymers. Each layer may contain several security features. Each of the sheets must be laid on top of each other in the same direction in order to minimise the shrinkage of materials during lamination. The layers also have to be placed exactly (in register) above each other, in order to prevent misalignment. The layers are then temporarily fixed together by heated spot stamping (welding) in order to ensure they do not move during the final lamination process. If several security features, such as security pattern printing, a Kinegram™, or a hologram are applied onto a card, several different layers have to be used.

Lamination is the bonding together of the layers using a combined process of pressure, heat and time:

- pressure increases surface contact and removes any air that has become trapped between the layers
- heat makes the layers soft, but not liquid, and causes them to fuse with each other
- time secures the fusion of the layers
1.2. Press

Basically, travel documents can be printed using four different printing techniques:

- letterpress
- offset lithography
- intaglio
- screen printing

Although there are more printing techniques, they can all be clustered into these four main methods. All of the techniques give the printer an opportunity to add specific security features, and special security inks are used in each, in order protect the document.

1.2.1. Theory of light and colour

Light is electromagnetic radiation within a certain portion of the electromagnetic spectrum. The word usually refers to visible light, that which is visible to the human eye and responsible for the sense of sight. Visible light is usually defined as light with wavelengths in the range of 400–700 nanometres (nm), between infrared (with longer wavelengths) and ultraviolet (with shorter wavelengths).

Above the range of visible light, ultraviolet light becomes invisible to humans, mostly because it is absorbed by the cornea below 360 nm and by the internal lens below 400 nm. Furthermore, the rods and cones located in the retina of the human eye cannot detect the very short (below 360 nm) ultraviolet wavelengths and indeed are damaged by ultraviolet light.
Examination of travel documents entails processes that involve light and the resulting perceptions of colour.

In documents, we see a lot of different colours.

For our purposes the term “colour” has two meanings:

- the (colour of the) ink used by the printer
- sensory perception (intangible)

To be able to see, our eyes first need to process light. Vision begins with light passing through the cornea, which does about three-quarters of the focusing, and then the lens adjusts the focus. Both combine to produce a clear image of the visual world on a sheet of photoreceptors called the retina, which is part of the central nervous system but located at the back of the eye.

The actual seeing process and the perception of colours does not only happen inside the eye, as the light stimuli received are sent to the brain by the optic nerve.

The human eye contains three types of cones (red, green and blue), each sensitive to a different range of colours. Because their sensitivities overlap, the cones work in combination to convey information about all visible colours. We can see thousands of colours using only three types of cones, but computer monitors use a similar process to generate a whole spectrum of colours.

Colour is the visual perceptual property corresponding in humans to the categories called “red”, “blue”, “yellow”, etc. Colour derives from the spectrum of light (distribution of light power versus wavelength) interacting in the eye with the spectral sensitivities of the light receptors. Colour categories and physical specifications of colour are also associated with objects or materials based on their physical properties, such as light absorption, reflection, and emission spectra. By defining a colour space, each colour can be identified numerically by its coordinates.
“White” light from the Sun or an artificial source is formed by a combination of all the colours of the spectrum, and these can be broken down into three “primary” colours - red, green, blue (RGB). Since these three colours when added together create white light, they are known as “additive” primaries (see image on the left below). We apply this principle in, for example, TV/PC screens, video technology or the scanning of colour pictures.

Where any two of these colours overlap you get secondary primaries, known as “subtractive” primaries. The combination of red and blue together produce magenta; red and green make yellow; and green and blue make cyan. The additive primaries (red, green, blue) can be used only with transmitted light (e.g. in a computer monitor). When printing, we start off with white paper and white light being bounced off it. What we need to do here to see the full spectrum of colours is to use ink colours that will subtract the light wavelengths and so show us colours. Cyan for instance is the red subtracting (absorbing) colour, magenta is the green subtracting colour and yellow is the blue subtracting colour. Where all three of the subtractive colours, C(yan), M(agenta), and Y(ellow), are added together, a dirty brown is produced. Because of the imperfection of the pigments it is necessary to add (blac)K in order to get a clean, solid black. Subtractive primaries do not produce as wide a range in the colour gamut as additive primaries, but do give an acceptable printed result, within the confines of the CMYK colour space.

The process colours used in four-colour printing are yellow, magenta, cyan and black. Each colour is printed as tiny dots and, because they are so small, the eye visually mixes the colours to reproduce all the colours of the original. In the images below you can see how the four process colours combine to give the full-colour effect.
Whatever printing technique is used, dots are employed to stimulate continuity. An illustration, printed on a substrate, consists of a mass of tiny dots. These dots sometimes cover a small part of the substrate, in which case we refer to “light tone reproductions”. We refer to “dark tint” when a large proportion of the substrate is covered by printing ink in the form of dots, or toner in the case of colour printers. The average illustration printed on a substrate covers, as an opaque layer, roughly 5% to 95% of the substrate.

All tint nuances are separated into dots ranging from light to dark. In the case of screens, we refer to screen lines, i.e. the number of lines per linear centimetre or inch. If there are 70 by 70 dots to a square centimetre, we will have 4,900 dots per square centimetre. The screening percentage depends on the lines to be distributed as an opaque layer, from 1% to 99%. All shade value tint nuances must match this volume. The various tones are produced by mixing the colours in various percentages in the form of dots (“screen dots”). The most important application of subtractive mixing is colour printing on paper.

Precisely because this mixing technique is used in commercial printed matter, the security printer tries to create their own pigments and uses these for their ink formulae. The compositions of the ink are never exactly from the spectrum accessible to normal colour filters. Designers of security printed matter try to choose colours for their inks from the colours of the spectrum that cannot be selected or split. Thus, it is very difficult for a forger to imitate these special inks in the process colours yellow, magenta and cyan.

**Screen angle**

The human eye is capable of distinguishing approximately 30 dots per linear centimetre. Beyond 30 dots, the eye perceives a shade of grey. An image simulated in this way appears to have a grey value. If we place the series of dots at an angle of say, 50, then our eye will no longer be capable of discerning each individual dot. A half-tone illustration or image is therefore formed from the dots in a certain line, subject to a certain screen angle and a certain dot shape. With the aid of laser control technology, electronic screening can print any shape of dot required. In the case of black and white illustrations, the dots cover a certain percentage of the substrate. In the case of subtractive colour synthesis using dots, we work with transparent inks or toners. One dot in one process ink and another in a different process ink are superposed onto a substrate (generally white paper). This enables the printing of any shade of colour.

Because of their susceptibility to being reproduced, security printers never use the process colours cyan, magenta or yellow. If you take a closer look at security printed documents, you will find in many cases pastel colours, or spot-colours. Another indicator is the presence of raster dots in rosette shapes. This indicates a conventional reproduction technique.
1.2.2. Introduction to printing techniques

Printing is the process of reproducing text and images using a master form or template.

All printing processes are concerned with two areas of the final output:
1. Image area (printing areas).
2. Non-image area (non-printing areas).

After the information has been prepared for production (the prepress step), each printing process has a definitive means of separating the image from the non-image areas.

As mentioned above, conventional printing has four types of processes:

1. **Planographics (lithography or offset printing)** - the printing and non-printing areas are on the same plane surface and the difference between them is maintained chemically or by physical properties; examples of this: offset lithography, collotype, and screenless printing.

![Planography (lithography)](image)

2. **Relief (or letterpress)** - the printing areas are on a plane surface and the non-printing areas are below the surface; examples: flexography and letterpress.

![Relief printing (letterpress)](image)
3 **Intaglio** - the non-printing areas are on a plane surface and the printing area are etched or engraved below the surface; examples: steel die engraving, gravure.

![Intaglio](image)

4 **Porous (or screen printing)** - the printing areas are on fine mesh screens through which ink can penetrate, and the non-printing areas are a stencil over the screen, to block the flow of ink in those areas; examples: screen printing, stencil duplicator.

![Porous (screen printing)](image)

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**Offset (Planography/Lithography)**

Offset printing is a widely used technique. It is an indirect printing process, i.e. the printing plate prints onto a printing surface indirectly via a cylinder.

In the offset printing process, the printing and non-printing areas of the plate are practically on the same level. The printing areas of the printing plate are oleophilic, ink-accepting and water-repellent, that is, hydrophobic. The non-printing areas of the printing plate are hydrophilic, and consequently oleophobic in behaviour. This effect is created by physical phenomena on the contact surfaces. The dampening system covers the non-printing areas of the printing plate with a thin film of dampening solution. This solution (water plus additives) spreads over the non-printing areas. To achieve good wetting, surface tension has to be reduced by means of dampening solution additives. In extreme cases, reducing the surface tension of the dampening solution too much can result in too great an emulsification of printing ink and dampening solution.

One of the most important functions in the printing process is prepress production. This stage makes sure that all files are correctly processed in preparation for printing. This includes conversion to the proper CMYK colour model, finalising the files, and creating plates for each colour of the job to be run on the press.
Offset lithography is one of the most common ways of creating printed materials. A few of its common applications include newspapers, magazines, books, documents, banknotes, etc.

The **advantages of offset printing** compared to other printing methods include:

- **consistent high image quality.** Offset printing produces sharp and clean images, this is because the rubber blanket conforms to the texture of the printing surface.

- **quick and easy production of printing plates**

- **longer printing plate life than with direct litho presses, because there is no direct contact between the plate and the printing surface.** Properly developed plates used with optimised inks and fountain solution may achieve run lengths of more than a million impressions

- **cheapest method for producing high-quality prints in commercial printing quantities**

- **ability to adjust the amount of ink on the fountain roller with screw keys.** Most commonly, a metal blade controls the amount of ink transferred from the ink trough to the fountain roller. By adjusting the screws, the operator alters the gap between the blade and the fountain roller, increasing or decreasing the amount of ink applied to the roller in certain areas. This consequently modifies the density of the colour in the respective area of the image. On older machines one adjusts the screws manually, but on modern machines the screw keys are operated electronically by the printer controlling the machine, enabling a much more precise result.
The disadvantages of offset printing compared to other printing methods include:

- Slightly inferior image quality compared to rotogravure or photogravure printing
- Propensity for anodised aluminium printing plates to become sensitive (due to chemical oxidation) and print in non-image background areas when developed plates are not cared for properly
- The time and cost associated with producing plates and the printing press setup. As a result, very small quantity printing jobs may now use digital offset machines

Every printing technology has its own identifying marks, as does offset printing. In text reproduction, the type edges are sharp and have clear outlines. The paper surrounding the ink dots is usually not printed upon. The halftone dots are always hexagonal, though there are different screening methods.

In many documents, security patterns are printed using offset lithography.

So-called “Orlov printing” (stereotype) is a special method of printing where the multi-coloured print of the image on paper is made through a printing cycle, and all the colours are placed on a typographic plate. The specifics of this type of printing reside in the fact that during the sudden change of colour the lines of the multi-coloured elements maintain perfect coincidence, and are not sharp when switching from one ink to another.
Letterpress, also called “relief printing”, or “typographic”, is the oldest form of printing. In this method, a surface with raised letters is inked and pressed to the surface of the printing substrate to reproduce an image in reverse (direct letterpress printing). When printing, the ink is pressed outward. This gives rise to “ink squash” which creates the halo effect which can be seen under magnification.

In indirect letterpress printing, also known as “letterset” or “dry offset”, the printing ink is first transferred from the printing plate to a printing blanket and then to the substrate. The indirect application of a rubber blanket cylinder gives rise to “crimped edges”, but not to an embossed effect.
**Blind embossing** is where by using a relief form and applying pressure (or a small, specially designed embossed stamping machine for specific application), a deep "dent" (impression) can be produced in a surface such as paper without any transfer of ink. The embossed stamping process can be used as an extra security feature in documents. An embossed stamp may contain the coat of arms of a country or city, or a text set in a circle. Such an effect can be swiftly detected using oblique light. Where a photograph and base are marked with a deep "dent" they can constitute a secure part of the document.

**Foil printing** was originally where foil was printed using a special hot foil press. Every sheet was printed manually and foil of real gold and silver was used. Because of the high costs and the time-consuming nature of the procedure, new techniques developed to speed up the process. Gold and silver were replaced by dyed metallic foil. The principle, however, is still based on letterpress. Modern foil printing has a wide range of applications in the field of security printing. Depending on the product, foil is either hot or cold stamped. Foil can be used also by means of self-adhesive stickers.
Intaglio

Intaglio printing, also called “gravure printing” or “steel engraving”, is a direct printing method. The printing is done directly from the printing form onto the printing surface. It is a technique in which the image is incised into a surface and the incised line or sunken area holds the ink. It is the direct opposite of relief printing. Unlike surface printing, intaglio printing - actually a process of embossing the paper into the incised lines - requires considerable pressure.

![Intaglio Diagram](image)

Intaglio may be recognised by the perceptible relief of the image, and the feathering of the ink. The thickness of the ink layer can be seen by using oblique light.

![Intaglio Images](image)

Usually this security printing method is found in banknotes, passports (cover, inside page), identity document (ID) cards, visas and other official documents.

Intaglio printing can be used to create latent images by laying down the ink at different angles. Oblique light will reveal the pattern through the effect of light and shadow.
Screen printing

As the name implies, the printing ink is pressed onto the substrate through a screen or stencil. For this, a squeegee is drawn across the printing form, which forces the ink through the screen’s open mesh. The printing form is a screen through which the printing parts allow ink to permeate.

The screen is a mesh of plastic or metal. Light exposure produces the areas permeable for ink.

A forgotten area of screen printing is the production of print plates, used in electronic equipment. Because of the improved resolution, screen printing can be used to print conductive electronic compounds. Metallic alloys are added to the printing ink to generate conductivity. In the latest generation E-documents, screen printing can be used to print the integrated antenna.
Special security features like optically variable ink (OVI), iridescent ink and diffuse printing are usually printed by means of screen printing.

A major advantage of screen printing is that there is little pressure involved in transferring the image to the substrate, and it is therefore suitable for delicate or breakable substrates. Because of the flexibility of the mesh, it is also possible to transfer the image onto rough or irregular substrates. It appears that screen printing is being increasingly used as a serious printing technique in the realm of secured printed documents.
1.2.3. Printing technologies without a printing plate

These are printing technologies that do not require a solid printing plate (master) with a fixed image and can basically produce successive pages with different printed images. These processes are referred to as non-impact printing technologies, a designation that is based on the early digitally and electronically controlled printing systems for outputting data by means of a matrix printer in a computer. In such matrix printers, the type is controlled electronically.

**Inkjet**

The inkjet process is a computer to print technology in which ink is sprayed from nozzles, which means that no image carrier is needed. Imaging is done directly onto the substrate. The data of the digital print job is transferred directly to control the imaging unit. In this case, the imaging unit is the inkjet system itself, which transfers the ink onto the paper via nozzles, mostly directly, or in some applications, indirectly, depending on the technology being used.

The basic variants of the process are continuous inkjet and drop on demand inkjet.

**Continuous inkjet**

In this process, only part of the continuously generated flow of small ink drops is directed onto the paper during printing, in accordance with the image. Ink flows continuously through the print head, no matter whether this ink is used for actual printing or not. If no dot is to be printed, the ink jet is diverted by means of an electrically controlled plate, so that the ink cannot reach the substrate. The ink is then collected in an ink storage reservoir.

Example in the German passport:
Drop on demand (thermal) inkjet

In the thermal inkjet process, the drop is generated by heating the liquid ink until it vaporises, whereupon a certain quantity of ink is ejected from the nozzle as a result of the pressure exerted by the vapour bubble, hence the name “bubble jet”.

Colour printers used in desktop publishing or in an office environment mostly use thermal inkjet systems. In a typical application a separate inkjet head is not used for each colour, although a separate head is often used for the most commonly printed colour, black, and a second head for the chromatic colours, cyan, magenta, and yellow.

Drop on demand (piezo) inkjet

In piezo inkjet systems, the drop is generated as a result of a change of volume within the ink chamber due to piezoelectric effects, which leads to the drop of ink being ejected from the nozzle system.

Special piezo crystals expand under electric current, causing pressure on the ink duct so that the ink is ejected through the nozzle.

Drop on demand (electrostatic) inkjet

Electrostatic inkjet is the third variant of the drop on demand inkjet process. There are different process variants, but common to all of them is the fact that an electrical field exists between the inkjet system and the surface to be printed.

The basic principle of electrostatic inkjet systems is to generate an electrical field between the inkjet writing system and the substrate. Ink drops are generated by sending image-dependent control impulses to the nozzles. These impulses cause a drop to be released and routed through the electrical field onto the substrate.

An inkjet printer uses yellow, magenta, cyan and black ink, though some manufacturers use additional inks in order to improve the print quality. Inks can also be made in specific colours and contain specific properties such as UV-reactive ink.
New technologies have increased inkjet printing quality dramatically, so much so that it has become hard to distinguish it from offset (e.g. memjet technology).

**Memjet technology**

The main specifics of inkjet printing are:

- image created by separate, randomly positioned dots of ink
- final colour composed of four (CMYK) basic colours
- opaque ink
- ink absorbed by the external layer of the paper
- ink stains may be created on margins

**Laser printing**

Laser printing (also known as xerography or electrophotography) works by using the physics of electrostatics. Negatively and positively charged particles of matter attracted to their opposites are used; a surface of the drum or belt is given a positive charge of static electricity.

The image to be printed is projected onto the drum by a lens and is then printed onto the surface. The dot matrix is transferred onto a drum with an electrostatic charge by means of a laser beam. A laser printer functions like a matrix printer, i.e. the characters are composed of individual dots.

**There are a few commonly used types of laser printers:**

- mono (black) laser printer (toner);
- multi-colour laser printer (toner);
- indigo (digital offset); uses the same technique as the other types of laser printer, but with liquid ink instead of toner.
The main specifics of laser printing are:

- ink is on the surface of the paper
- ink has a metallic gloss
- some dots may be observed on the background
- toner is acetone-dissolvable
- grid pattern with dots at a fixed distance from each other

Thermography

Thermography can be divided into direct thermography and transfer thermography. Transfer thermography can be subdivided into thermal transfer and thermal sublimation.

Direct thermography is a process where the substrate is treated with a special coating, which changes colour when heated (e.g. fax machines, label printers, receipt printers, etc.).
Transfer thermography is different from direct thermography in that ink for printing is stored on a donor and transferred to the substrate by heating.

In thermal transfer (also called thermal mass transfer), a heat-sensitive ribbon containing wax or resin-based ink is heated over an area and the melted ink is transferred from the ribbon onto the printing surface.

During the thermal sublimation, the ink is transferred from the donor to the substrate by diffusion. The heat melts the ink and initiates a diffusion process onto the paper.

The main features of transfer thermography are:

- colour foil containing the basic (secondary) colours, cyan, magenta, yellow, and in some printers, black
- margins of the heating element may be visible (thermal transfer)
- images are converged (thermal sublimation)
1.2.4. Graphical security features

Guilloches

Guilloches are complex geometrical, interwoven, fine, continuous line patterns in security paper and documents that make them more difficult to counterfeit. Due to the finesse of the lines, they cannot be correctly reproduced with copying devices. They are usually used for the background of the document and printed using offset or intaglio.
Rainbow printing

Rainbow printing is another method of security printing. The subtle shift in colour produces a rainbow-like effect.

Below is shown a special ink fountain. Dividers separate the ink fountain into several segments, crosswise to the direction of printing. Each segment of the fountain can be filled with a different colour, meaning that several inks can be printed on the same sheet (side by side) in one printing unit. The ink fountain variant is used for special applications such as rainbow printing (printing of securities). Deliberate use of lateral distribution allows the inks to run into each other in the intended areas to produce special colour effects during printing. The printing plate is inked in different colours through ink fountains arranged next to each other.
**Microprinting**

Microprinting is the production of recognisable patterns or characters in a printed medium on a scale that requires magnification to be seen with the naked eye (height 0.2-0.3 mm). Usually microprinting is used as a text line that is repeated every other row. It can be integrated into the substructure (background) printing, security threads, etc. It is used for filling in the fields, the specific areas of the image.

Attempts to reproduce such materials by methods of photocopying, image scanning, or pantographing typically produce a dotted or solid line. The graphical structuring of the background nets (image of symbols, characters, digits, coat of arms or forming a complex image) may be different.

Microtext can be positive and negative and usually is printed using the intaglio or offset printing techniques.
See-through register

Parts of a character or symbol are printed on both sides of the document or on an inner page and only appear as a complete character when held up to the light.

The offset printing technique is usually used to print this security feature.
Latent images

Intaglio printing can be used to create latent images by laying down the ink at different angles. Oblique light will reveal the pattern through the effect of light and shadow. Depending on the angle of the oblique light, the image becomes lighter on a darker background or vice-versa. Due to the contrast, some images, figures or characters become visible.

When copying, latent images are not visible at all, or the opposite becomes clearly visible, disregarding the angle of the oblique light under which it is being viewed by the observer.

**PEAK®** - Printed and Embossed Anti-Copy Key. This is an advanced version of the latent image. An image is formed by lines of blind embossing in the foreground and parallel straight strokes in the background. The image is almost invisible in incident white light. When sliding light is perpendicular to relief lines, a shadow is formed and the latent image becomes visible on the ridges of these lines. When rotating a document around vertical and horizontal axes, its different areas become lighter or darker relative to the background. PEAK® combines offset printing with intaglio embossing technology.
Other printed security features

There are a number of security printing measures which function as anti-copy features or hide (encode) images. Scrambled indicia - is a protection element, fabricated by means of special software, where the image or text are scrambled in the background of another image.

Some security documents are printed with a carefully adjusted “copy evident” background pattern that looks uniform to the unaided eye but shows a clearly visible large-letter warning, like “COPY”, when photocopied. Screen trap and scan trap printing techniques use periodic screens of arbitrarily shaped image elements (such as dots and lines) as a carrier, into which an invisible message is modulated.

**SAM** - Screen Angle Modulation. The screen elements for this technique are very fine lines, whose orientation is locally modulated with a covert image. The chosen image becomes visible after copying.

**IPI** - Invisible Personal Information. This technology allows personal data to be embedded within a photograph printed in a document such as a passport or ID card.
1.2.5. Inks

For different printing techniques, different printing ink components compositions are used in order to meet the particular requirements. Printing inks components can be various colourants (pigments), varnish, waxes and other auxiliary additives. These additives give special security features to the inks commonly used in security printing.

There are numerous types of inks that can be used in travel documents, including:

**UV and fluorescent inks**

UV and fluorescent inks, which are visible when placed under a UV light source. This kind of protection implies the insertion of phosphors into the materials of the documents, thus causing luminescence of the image fragments and document elements under UV light. This ink is used for printing texts, images, secondary loader images or for dyeing security fibres, security threads, stitching threads, etc. The inks can be visible or invisible (uncoloured) under normal light. When checking the UV protection, a light source with a ray length of 365 nm is usually used, but there are also security inks that react differently under ray lengths of 313 nm and 254 nm.

**Solvent-sensitive (reactive) ink**

As the name implies, this kind of ink presents a visible indicator when it has been attacked by a solvent. You will mainly find it used in printed watermarks or fine guilloche artwork designs. Once a solvent has been applied, the ink will change colour to show that alteration has been attempted.
**Thermochromic inks**

Thermochromic inks are sensitive to temperature changes and will appear or disappear at different temperature ranges. If you apply a finger and thumb to a printed thermo spot on the document, the ink will disappear to nothing and as soon as you remove the heat source the ink will reappear. Inks come in various temperature sensitivities and the common temperatures available are 15°C, 31°C, and 45°C. The thermochromic effect is caused by changes in the chemical composition or physical properties of the thermo-sensitive pigments. It may have more than two colour transitions depending on the particular transition temperature. This ink is usually applied by the offset, letterpress or gravure printing techniques, on a paper or polymer substrate.

**Photochromic inks**

Photochromic inks contain photochromic pigments that change colour and are activated, depending on their composition, by sunlight, strong artificial light or UV light. When the light source is removed the image reverts to its original state. This process can be repeated an endless number of times.
Optically Variable Ink (OVI)

OVI ink changes colour unevenly due to the angle of view and illumination. The colour-changing effect is determined by a thin film interference of pigments placed in a transparent bounding ink medium. Selective absorption of white light beams occurs as a result of interference and multiple reflection of beams by two reflective surfaces. Those waves which have not been absorbed determine the ink colour that may be observed.

These inks are very expensive and are usually printed in small areas. The most common colour changes are brown to green (and vice-versa) and red to purple. These inks are applied by either deep or screen printing.

Optically variable ink with embossing is a complex, optically variable security element. It contains an image printed by an OVI that plays a role in the background of the second image applied by blind embossing. A dual optical effect appears when viewed at different angles of observation and illumination. A colour change in the background image and visibility of the second image occur due to treatment of light and shade.
Optically Variable Magnetic Ink (OVMI, Spark®)

These ink pigments are oriented with the help of a magnetic field. Images change colour upon changing the angle of illumination and observation. The effect of a bright light stripe movement occurs. This type of ink is usually applied by the screen printing method and contains ferromagnetic pigments.

Metameric inks

Metameric inks are special security inks (usually a pair of inks) that are chemically different but look similar when seen under some type of illumination. Noticeable differences appear when viewed under another type of light source or through a filter (usually a red filter). They are used for printing different segments of the same image.
**IR-metameric inks**

IR-metameric inks are inks that have similar features in visible light but appear differently under infrared (IR) illumination (some inks absorb IR light, others reflect). As a result, when examining an image with IR-metameric inks only IR visible parts of the image can be seen on the monitor.

Infrared security features are based on the property of a document’s material (usually dyes) to absorb or reflect IR light in different ways.

**Iridescent ink**

Iridescent ink is a semi-transparent ink with a mother-of-pearl lustre determined by an interference structure of thin film. When falling on the pigment scale, part of the light is reflected and another part is transmitted onto multilayer scales. As a result, multiple reflection and transmission of light by different layers occurs and one may observe interference. The colour depends on the thickness of the oxide layer.

The brightness and blinking effect are determined by the size of the pigments. If the background colour is dark and rich, it also affects the ink tone. The colour will also depend on the angle of view or illumination.
Anti-Stokes ink

This is a type of ink that contains crystals of rare-earth metals (e.g., ytterbium, thulium, etc.) and glows when exposed to IR light of high intensity. Luminophores, which glow green, are the most commonly used chemical compound.

Bleeding ink

This is security ink containing components which penetrate the printing substrate - pores. It colours the paper red or blue in the form of a colourful halo from both the front and reverse sides and any attempt at mechanical erasure will cause visible damage to the document. A bleeding ink is used for applying numbers to passports and other travel documents, usually using the letterpress technique.
**Magnetic ink**

Magnetic ink is an ink containing ferromagnetic components, which have a specific reaction to the external magnetic field. Texts or symbols applied using this ink can be identified by special magnetic sensors or seen by employing magneto-optic converters. The ink can be applied on security threads and fibres, and used for printing images, serial numbers, barcodes, etc.

**Metallic ink**

This is an ink containing a fine dispersed powder of bronze and aluminium. It has a specific metallic gloss. Only the gloss intensity and the illumination of the image applied by the metallic ink change when the viewing angle is changed. No significant changes in colour can be observed. It is used as an anti-copy ink.
1.3. After Press

During the after press process, the documents are prepared for distribution. In many cases, printed sheets need to be cut, folded, perforated, embossed or glued, etc. Documents containing several pages, such as passports, are stitched together during the after press. When a booklet is stitched, several security features are available to secure the binding. All these techniques can be found in the after press.

1.3.1. Passport components

Passports usually consist of the following parts: the cover, the data page, the endpaper, the book block, and the binding.

Cover - the outer document coating, a decorative element in the form of a sheet of heavy paper or a board covered with synthetic material. The document cover usually consists of: the cover material, cardboard, and the endpaper. It can be made from various materials, such as linen, leather, or plastic. A gold or silver blocking design is usually applied to the cover by foil stamping, blind embossing or another printing technique. The elements on a travel document’s cover are usually aligned vertically and horizontally.

Other security features can be incorporated into the cover such as embossing or UV printing.
Data page - the page of a passport or travel document on which the issuing state applies the holder’s personal data and the issue and expiry dates. The main holder’s picture is located on this page. The data page of a machine-readable document (as described in International Civil Aviation Organization (ICAO) Document 9303) contains a visual inspection zone and a machine-readable zone. The data page is filled according to certain standards to make the reading process in different countries easier.

The data page may be located on:

- the insert page
- the end page
- an inner page

Endpapers - the sheets which are glued to the inside of the covers. Endpapers are usually made of special security paper which differs from the inner paper sheets in order to prevent partial document forgery. Motifs printed by intaglio or offset are usually found on the endpapers. The holder’s data may also be found on the back endpaper.
**Book block** - a type of document construction in the form of a folded set of sheets or sections which are formed as a single or multiple booklet. In a single booklet, folded sheets are gathered together one inside the other (sheet inside sheet) starting from the inside one. In a second method, successively folded sheets are placed one upon the other (sheet on top of sheet).

The book block consists of the individual passport pages. These are printed on a full-size sheet. Eight passport pages are printed onto the front and back of each full-size sheet.

**Binding** - stitching thread is the most widely used type of binding for travel documents. In old or other simple documents, one can find bindles used as the binding technique. Stitching thread is a material that is used to hold together the pages of a book block.

A stitching thread consists of a single thread, twisted or stuck together. Stitching threads may vary in the number of threads, colour, formation method and material used. Synthetic threads with additional security features such as reaction to UV or IR light sources are usually used for stitching travel documents.
Nowadays, in many documents the biodata page consists of a plastic card. Plastic cards are integrated into the book block by different methods:

- mesh hinge
- plastic hinge
- additional material (e.g. Teslin®)
1.3.2. Perforation

This is a process of polygraphic finishing that punches texts or images in the paper or polymer layer. The punching is composed of microscopic holes. Perforation may fit well the design and holes in the substrate, which when located in a certain order can form a pattern (a holder’s portrait, a document number, etc.). Both laser and mechanical perforation are used in document production.

**Mechanical perforation** is made with a special roll needle. Holes are made using the pressure of tubular metal needles. The edges of the holes have ridges which are tactile from the back of the substrate.

Mechanical perforation is usually used to make the serial numbers of documents. They can be numerical or letter-numerical. The linear horizontal and vertical placement of the dots should be aligned.
**Laser perforation** - holes created by a laser beam. They have a regular form, smooth edges and no raised edges on the reverse side. With this technology different images and symbols can be perforated. If several sheets are perforated simultaneously, a conical decrease in size of the perforated holes is observed when viewed from the back. The edges of each hole are slightly burned due to exposure to the laser beam.

Holes can vary in size and shape. The density of perforated holes may also vary. This technology can be used to perforate a document’s serial numbers, fine lines and images, the holder’s secondary picture, etc.

Because the laser burns through the paper, scorch marks are left around the holes, which can react under UV light.

Laser perforation used to create the holder’s secondary picture. This can be clearly seen under penetrating rays.
1.3.3. Laminate

Laminate is a transparent polymer film applied onto the substrate over the whole data page, or only over part of it, in order to protect the document against damage or forgery. Laminates can be classified into cold-applied laminates and heat-applied laminates.

A cold-applied laminate is like a sticker, which is glued onto the personal data page. It could also be a separate laminate stitched into the passport booklet laminate.

Heat-applied laminates are coated with a layer of glue on the underside which when heated adheres to the stock. It could also be a separate laminate stitched into the passport booklet laminate.

The biodata page is a separate sheet sealed between the two laminates; a “pocket laminate”.

A laminate can cover a page from either one or both sides, and may have sharp or rounded edges. It can also incorporate additional security features such as optically variable devices, embossing, UV safeguards, etc.
UV safeguards on laminate

This is where various fluorescent elements are used for the protection of the laminate. Various colours and information, including personal information (secondary image, blank number, etc.), can be applied onto the laminate and become visible when held under a UV light source. Fluorescent overprint is usually invisible under normal light and tends to be placed on the reverse (inner) side of the laminate, or between the layer of adhesive and the laminate, to protect against wear and tampering.
**Embossing in laminate**

This is tactile embossing in the laminate which becomes visible under oblique light. Usually, hot stamping is used.

**Hot stamping** - producing a cliché-made image under high temperature and pressure. Due to the stamping, the material melts, creating the needed relief.

**Laminate overprinting**

This is an image which is applied onto the laminate coating to protect against forgery. The overprint on the laminate may be text, decoration, or coloured lines printed on the interior of the laminate or between the adhesive layer and the laminate itself.

Screen printing and gravure printing are the printing methods most frequently used for the laminate overprinting but it can also be done through indirect letter-press, as in the example above.
This is a diffractive optically variable device known as a **hologram**, which contains an image applied by the holographic method. A holographic image changes depending on the angles of observation and illumination. Depending on the angle of incidence, light will reveal various texts or designs in different colours.

Depending on the visual elements of the design, holograms can be classified into three-dimensional (3D) holograms (the plane image lies at a different visual depth), multi-channel holograms (hologram images with a switch effect, completely different scenes can be observed on the same hologram after changing the angle of observation), Kinegram® (a motion effect of contour images).

Travel documents usually contain holograms with special security features such as a microprinting (nanoprinting), laser demetalisation and numbering, latent scrambled images, etc.
Laminate with rated breaking points

This is laminate that contains weak points that are intentionally designed to tear or break if tampered with.

Floating image

This is an optically variable element visually perceived as an image hovering or floating in space above or below the document surface. The effect of floating in space appears when the image is viewed at a right angle and disappears when viewed at an acute angle. The kinetic effect is perceived as a slight movement of the image towards the observer when the viewpoint is changed. The floating image effect is achieved through multilayer cell-structured laminate that consists of an array of spherical, diverging and converging micro lenses. According to the laws of geometrical optics, micro lenses produce false images that are perceived by the human eye as floating above or below the surface.

A retroreflective effect characterised by bright luminescence and colour changing is observed when colour images are viewed in coaxial light.
The data page of the German EU passport is protected against copying by Identigram®, a complex, full-surface feature consisting of the following elements: kinematic structures, the passport holder’s image in holographic form, a three-dimensional image of the federal eagle and a bicoloured holographic repetition of the machine-readable zone. The holographic secondary image is visible in green, to the right of the full-colour portrait.

**Retroreflective foil**

An optical device with the retroreflective effect (known as 3M™ laminate) consists of several layers: the retroreflective layer with micro lenses (microspheres), the graphic image layer, and the reflective layer.

When the surface is illuminated by parallel, direct (coaxial) light beams, light, semi-transparent images which contrast with the background are visible. Microspheres focus light beams on the surface of the reflecting layer the way that reflected light bounces back towards the light source, providing a clear visual perception of the image. The hidden image can be detected by using special devices with directed rays.
**Iridescent laminate**

An iridescent laminate is a thin-film coating in the form of a stripe, text or image with a colour changing effect. The effect appears when the angle of observation or illumination changes. Iridescent laminate does not contain ink pigments and is transparent when viewed at a right angle in diffuse white light. The coating is red when seen under direct incident light at a right angle, and becomes green when viewed under oblique light at an acute angle. An even change in the angle of illumination and observation leads to a colour change into medium compound spectral tones. The colour changing effect is determined by thin-film interference. The iridescent laminate is applied to the inner surface of the laminate on the data page.

**1.3.4. Blind embossing**

This is where a colourless relief image is applied to the substrate by deforming the material under pressure and heat. The image is palpable and used both for paper and polymer materials (embossing). It is visible under oblique light. A colourful image gradually transformed into blind embossing is a more complex security feature. Blind embossing is used on images, texts and microprinting.
1.3.5. Barcodes

These are graphic information in the form of sequences of figures, lines of different thickness and white stripes or just lines and other geometric figures. This information is readable by special devices.

A barcode can be printed using different printing techniques (letterpress, etc.) and with inks containing special security features (UV luminescence, ferromagnetic components, etc.).

Types of barcodes:

- linear barcode, one-dimensional (1D), encoded and read in one direction
- two-dimensional (2D) barcode encoded and read not only horizontally but vertically as well

1.3.6. Photograph integration and protection

Nowadays, the pictures in most travel documents are digitally printed or laser engraved. But we cannot forget about old-style picture protection methods used in documents, because in some cases they are still being used; mostly in temporary or short-term documents.

Photograph protection methods:

- wet ink stamp (wet stamp). Due to the thickness of the photograph, there is a break where the impression extends from the photograph onto the page. This depends on the thickness of the photograph, the pressure applied when stamping and the nature of the stamp plate
embossing stamp (dry stamp). Embossing is an impression in relief made by means of a seal or stamp, e.g. to authenticate a document, or a conventionally fixed (e.g. glued) image of the holder in the document. An embossing machine typically consists of a press and two dies (patrix and matrix). Through the different depths of the matrix (engraved) and the raised patrix (the matrix’s exactly matching counterpart in relief), the embossed material is deformed so that the impression appears with a partly raised/lowered surface both on the front and reverse sides. Tweezers are used to examine a dry stamp.
1.3.7. Laser engraving

This is a technology that burns data into an ID card or the data page of a passport. It enables standard text and images to be added as well as special security features such as microtext, tactile data, perforated images, and variable images that change with different viewing angles. Laser engraving of information is possible only on the document layer containing particles of black carbon. As a result of the carbonisation of these particles, black and white images are produced.

Laser engraving can be conducted on various materials, but it works best with documents made of polycarbonate. When a laser beam is applied to the polycarbonate substrate, the heat causes a chemical reaction that essentially burns, or carbonises, a minute area, changing it from white to black. Repeated and controlled application of the laser beam creates the text and images within the card.

When a laser beam is applied to a specially designed polycarbonate card, it penetrates the transparent outer layer and reacts with a carbon-enriched layer. This reaction creates a dark-coloured material that moves through the card to the surface. Both the front and back of the card can be separately engraved.
Depending on which layer is carbon enriched, the different laser methods deployed, and their varying parameters, such as speed, strength of beam and the width of focus, laser engraving with different features can be obtained:

- laser engraving on one layer of the document

- laser engraving with tactile effect:
  - tactile laser marking
  - recessed laser engraving
1.3.8. Variable laser images

This is where two different images are engraved at different angles through an array of cylindrical lenses embossed into the surface of the polymer material. The image that can be seen changes depending on the angle of observation. Variable laser images are used as security elements on documents made of polymer materials and are executed at the time of personalisation.

Depending on the type of matrix - the direction of the relief lines, there are a few types of variable laser images:

- **CLI®** - changeable laser image (vertically directed matrix)

- **MLI®** - multiple laser image (horizontally directed matrix)
II. Travel Documents

This part of the textbook provides a short overview of the main types of travel documents, which will prepare the reader for the document examination part that follows it.

A travel document is an identity document issued by a government or international treaty organisation to facilitate the movement of individuals across international boundaries. The most common travel document is a passport, which is a small book with a hard or soft cover. It contains person-identifying information, security features, the holder’s personal data, information about the issuing country and the issuing authority, and blank pages for visas and other entries.

Each country usually issues several types of passports: a national passport, a diplomatic passport, a service passport, an official passport, etc.

There exist the following types of passports, according to way of personalisation and data processing:

- passport without a machine-readable zone or electronic medium
- passport with a machine-readable zone containing machine-readable data. This data consists of a combination of figures and letters which according to international machine-readable travel document standards must include the main data of the document.
- passport with an electronic medium (biometric passport), containing a microchip. The secured graphic and text data of the document holder is stored on the chip. A special microchip logo appears on the cover of a biometric passport.
An identity document or identity card is a document that may be used to prove a person's identity. Identity cards are generally issued as a means of identification within a country, but in some cases they may also be used as a travel document. A card is a type of a document construction in the form of a standard right-angled sheet. According to the International Organization for Standardization (ISO) standard 7810 there are four acceptable card sizes:

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
<th>The main use</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID-1</td>
<td>85.60 mm x 53.98 mm</td>
<td>ID-cards, driver licences, bank cards</td>
</tr>
<tr>
<td>ID-2</td>
<td>105 mm x 74 mm</td>
<td>ID-cards, driver licences, vehicle documents, visas</td>
</tr>
<tr>
<td>ID-3</td>
<td>125 mm x 88 mm</td>
<td>Passports (plastic inserts and visas)</td>
</tr>
<tr>
<td>ID-000</td>
<td>25 mm x 15 mm</td>
<td>SIM cards, may be a part of a ID-1 card</td>
</tr>
</tbody>
</table>

The thickness of all cards is about 0.76 mm. A card can be made of either a laminated homogeneous or multilayer composite material (polycarbonate, PVC) with or without inserts.

There exist the following types of cards, according to the technology used:

- cards without any digital data
- cards with a barcode
- cards with a magnetic stripe
- chip cards
- combined magnetic chip cards
2.1. Machine-Readable Document (MRD)

Due to increased air passenger traffic, the 7th ICAO Special Assembly for simplification of control formalities in 1968 examined proposals on implementation of a machine-readable passport that could ultimately have replaced traditional passports and, at that time, aimed at the acceleration of the verifications made to travel documents. During the years, various different proposals have been examined in order to reach a standard that would not involve additional production costs, and at the same time speed up document examination, enhance security, and ensure precise and flexible data examination, by using automated reading.

The ICAO’s competences and responsibility in the elaboration of machine-readable passports was examined by the European Council in 1980 and 1983, keeping in mind that these passports were also to be used by travellers with other transportation means. The Council adopted a resolution calling on the Member States to start the issuance of machine-readable passports on 1 January 1985. The resolution also prescribed that the information on the passport holder should match the requirements of ICAO Document 9303.

Parameters of machine-readable documents

The size of machine-readable documents is prescribed by ISO standard 7810. The nominal size is based on the size of ID-3 cards and the dimensions are as follows:

- Composition of machine-readable passport (MRP)

The data page in the passport is made of the visual verification zone and the machine-readable zone (MRZ).
### Visual Inspection Zone (VIZ):

<table>
<thead>
<tr>
<th>Element No.</th>
<th>Data Element</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Issuing state or organisation (full title)</td>
<td>State or organisation responsible for issuing the MRP. This should be printed, the type font being selected at the discretion of the issuing state or organisation.</td>
</tr>
<tr>
<td>2</td>
<td>Document</td>
<td>The word for “passport” in the language of the issuing state or organisation, plus either “PASSPORT” (English), “PASSEPORT” (French) or “PASAPORTE” (Spanish) if the language of the issuing state or organisation is not English, French or Spanish.</td>
</tr>
<tr>
<td>3</td>
<td>Document code</td>
<td>Capital letters to designate an MRP.</td>
</tr>
<tr>
<td>4</td>
<td>Issuing state or organisation (in code)</td>
<td>Three-letter code (ISO 3166).</td>
</tr>
<tr>
<td>5</td>
<td>Passport number</td>
<td>As given by the issuing state or organisation.</td>
</tr>
<tr>
<td>6</td>
<td>Name</td>
<td>Full name of the holder, as identified by the issuing state or organisation.</td>
</tr>
<tr>
<td>7</td>
<td>Surname</td>
<td>Surname(s) of the holder.</td>
</tr>
<tr>
<td>Element No.</td>
<td>Data Element</td>
<td>Specification</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>---------------</td>
</tr>
<tr>
<td>8</td>
<td>Nationality (in full)</td>
<td>Nationality of the holder, registered in the state of issuance, in the official language of that state.</td>
</tr>
<tr>
<td>9</td>
<td>Date of birth</td>
<td>Holder’s date of birth as recorded by the issuing state or organisation.</td>
</tr>
<tr>
<td>10</td>
<td>Identification Number of Person (IDNP)</td>
<td>Field optionally used for personal identification number given to holder by issuing state or organisation.</td>
</tr>
<tr>
<td>11</td>
<td>Sex</td>
<td>Sex of holder, to be specified by use of the single initial commonly used in the official language of the state where the document has been issued and, if translation into English, French or Spanish is necessary, followed by a dash and the capital letter “F” for female, or “M” for male.</td>
</tr>
<tr>
<td>12</td>
<td>Place of birth</td>
<td>Field optionally used for city and state of holder’s birthplace. A translation of the name into one or more languages (one of which should be English, French or Spanish) should be given when the translated name is more familiar to the international community. At the discretion of the issuing state, the town or suburb of birth may be used. When the MRP is used for a person whose place of birth was outside of the state issuing the document and it is desired that the state or territory of birth be shown, the three-letter ISO code should be used.</td>
</tr>
<tr>
<td>13</td>
<td>Date of issue</td>
<td>Date of issue of MRP.</td>
</tr>
<tr>
<td>14</td>
<td>Authority or issuing office</td>
<td>Authority or issuing office of the MRP. This field may be used to indicate both the issuing authority or issuing office and its location, which should be printed or stamped within this field.</td>
</tr>
<tr>
<td>15</td>
<td>Date of expiry</td>
<td>Date of expiry of the MRP</td>
</tr>
<tr>
<td>16</td>
<td>Holder’s signature</td>
<td>Signature of holder either directly on the data page in this field or on a label to be affixed within this field.</td>
</tr>
<tr>
<td>17</td>
<td>Identification feature (photograph)</td>
<td>This field should contain a portrait of the holder. The portrait should be 45.0 mm x 35.0 mm (1.77 in x 1.38 in). The length of the face from the chin to the forehead varies from 25 to 35 mm.</td>
</tr>
<tr>
<td>18</td>
<td>Machine-readable zone</td>
<td>See description below.</td>
</tr>
</tbody>
</table>
Machine-Readable Zone (MRZ)

The elements of the data fields 03-11 and 15 of the visual inspection zone are printed in the machine-readable format in field 18, from left to right, in two lines. A passport contains 44 symbols, and a visa (ID) 36 symbols, in each row. The machine-readable data is printed with OCR-B characters of a consistent thickness. The left margin of the first symbol on each of the lines is placed 6 +/- 1 mm from the closest vertical section of the MRD.
Data structure of the UPPER machine-readable line:

1. If the name consists of primary and secondary standard name identifiers, use two filler characters (<<) between them.

2. Any special character or sign in the name or surname are replaced by a “<" character.

3. The suffix of the name (e.g. “junior”, “II” or “III”) is printed with uppercase characters as the last part of the name (surname) and should be separated by the character “<".

4. The name is separated from the surname by two filler characters (“<<”) at the end of the main identifiers.

5. If the holder has several surnames, they should be separated by the character “<".

6. If the primary and secondary identifiers and required separators (filler characters) exceed the number of character positions available for names (i.e. 39), characters should be removed from one or more components of the primary identifier until three character positions are freed up, so that two filler characters (“<<”) and the first character of the first component of the secondary identifier can be inserted.

7. Any empty spaces are filled with the character “<".

<table>
<thead>
<tr>
<th>MRZ Character Positions</th>
<th>Field No. in VIZ</th>
<th>Data Element</th>
<th>Specification</th>
<th>No. of Characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>03</td>
<td>Document code</td>
<td>The first character should be “P”, to designate an MRP. One additional letter may be used, at the discretion of the issuing state or organisation, to designate a particular MRP. If the second character position is not used for this purpose, it should be filled by the filler character “&lt;&quot;.</td>
<td>2</td>
</tr>
<tr>
<td>3-5</td>
<td>04</td>
<td>Issuing state or organisation</td>
<td>The three-letter code should be used. Any space should be replaced by the filler character “&lt;&quot;.</td>
<td>3</td>
</tr>
<tr>
<td>6-44</td>
<td>06 07</td>
<td>Name and surname*</td>
<td>Name and surname of the holder.</td>
<td>39 (name, surname(s) and “&lt;&quot; characters)</td>
</tr>
</tbody>
</table>
## Data structure of the LOWER machine-readable line:

<table>
<thead>
<tr>
<th>MRZ Character Position</th>
<th>Field No. in VIZ</th>
<th>Data Element</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-9</td>
<td>05</td>
<td>Passport number</td>
<td>As given by the issuing state or organisation to uniquely identify the document. Any special character or space in the passport number as shown in the VIZ should be replaced by the filler character (“&lt;”). The number should be followed by the filler character repeated up to position 9 as required.</td>
</tr>
<tr>
<td>10</td>
<td>Check digit</td>
<td>See the “Check digit” paragraph below.</td>
<td></td>
</tr>
<tr>
<td>11-13</td>
<td>08</td>
<td>Nationality</td>
<td>As a three-letter code represents the holder’s nationality, any space is replaced by the filler character “&lt;”.</td>
</tr>
<tr>
<td>14-19</td>
<td>09</td>
<td>Date of birth</td>
<td>The structure is YYMMDD, where: YY = Year (2 positions) MM = Month (2 positions) DD = Day (2 positions)</td>
</tr>
<tr>
<td>21</td>
<td>11</td>
<td>Sex</td>
<td>F = Female; M = Male; &lt;= unspecified.</td>
</tr>
<tr>
<td>22-27</td>
<td>15</td>
<td>Date of expiry</td>
<td>The structure is YYMMDD, where: YY = Year (2 positions) MM = Month (2 positions) DD = Day (2 positions)</td>
</tr>
<tr>
<td>28</td>
<td>Check digit</td>
<td>See the “Check digit” paragraph below.</td>
<td></td>
</tr>
<tr>
<td>29-42</td>
<td>10</td>
<td>IDNP</td>
<td>Any special character, including a space, in the personal identification number given to the holder by the issuing state or organisation, should be replaced by the filler character “&lt;”. The number should be followed by the filler character repeated up to position 42 as required. When the personal number field is not used, each character position from 29 to 42 in the second MRZ line should be filled in with the filler character (“&lt;”).</td>
</tr>
<tr>
<td>41</td>
<td>Check digit</td>
<td>See the “Check digit” paragraph below. When the personal number field is not used and the filler character (“&lt;”) is used in each position from 29 to 42, the check digit may be zero or the filler character, depending on the option chosen by the issuing state or organisation.</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Composite check digit</td>
<td>The composite check digit for the characters of the machine-readable data of the lower line in positions 1 to 10, 14 to 20 and 22 to 43, including values for letters that are a part of the number fields and their check digits.</td>
<td></td>
</tr>
</tbody>
</table>
Check digit:

The data structure of the lower machine-readable line provides for the inclusion of five check digits, for positions 10, 20, 28, 43 and 44. A special check digit calculation has been adopted for use in MRPs. Their calculation and verification is done as follows:

1. Going from left to right, multiply each digit of the pertinent numerical data element by the indicator 731.
2. Add the products of each multiplication.
3. Divide the sum by 10 (the modulus).
4. The remainder should be the check digits.

For data elements in which the number does not occupy all available character positions, the symbol "<" should be used to complete vacant positions and be given the value of zero for the purpose of calculating the check digit. When the check digit calculation is applied to data elements containing alphabetic characters, the characters A to Z should have the values 10 to 35 consecutively, as follows:

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 |
**Example 1:**

Using as an example date of birth 15 March 1975 with the date in the numeric form specified in ISO 8601 (according to ISO Standard 8601 its format in the MRZ is 7503153), the calculation is made as follows:

Date: 7 5 0 3 1 5

Indicator 731: 7 3 1 7 3 1

1st step - multiplication: 49 15 0 21 3 5

2nd step - sum of products: 49 + 15 + 0 + 21 + 3 + 5 = 93;

3rd step - division by modulus 10: 93/10 = 9.3, with the remainder 3

The check digit is the remainder 3, the date and its check digit should consequently be written as: 7503153 3.

**Example 2:**

Using the number PA12345<< as an example, the calculation will be:

Passport number: P A 1 2 3 4 5 < <

Assigned numeric values: 25 10 1 2 3 4 5 0 0

Indicator 731: 7 3 1 7 3 1 7 3 1

1st step - multiplication: 175 30 1 14 9 4 35 0 0

2nd step - sum of products: 175 + 30 + 1 + 14 + 9 + 4 + 35 + 0 + 0 = 268

3rd step - division by modulus 10: 268/10 = 26.8, with the remainder 8

The check digit is the remainder 8, the date and its check digit should consequently be written as: PA12345<<8.

For calculating the composite check digit, the same method is used, using the indicator 731; going from left to right, with the inclusion of the check digits and the “<” characters and excluding the positions 11-13 (nationality) and 21 (sex).

ICAO Document 9303 contains information on the technical requirements for any machine-readable visa that is a machine-readable document or permit of entry. There are two types of visas: format A with the nominal dimensions 120 x 80 mm, and a smaller version, format B, with the nominal dimensions 105 x 74 mm, that is similar in size to the ID-2 (ISO 7810) type of identity document.
2.2. Electronic (E-passport/Biometric) document

This is a combined paper and electronic document containing biometric information that can be used to authenticate the traveller’s identity. The document and chip characteristics are documented in Document 9303 of the ICAO. A special symbol is used to denote a biometric passport and is usually located on the cover of such passports:

![Biometric Passport Example]

This type of document contains contactless smart card technology, including a microprocessor chip (computer chip) and antenna, which are incorporated into a particular page of the document. The location of the contactless chip and its antenna can be chosen and may be in the data page, a separate page of the booklet or the cover. Apart from some exceptions (e.g. the United Kingdom passport), contactless chips and antennae are usually only visible under intensive transmitted light.

![Contactless Chip Example]

The technical specifications for electronic devices for passport first appeared in 2006, in the sixth edition of ICAO Document 9303. Previous versions were available just as ICAO technical reports.

Reasons for introducing electronic devices in travel documents (and other identity documents):

- overall increase of the document’s security level (it is more difficult to forge)
  - cryptography
- establishes link between the document and the holder - biometrics
  (physical electronic device and digital data)
Basically, the chip contains all the same information as the passport (except for fingerprints). Inside the chip, this information is stored in a special file format. The stored information is divided into the data groups DG1 - DG16.

<table>
<thead>
<tr>
<th>Data Group</th>
<th>Data Stored</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG1</td>
<td>Machine-readable zone (MRZ) - mandatory</td>
</tr>
<tr>
<td>DG2</td>
<td>Biometric data: face - mandatory</td>
</tr>
<tr>
<td>DG3</td>
<td>Biometric data: fingerprints</td>
</tr>
<tr>
<td>DG4</td>
<td>Biometric data: iris</td>
</tr>
<tr>
<td>DG5</td>
<td>Picture of the holder as printed in the passport</td>
</tr>
<tr>
<td>DG6</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>DG7</td>
<td>Signature of the holder as printed in the passport</td>
</tr>
<tr>
<td>DG8</td>
<td>Encoded security features - data features</td>
</tr>
<tr>
<td>DG9</td>
<td>Encoded security features - structure features</td>
</tr>
<tr>
<td>DG10</td>
<td>Encoded security features - substance features</td>
</tr>
<tr>
<td>DG11</td>
<td>Additional personal details (address, phone number)</td>
</tr>
<tr>
<td>DG12</td>
<td>Additional document details (issue date, issuing authority)</td>
</tr>
<tr>
<td>DG13</td>
<td>Optional data (anything)</td>
</tr>
<tr>
<td>DG14</td>
<td>Data for securing secondary biometrics (EAC)</td>
</tr>
<tr>
<td>DG15</td>
<td>Active authentication public key information</td>
</tr>
<tr>
<td>DG16</td>
<td>Next of kin</td>
</tr>
</tbody>
</table>

DG1 (MRZ) and DG2 (facial image) are mandatory. The other data groups are optional. Not every verification system can read all the data groups or the content of the optional groups.

To be sure that all data stored on the chip is genuine, all the data groups are digitally signed by the issuing state. This feature is called Passive Authentication (PA). PA can recognise if the digital signature has not been made by a competent authority or if the data has been modified (e.g. photograph substitution). PA requires a specific digital certificate from the issuing state - known as the Country Signing Certification Authority (CSCA). If the CSCA certificate from the issuing state is not available, the digital signature cannot be verified and the passport therefore cannot be validated. PA cannot verify or reveal:

- physical security features, blank of the document, incorporation of the chip, etc.
- data that was copied exactly from the original document (cloning).
An additional but optional integrated security element is Active Authentication (AA), in order to prevent cloning of the data. This is based on a cryptographic algorithm of interrogation - a response that can verify the content of the chip (its protected memory), by using a secret key stored during personalisation by the issuing state. It is resistant to potential alteration of the chip. There is a theoretical possibility, in the case where sophisticated and expensive equipment is used, that the secret key may be read and the passport cloned, but the risk of this is quite low. The result of active authentication is: access/denied. The AA result is valid only if the PA is positive.

In order to avoid non-desired data transfer with electronic passports, the majority of electronic documents are protected by Basic Access Control (BAC). Access is permitted solely upon authentication based on control keys obtained from the MRZ:

- number of document
- date of birth
- date of expiry

This function guarantees that the travel document was issued just for border control checks. The role of BAC is to protect the personal data of the travel document holder, and this data cannot be read from a remote location without knowing the information stored in the MRZ. The cryptographic protocol of BAC has some weaknesses (low entropy of the security keys). The real security level of BAC is not perfect, but this does not affect the security of the inspection process, being only an issue of personal data protection. BAC can be an efficient obstacle when reading the content of electronic passports. If MRZ cannot be read automatically, then the data should be inputted manually.
Methods of reading electronic passports:

There are two options for reading these types of documents:

- with a reader - exposure to different wavelengths (VIS+IR+UV),
  the optical character recognition (OCR) of the MRZ, integrated reader radio
  frequency (RF)
- separate reading of the OCR of the MRZ, separate reader RF.
  MRZ is necessary for BAC.

Possible results of reading:

- chip is not detected at all
- chip is damaged or the interoperability is missing
- chip is detected but the exchange of information is not stable, overall
  reading of the passport is not possible
- chip is damaged or interoperability problems are detected
- data is read, validation problems are detected:
  ▶ falsification
- data is read, validation is not possible:
  ▶ without an acceptable answer (e.g. certificate missing)
- data is read, validation is okay:
  ▶ authentic passport or clone
The border guard (BG) officers working at border crossing points should carry out effective border control. BG officers have to always try to strike a balance between the need, on the one hand, to ensure smooth crossing of the border by persons who fulfil the entry conditions, and who represent the great majority of travellers (e.g. visitors, seamen, etc.), and the need, on the other hand, to always be vigilant in order to detect persons posing a risk to public policy and internal security as well as potential illegal immigrants.

All persons must pass an immigration check upon entry and exit, involving the matching of the identity of the person with the documents enabling them to cross the border. The immigration check usually consists of a rapid and straightforward verification of the travel document, with the aim of checking its validity and detecting the presence of signs of falsification or counterfeiting.

There are a number of methods and ways of falsifying documents and they change all the time, hand in hand with the new security features of the genuine documents. This is why it is more important to know and focus on original document production instead of ways of falsification. In any case, to run an efficient document check the representatives of the competent authorities must have solid knowledge not only regarding their security features but also regarding the basic methods of their falsification and indicators of falsification. Depending on the goals of the falsification process, the technical knowledge available and the opportunities for falsification, falsification (and fraud in general) in different countries can be classified differently. Below is shown the fraud classification common in Europe.
Advice for BG officers conducting border checks:

- Before you take the travel document, always first have a look at the face of the traveller (try to remember as much as possible of their notable facial features).

- Compare the features of the traveller with the photograph and the description included in the travel document, match them also with their visa, if one is required (this could help to eliminate impostors).

- Check the travel document through in order to rule out the possibility of it being counterfeit or forged (pay attention to the numbering, the printing and stitching of pages, seals and stamps inserted, the inclusion of other persons); all corrections made in the document, especially on the personal data page, should be clarified by the traveller.

- Where appropriate, the examination of travel documents, visas and residence permits should be carried out through comparison with samples of the current documents entitling the traveller to cross the border, with sample visa stickers, and by using equipment such as UV lamps, magnifying glasses, retrieval lamps, microscopes, document boxes and, where necessary, more advanced equipment such as video spectral comparators, etc.

- Check the data in the file system or in the relevant databases of information concerning stolen, misappropriated, lost or invalidated documents, based, where considered necessary, on a risk assessment. In case such checks reveal an alert on the need to seize a document, the document in question should be seized immediately and information to that effect passed via the chain of command to the appropriate officer in charge.

- While doing checks always maintain verbal contact and observe the behaviour and reaction of the traveller (e.g. nervousness, an aggressive attitude, excessive willingness to co-operate).

- Before you administer the border stamp make sure that the person has not overstayed the allowed period during his/her last stay within the territory of Azerbaijan.

- Do not interrogate the traveller as a potential criminal or illegal immigrant. All questions should be well balanced and asked in a friendly way.

- Questions posed by the traveller should not be construed as intrusive and should be answered in a factual and polite manner.
Falsified documents are usually classified into complete and partial falsifications.

**Complete falsification - Counterfeit** is falsification where, based on a genuine document, all of the components are reproduced (cover, paper, security features, etc.), the blank filled in, the signatures of the authorities provided, impresses of the stamps used, and other requisites met. It is very difficult to produce a complete falsification. It is practically impossible to precisely produce a complete falsification of a document, and it may be easily detected without a profound analysis of its components.

Nevertheless, due to the rapid development of IT tools and digital techniques, which can easily replicate the polygraphic production and are very accessible, there is an increase in the uncovering of complete falsifications, especially residence permits - the originals of which are produced with digital technical devices and contain basic security features (not complications). These falsifications can sometimes be very accurate, and detectable only after detailed examination at the second control level, using specialised control devices and knowledge on the printing techniques and materials used in the document's production.

**Partial falsification - Forged** is the falsification method where unauthorised changes or supplementations are made to the requisites of the genuine document, or a part of the document is substituted. The choice by the forger to produce a partial falsification is dictated not only by the goals of the procedure and the technical opportunities presented, but also by the characteristics of the specific document; the quality of the materials used for its production (the quality and characteristics of the paper, inks, laminate, etc.), the presence of security features (their quantity and complexity), the technologies used in the production of the document.

The subchapters below describe the main types of fraud and also provide important tips and advice for border guards and other state officials with regard to document examination.
3.1. Counterfeit documents

The complete falsification of a document includes the fabrication of all its components: paper (or plastic), blank, handwritten (or printed) text, and of all the document's requisites. Usually, documents that are complete falsifications consist of one or two fragments (certificates, vouchers, permit of residence and ID documents) containing less security features, and those produced with accessible digital devices. Much more rare are completely falsified documents produced by typographic means, with a high number of security features, using several printing methods, and applying in their production sophisticated materials and techniques.

It is advisable to start the document examination with the basics such as the document's substrate material and the printing method used, later on, the graphics of the elements should be assessed. Examinations of different types of documents have their own specifics, but generally examination of a travel document has the following sequence:

1. Examination should start (if it is a passport) with the cover, by assessing or comparing (if one has a comparable sample-specimen) the size and position of the fragments of the image on the examined blank.

2. Documents should have UV dull paper (or other substrate) with the controlled response to UV.
3 Pay attention to **watermarks**.
   
a) They can be simulated by inserting printed replicas of the original between two sheets of paper.

b) They are not visible under UV light.

4 Pay attention to the **coloured fibres, planchettes**. These security features have to be integrated into the paper.
   
a) In counterfeits, they may have been drawn using a neon pen.

b) They may have been applied onto the paper by means of a printing process.

c) Real fibres may have been glued onto the paper.

d) Coloured fibres that have been printed onto paper may be frequently positioned identically on different pages of the document.
5 Notice the **security thread**.
   a) A simulations may have been printed onto the page.
   b) It may have been embedded between two sheets of thin paper.

6 Focus on the background- or pre-printed text – **printing technique** (usually offset).
   a) It may lack fine line pattern quality.
   b) There may be a lack of micro-text quality.
   c) The rainbow printing may be imitation.
“Sound test”, if it is a polycarbonate document.

Other security features which could be counterfeit in a totally counterfeit document:

- **optically variable ink:**
  - may have been imitated with shiny inks
  - OVI may have been used, but in a different colour (available on the open market), etc.

- **letterpress printing:**
  - different printing techniques to replicate letterpress may have been used, or even handwriting, etc.
intaglio:
- it may have been imitated by embossing the printing surface
- an imitation may have been produced by melting granules (thermography), etc.

perforation:
- different possible ways of imitating mechanic perforation
- there may be misalignments, etc.

see-through register:
- misalignments are usually visible where this security feature has been replicated
Optically variable devices:

- this is usually hard to recognise without a comparable sample, because of the good quality of reproductions available on the market;
- there typically are not any words visible within the devices; like "security", "genuine", etc.
3.2. Partial falsifications

The most used method of document falsification is partial falsification. For its implementation, it is not necessary to possess the same expensive or complicated equipment as used in producing completely genuine documents and the process is performed on genuine blanks of the documents.

Partial falsification - any unauthorised change to the blank of the document after issuance. There are a number of methods of partial falsification and indicators of the process. The most common of these are:

- **substitution (replacement) of the photograph**

Substitution of the photograph is a widely used method of falsification of travel documents. The level of difficulty involved depends on the method of photograph affixation (integration), which is also a method of protection against substitution, as well as on the technique used for the fabrication of the photograph. There may be complete or partial substitution of the photograph.

- **substitution (replacement) of a fragment of the document**
Usually, sensitive parts (fragments) of the document are the target of the counterfeitors:

- document number can be changed to trick the databases;
- document validation part is always high risk;
- documents donors may be used to keep authentic security features (a collage method may be used, where a section of the page containing the data is cut from the document and replaced by an equivalent section from a similar document. This type of alteration may be visible under oblique, transmitted, or UV light).

**data alteration**

- mechanical alteration of the data may not only be on the paper but also on the plastic substrate;
- mechanical erasure leads to defacement of the structure of the optical specifics of the paper. In the place where the erasure was executed, the fibre tissues become weaker and erect, creating a specific type of fuzz. The paper loses its gloss and become opaque;
- chemical alteration. The text may be removed by chemical bleaching, due to the property of the colourants used in the dyeing process interacting with some reagents. Together with the chemical change in the ink’s colourants when bleaching, the quality of some components of the paper also changes. This chemical intervention usually decreases the gloss of the surface and in the bleached area the paper become porous and opaque. UV or IR light sources may reveal traces of chemical bleaching.
Other examples and ways of falsifying documents:

- an extra layer might be used on the bio page;

- the bio page of may be split and changes to the personalisation made. Traces of splits made in the bio page:

- alterations to the bio page are very often made from the backside of the document;
some security features may be taken from original documents and used, even from polycarbonate substrate documents;

3.3. Stolen blanks

This is one of the most challenging fraudulent types, where a genuine blank with all the security features is used, with the personalisation being made without the legal authority to do so. This type of fraud can be prevented by using databases with registered stolen blanks, and one may also be able to find some traces of falsification in the personalisation:

- incorrectly filled MRZ;
- grammatical mistakes;
- document number changed to trick the databases, etc.
3.4. Fantasy documents

Fantasy documents bear the names of imaginary states or organisations - the issuer is neither a state recognised under international law, nor an authorised institution - or are documents that claim to come from countries or organisations that no longer exist, or have a new name.

It is impossible to review all possible falsification methods. They are changing rapidly, together with the new technologies being used in the world of document security. That is why it is advisable to focus on genuine documents and learn how to recognise original security features and printing techniques.

3.5. Impostors

Ongoing enhancement of physical protection of travel documents has made them much more difficult to forge or counterfeit than in the past. The use of genuine, unaltered documents by impostors thus has become more frequent.

This is why BG officers should pay special attention to documents presented during immigration control at BCPs, in addition to their holders, in order to identify impostors, i.e. persons trying to impersonate other persons by presenting their genuine documents, taking advantage of their physical resemblance to the genuine holders.

Impostors presenting genuine documents without any alterations are more difficult to detect than some other types of document fraud.

The extent of the problem, however, is very difficult to estimate. It is suggested that most cases of document abuse by impostors go undetected. Despite wide use of the latest technologies and biometric data chips in passports currently
being issued, the physical check of the person may still be problematic as the equipment allowing automated comparison is not always in place.

When checking travel documents against the person presenting them, factors such as aging or photograph size, as well as additional security features protecting the photograph of the holder, can make comparison difficult (see below).

The identification of the person against the photograph is the process of matching the appearance features of the person with the image in the photograph for the purposes of establishing their identity.

Indicators of the human appearance are divided into:

- general physical;
- anatomic;
- functional.

General physical indicators are: sex, age, race, physical condition of the person.

Anatomic (morphological) indicators of appearance are: indicators of the stature, head, face, neck, shoulders, chest, limbs, skin (in areas normally exposed), hair, forehead, temple, eyebrows, eyes, cheeks, nose, mouth and ears.

Functional indicators - expressed by the external display of the human’s vital activity: (facial) gestures, walking.

It may not be easy to detect in the short time available for immigration control an impostor who uses another person's genuine travel documents. BG officers should take a moment to properly examine the image on the document or picture stored in the electronic chip and compare it with the traveller presenting it. To be certain, BG officers can follow this simple technique:

1. Divide the face visually into individual facial features.
2. Compare the facial features against the image one at a time.
3. Compare the relative positions of particular facial features against the image.
The systematic and comprehensive analysis of two or more faces can be carried out by first comparing the shape of the face. The majority of faces match one of the several basic shapes.

The next step is segmentation of the facial image into several facial elements and comparison of these elements.

The last step is to compare one facial element to another, e.g. the alignment of the mouth to the ears, the alignment of the eyes to the ears, the distance between nose and chin, etc.
Important indicators that should be taken into consideration when examining eyes are:

- eyelids (updrawn or lowered);
- shape of the eyes (round or elongated);
- depth of the eyes;
- colour of the eyes;
- specific shape of the eyes;
- positioning of the eyes;
- shape and positioning of the eyebrows.

The nose is one of the dominant elements of the face. When looking at a face from a frontal position, it will be dominated by the shape of the eyes and the nose, and when looked from the side, the nose’s contour will be the dominant element.

The nose should be divided into several zones and each one should be examined separately:

The following can be mentioned as peculiarities: cicatrix, verrucae, scars, abundance of hair in the nostrils, excessive dilatation of the pores, and congenital or accidental malformations.
The mouth is a combination of the upper and lower arcs. When examining the mouth, divide it into these segments:

When examining the ear, look at the area that merges with the head and the extended parts of the ear:

The ears contain the most details of any of the components of the face and their careful examination is a crucial process for identification of the person. This part of the face does not change its shape during one’s lifetime. The ear can be analysed in terms of the following aspects: size, shape, the place where it merges with the head.

Size is assessed by comparing the ears to the overall size of the head and can be: large, normal or small. According to the shape, the ears can be round, oval or rectangular.
Upon completing observation of the abovementioned features, the next step to be taken is examination of the particulars of the person - which may have different causes, such as anatomic abnormalities, surgical interventions or accidents, whilst also paying attention to bone structure, neck width, size and positioning of the Adam’s apple and the specifics of the skin.
Peculiarities of the skin include:

- scars;
- cicatrix/moles, acne;
- tattoos;
- dimples;
- piercings.

Remember:

1. Imaginatively divide the face into the separate elements.
2. Whilst examining personal characteristics, compare each element separately.
3. Compare the positioning of each element in relation to each other.
4. It is easier to compare two pictures than a person’s appearance and their picture in their document.

3.6. Profiling

Traveller profiling is a method of identifying illegal travellers, criminals and terrorists by behavioural analysis, documentation and BG officer observation and/or questioning techniques.

Profiling can selectively target certain individuals for additional searches and questioning and quickly isolate those few individuals who might warrant more thorough scrutiny by officers.

Risk indicators can be defined as the attributes and characteristics of the persons travelling, the vehicles involved, and the transported items and goods (cargo), which may be used to determine the likelihood of illegal border crossing.
Possible sources for risk indicators:

- regular following of intelligence data, changes in the political, economic and demographic situation in neighbouring countries and the broader world;
- reports on the circumstances of performed detentions, disclosed ways of illegal state border crossing, routes of violators, modus operandi used, and experience of other countries, as well as other information;
- personal experience, constant observation of persons crossing the border in order to form typical images (profiles) of particular groups or individual persons;
- consultations with experts (officers from the police and migration services, psychologists, experts from carrier associations, etc.); analysis of the experience of foreign countries.

Risk indicators related to travellers:

- appearance;
- behaviour;
- luggage, means of transport and transported cargo;
- routing;
- presented documents;
- indicators related to answers given during questioning.

Risk indicators related to the traveller’s appearance:

- appearance is not consistent with declared purpose of trip;
- clothing not suitable for the climate of the destination country;
- clothing is designed to provoke distress;
- clothing is designed to hide something.

Some people may experience reactions to stress such as: an increase in bowel movements; a decrease in digestive functions; relaxation of the bladder; an elevated heartbeat; a decrease in the production of saliva. Some of the effects are not visible, however, let us mention those which can be clearly observed: lip biting; empty swallowing; tense and rigid body; excessive movement of the hands or feet; cold/hot sweating; the need to go to the bathroom; mood changes; twitches; increased nervousness; blushing; the need to smoke; quicker breathing.
Risk indicators related to behaviour:

- traveller rushes border staff to complete the procedures;
- traveller refuses to cooperate with border staff, or is too cooperative;
- traveller, or those accompanying them, display unusual nervousness or fear;
- traveller maintains covert (secret) interaction with others.

Risk indicators related to luggage and personal belongings:

- baggage contents are inconsistent with the passenger’s appearance, profession or declared purpose of visit;
- luggage (size, quality, quantity) does not match the purpose of travel.

Risk indicators related to routing:

- the person chooses an unusually complicated way to reach their destination, as, for example, in the image below:
Risk indicators related to the presented travel documents:

- newly issued document;
- documents have primitive, imperfect or out-dated protections against counterfeiting;
- documents that entitle visa-free entry into countries with high living standards;
- documents issued by “high-risk” countries;
- traveller does not possess supporting documents (invitation, hotel bookings, return ticket).

Risk indicators related to the questioning and answers:

- traveller appears to be lying or withholding information;
- traveller is unfamiliar with their passport and/or ticket data;
- traveller does not speak the language of the country of citizenship or current residence;
- traveller does not know basic information about their country of residence.

When attempting to reveal illegal intentions of potential offenders you should remember the following rules of interrogation:

- be an active listener;
- ask relevant questions (open-ended, no “yes”/“no” replies possible);
- do not interrupt;
- speak to everyone in the group;
- maintain eye contact;
- be attentive;
- do not treat every person as a potential criminal, but do not be friends with everyone either;
- be aware of multicultural differences and gender issues;
- control your stress and act calm under time pressure;
- be polite and professional.
## IV. Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC gates</td>
<td>Automated Border Control (ABC) gates are self-service barriers operated at some border crossing points offering the traveller border check without using the desk staffed by border guard or migration officer. The gates use facial recognition technology to verify the user's identity against the data stored in the chip in their biometric passport. Also known as e-gates.</td>
</tr>
<tr>
<td>Additive Colours</td>
<td>The primary colours, red, green and blue, with which other colours can be made.</td>
</tr>
<tr>
<td>Advantage Seal®</td>
<td>A variable optical image created on the glue side of a laminate or foil by a special process (overlamination).</td>
</tr>
<tr>
<td>Authorisation Stamp</td>
<td>An image or impression from an ink (rubber) or embossing stamp which serves to make a document legitimate. Issued by the issuing authority.</td>
</tr>
<tr>
<td>Back Stapling</td>
<td>The same as Back Stitching, but using staples.</td>
</tr>
<tr>
<td>Back Stitching</td>
<td>Applying a Binding Thread by stitching through the middle of a folded document. Also known as &quot;spine stitching&quot;.</td>
</tr>
<tr>
<td>Background Printing</td>
<td>The first layer of printing in a document, which is usually consistent throughout the document.</td>
</tr>
<tr>
<td>Barcode</td>
<td>A series of lines that can be read by a special barcode reader. The lines stand for numbers. One line is equal to 1, two lines is equal to 2. A distinction is also made in the spacing of the lines. There is also a two-dimensional (2-D) barcode consisting of images instead of lines. Much more information can be contained in a 2-D barcode.</td>
</tr>
<tr>
<td>Base Colour</td>
<td>A colour used as the base in printing; cyan (C), yellow (Y) and magenta (M), plus black (K) = CYMK. See Subtractive.</td>
</tr>
<tr>
<td>Base Material</td>
<td>The original or starting material before any printing has taken place. Also known as Substrate or printing surface.</td>
</tr>
<tr>
<td>Binding</td>
<td>The method by which a number of loose pages are attached to each other on one side. Examples: glue, staples, thread, etc.</td>
</tr>
<tr>
<td>Binding Thread</td>
<td>Organic, plastic or combined material used to bind together loose sheets (both printed and blank).</td>
</tr>
<tr>
<td>Biometrics</td>
<td>Measurable physical characteristics or person-specific traits used to check and verify someone's stated identity using automation.</td>
</tr>
<tr>
<td>Bite</td>
<td>A characteristic of Offset Printing. The harmful side-effects of water, grease and Ink can lead to paper fibres coming loose. The background is visible through the print at the place where the Fibres have come loose.</td>
</tr>
<tr>
<td>Bleaching</td>
<td>A chemical process used to change printed documents.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
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</tr>
<tr>
<td>Blind Stamping</td>
<td>A high-pressure method employed by either using a high pressure (plate) press or a smaller embossing machine to make an impression in the Substrate.</td>
</tr>
<tr>
<td>Blind Tooling</td>
<td>See Embossing.</td>
</tr>
<tr>
<td>Calander</td>
<td>The part of the paper machine that ensures that the Paper has a smooth surface.</td>
</tr>
<tr>
<td>Card</td>
<td>A plastic document containing information, and sometimes also a microchip.</td>
</tr>
<tr>
<td>Cardboard</td>
<td>A thick type of Paper with a weight greater than 180 grams. It is usually made from old Paper or straw.</td>
</tr>
<tr>
<td>Centre</td>
<td>Placing text in the middle of a page.</td>
</tr>
<tr>
<td>Centric</td>
<td>Stamps (should always be) built up centrically, meaning that all letters point to the middle of the stamp.</td>
</tr>
<tr>
<td>Check Digit</td>
<td>A control number included in a document’s Machine-Readable Zone. The document can be checked on the basis of this number.</td>
</tr>
<tr>
<td>Chemical Security</td>
<td>An addition to the Paper during the wet end stage intended to make chemical erasures visible by discolouring the Paper. See Reacting Agents.</td>
</tr>
<tr>
<td>Chip</td>
<td>A copper-coloured element used as a contact point on a card. Information can be stored on a chip.</td>
</tr>
<tr>
<td>CLI/C.L.I.®</td>
<td>Changeable Laser Image with vertical line matrix.</td>
</tr>
<tr>
<td>Cliché</td>
<td>Metal or plastic material plate, on which an image is created using engraving, etching or pouring, with the purpose of using it as a matrix (letterpress). See Polymer.</td>
</tr>
<tr>
<td>Coating</td>
<td>An extra layer applied on top of the printing. Often used in OVI.</td>
</tr>
<tr>
<td>Counterfeit</td>
<td>Reproduction of an original document with the intention of misusing it.</td>
</tr>
<tr>
<td>Cover</td>
<td>The front of a document; usually made from plastic materials with a linen structure. It usually includes an image, such as the national coat of arms or the logo of an organisation. False documents usually have a cardboard cover.</td>
</tr>
<tr>
<td>Diffuse Printing</td>
<td>A line pattern, logo or text applied to the adhesive side of a laminate, used for security. The Ink used is often Fugitive Ink; one meaning of the word “diffuse&quot; is “vague&quot;. The objective of this type of security is that if the laminate is removed, the print will be damaged or destroyed.</td>
</tr>
<tr>
<td>Digital Offset (Indigo)</td>
<td>A printing method characterised by the use of liquid Ink instead of Toner. Colorant distribution in the image is in the form of dots placed orderly. One of the characteristics of this method is a special ornamental design in the form of a rosette which is made as a result of colour printing at different angles.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td>Direct To Plate</td>
<td>Applying the image information directly to the printing plate, without the intermediary step of film material.</td>
</tr>
<tr>
<td>Direct To Press</td>
<td>Sending the image information directly to the printing press without using film or printing plates. Used in digital printing techniques.</td>
</tr>
<tr>
<td>Document Number</td>
<td>A series of numbers either preceded or followed by one or more letters with the objective of making a document unique. Usually applied using Letterpress Printing, Perforation or laser techniques.</td>
</tr>
<tr>
<td>Dots</td>
<td>Marks used to indicate the number of points in a Raster. See Planchettes.</td>
</tr>
<tr>
<td>Dotted Line</td>
<td>A broken line made up of dots.</td>
</tr>
<tr>
<td>Dry Offset</td>
<td>A Printing Technique used in security printing. It has the characteristics of Letterpress Printing, but uses a raised printing plate printing on an offset machine.</td>
</tr>
<tr>
<td>Dye Diffusion</td>
<td>See Dye Sublimation.</td>
</tr>
<tr>
<td>Dye Sublimation</td>
<td>A digital printing method, usually used for printing passport photographs in colour. A roll of transparent plastic material with CYM colours is placed in the printer. The colours are transformed into a gas by heating and this is transferred to the Substrate, where it is partially absorbed. A somewhat vague image will result from the gassing of the Substrate. Also known as D2T2™. It is a colour variation of Thermal Transfer.</td>
</tr>
<tr>
<td>E-gate</td>
<td>See ABC gates.</td>
</tr>
<tr>
<td>Egoutteur</td>
<td>A (Dandy) roll on which an image is placed to press onto wet paper, creating a Line Watermark. See Press Mark.</td>
</tr>
<tr>
<td>Embedding</td>
<td>Inserting (a microchip into a card).</td>
</tr>
<tr>
<td>Emblem</td>
<td>Insignia; in security printing this is usually the national coat of arms or a logo.</td>
</tr>
<tr>
<td>Embossing</td>
<td>By means of a raised (patrix) and a deep (matrix) image, applying an image to metal or plastic materials without using Ink. Seen as offering better security than an Ink Stamp.</td>
</tr>
<tr>
<td>Emulsion</td>
<td>The upper three layers of a colour photograph, or the upper layer of a black and white photograph. The use of silver halide crystals, after exposure, development, fixation and removal of the non-exposed crystals, results in the image.</td>
</tr>
<tr>
<td>Erasing</td>
<td>Removing written or printed information by chemical or mechanical means.</td>
</tr>
<tr>
<td>Expiry Date</td>
<td>The date on which a document ceases to be valid.</td>
</tr>
<tr>
<td>Extra Small Print</td>
<td>See Microtext.</td>
</tr>
<tr>
<td>Eyelet</td>
<td>A round piece of copper-coloured metal with a hole in the middle, applied to a passport by a machine to affix the passport photograph. Eyelets usually include text in Extra Small Print.</td>
</tr>
<tr>
<td>False</td>
<td>A completely forged document. Also known as a Reproduction.</td>
</tr>
<tr>
<td><strong>Fantasy Document</strong></td>
<td>A passport or other document that has not been issued by a competent authority and which creates the impression of being a real document.</td>
</tr>
<tr>
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</tr>
<tr>
<td><strong>Feathering</strong></td>
<td>A characteristic of Intaglio Printing. Using a Loupe, it will be obvious that the Ink is overflowing along the paper fibres.</td>
</tr>
<tr>
<td><strong>Fibres</strong></td>
<td>See Filaments.</td>
</tr>
<tr>
<td><strong>Filaments</strong></td>
<td>Visible or invisible hairs applied to the Paper during manufacture. Mixed into the cotton pulp and distributed randomly in or on the Paper. Invisible filaments become visible after exposure to UV Light.</td>
</tr>
<tr>
<td><strong>First-Line Control</strong></td>
<td>Document control without the use of any aids.</td>
</tr>
<tr>
<td><strong>Flat Printing</strong></td>
<td>See Printing Techniques; Offset Printing.</td>
</tr>
<tr>
<td><strong>Flexographic Printing</strong></td>
<td>A relief printing technique in which the printing plate is flexible and changes in accordance to the substrate. Recognisable by the presence of Haloing.</td>
</tr>
<tr>
<td><strong>Fluorescence</strong></td>
<td>The reaction of Paper, Ink or other elements to exposure to a light source.</td>
</tr>
<tr>
<td><strong>Fluorescent Fibres</strong></td>
<td>See Filaments.</td>
</tr>
<tr>
<td><strong>Fluorescent Ink</strong></td>
<td>Special Ink that becomes visible after exposure to particular kinds of light. UV Light is usually used. It is also possible to see such Ink using Infrared Light.</td>
</tr>
<tr>
<td><strong>Flyleaf</strong></td>
<td>The inside front and inside back cover pages of a passport.</td>
</tr>
<tr>
<td><strong>Foil Stamping</strong></td>
<td>A special form of relief printing that does not involve the use of Ink. A foil is heated and a raised image is melted into the Substrate using a steel stamp. An example is the overprint on the Cover of a passport. The national coat of arms is usually applied using this technique. Can be done in several colours and types of material.</td>
</tr>
<tr>
<td><strong>Forgery</strong></td>
<td>Illegally (fraudulently):</td>
</tr>
<tr>
<td></td>
<td>1. Changing variable information (i.e. passport photograph, name, expiry date, etc.).</td>
</tr>
<tr>
<td></td>
<td>2. Adding original pages from another document.</td>
</tr>
<tr>
<td></td>
<td>3. Adding pages that are genuine but which have been manipulated.</td>
</tr>
<tr>
<td></td>
<td>4. Adding forged pages.</td>
</tr>
<tr>
<td></td>
<td>5. Adding false stamps.</td>
</tr>
<tr>
<td><strong>Frame</strong></td>
<td>The trim around a text or image.</td>
</tr>
<tr>
<td><strong>Fraud</strong></td>
<td>Acquiring documents illegally.</td>
</tr>
<tr>
<td><strong>Fugitive Ink</strong></td>
<td>Ink which bleaches, discolours or disappear under the influence of chemicals. Often called “bleeding ink”. Usually applied in the background printing and as diffuse print.</td>
</tr>
<tr>
<td><strong>Gatefold (Triptych)</strong></td>
<td>A single piece of Paper folded in two or more places, and therefore consisting of three or more parts.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
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</tr>
<tr>
<td>Geometric Figures</td>
<td>A collection of thin intersecting lines and curbs (complex geometric designs, frames and other decorative elements) that create the background image. Due to the finesse of the lines, they cannot be correctly reproduced with copying devices. Also called Guilloche.</td>
</tr>
<tr>
<td>Gravure Printing</td>
<td>Printing Technique similar to Intaglio Printing. It uses printing plaques with secluded zones or alveolus, created by engraving the printed image onto copper or bronze plaques or by burning it in with acid or laser.</td>
</tr>
<tr>
<td>Grooved</td>
<td>Mechanically applying a type of Blind Stamping to the Paper so that it can be folded more easily.</td>
</tr>
<tr>
<td>Guilloche</td>
<td>See Geometric Figures.</td>
</tr>
<tr>
<td>Haloing</td>
<td>The effect that results from using relief printing; an extra edge of Ink around the impression.</td>
</tr>
<tr>
<td>Hi-Lites</td>
<td>Fluorescent particles inserted into the Paper (visible under UV Light). Mixed with the paper mass during the paper production, and designed as a security feature.</td>
</tr>
<tr>
<td>Hologram</td>
<td>A three-dimensional image created photographically that has the ability to change colour and image. Often used on metallic foil or in transparent form.</td>
</tr>
<tr>
<td>ID 1</td>
<td>Credit card dimensions; 85.6 mm x 53.98 mm, with a thickness of 0.76 mm.</td>
</tr>
<tr>
<td>ID 2</td>
<td>The dimensions of old ID-model cards; 105 mm x 74 mm.</td>
</tr>
<tr>
<td>ID 3</td>
<td>The document dimensions 88 mm x 125 mm.</td>
</tr>
<tr>
<td>ID Tracing Code</td>
<td>The unique identification code of a colour copy machine. Invisibly printed on each copy.</td>
</tr>
<tr>
<td>ImagePerf®</td>
<td>A patented process for creating a laser-perforated second passport photograph. Invented by the Dutch company IAI in Veldhoven and used in cooperation with Enschede/SDU.</td>
</tr>
<tr>
<td>Imitate</td>
<td>Using a production or reproduction method and materials to copy an original.</td>
</tr>
<tr>
<td>Impostor</td>
<td>Person who uses a document in someone else's name, which therefore does not bear the genuine holder's photograph. Also known as a &quot;lookalike&quot;.</td>
</tr>
<tr>
<td>Impression</td>
<td>A tangible and visible indentation on the reverse side of the Paper created as a result of setting the pressure of a relief press too high.</td>
</tr>
<tr>
<td>Indigo</td>
<td>See Digital Offset.</td>
</tr>
<tr>
<td>Infrared</td>
<td>Part of the electromagnetic spectrum, used to examine the fluorescent characteristics of Ink. Makes it possible to see differences in ink composition.</td>
</tr>
<tr>
<td>Infrared Light</td>
<td>A particular part of the light spectrum not visible to the naked eye. To make it visible, an infrared camera and monitor have to be used. Infrared ink is currently applied to documents such as the Euro banknotes and the Portuguese passport.</td>
</tr>
<tr>
<td>Ink</td>
<td>Dye or pigment composed of finely ground, usually plant-based or organic material with a water-based or oil-based additive. Printing inks differ widely in composition. The ink used will depend on the Printing Technique being employed.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
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</tr>
<tr>
<td><strong>Ink Stamp</strong></td>
<td>Also known as a &quot;rubber stamp&quot;. A mirror image created usually in polymers or rubber. An impression is applied to Paper by means of exerted pressure. A halo effect results from the pressure.</td>
</tr>
<tr>
<td><strong>Inkjet Printing</strong></td>
<td>A Printing Technique recognisable by the dots it produces, each of which have a separate colour in CMYK.</td>
</tr>
<tr>
<td><strong>Intaglio Printing</strong></td>
<td>Printing technique; in document examination, the term &quot;plate printing&quot; is usually used. After the introduction of the Euro, the term “intaglio” also became well known. The printing image is applied to the matrix and then applied to the Paper by means of a thick ink. This type of printing results in a palpable impression and is characterised by the fact that the printed elements are placed on an inferior plane in comparison to the non-printed elements.</td>
</tr>
<tr>
<td><strong>Integrated Passport Photograph</strong></td>
<td>A passport photograph that is part of the Substrate; it cannot be felt. Usually applied digitally.</td>
</tr>
<tr>
<td><strong>IPI</strong></td>
<td>Invisible Personalisation Information. Digital security hidden within a passport photograph that becomes visible by means of a special reader or lens. The security information usually contains the name of the bearer and the passport number. Appears in the passports of Hong Kong, Nigeria and Portugal, among others.</td>
</tr>
<tr>
<td><strong>ISO</strong></td>
<td>International Organization for Standardization. The organisation responsible for standardisation. The ISO is responsible for setting document dimensions, among other competences.</td>
</tr>
<tr>
<td><strong>Isogram®</strong></td>
<td>An anti-copying security method.</td>
</tr>
<tr>
<td><strong>Kinefilm®</strong></td>
<td>A Kinegram® applied to foil. Also known as a “kinefoil” or a “transparent kinographic overlay”.</td>
</tr>
<tr>
<td><strong>Kinegram®</strong></td>
<td>A stylistically created image that changes form and colour. “Kinen” means “move” in Greek. The company Landis and Gyr, now Kurz, invented and patented the Kinegram®. It is comparable to a hologram; if a hologram is made by Kurz, however, it is called a Kinegram®.</td>
</tr>
<tr>
<td><strong>Laminate</strong></td>
<td>A composition of plastic material applied for security and protection on top of the passport photograph and personal data. If the foil is applied by lamination, it is called a laminate. In the foil or laminate, various authenticity characteristics can be applied, such as a Kinegram®, foil stamp, UV, print, etc.</td>
</tr>
<tr>
<td><strong>Laser</strong></td>
<td>Light Amplification by Stimulated Emission of Radiation. Single-coloured, more or less parallel, intense light radiation.</td>
</tr>
<tr>
<td><strong>Laser Engraving</strong></td>
<td>A type of secured document personalisation, consisting of laser engraving of the information into the document (possible only on document layers containing particles of black carbon!) As a result of the carbonisation of the particles, black and white images are produced.</td>
</tr>
<tr>
<td><strong>Laser Perforation</strong></td>
<td>Burning a hole in a substrate with a laser. When used, a brown edge will be visible around the holes caused by the slight burning of the Substrate. The holes will be conical. The perforated Document Number can be applied by laser. ImagePerf® is a variant of laser perforation.</td>
</tr>
<tr>
<td><strong>Laser Printing</strong></td>
<td>Using Toner to apply information to a Substrate. Has virtually identical characteristics to photocopying. It is not possible to determine whether the printing was done with a photocopy machine or a laser printer (this applies only for black-and-white photocopy machines in comparison with black laser printer text). It is also now possible to print in colour using laser printing. In contrast with Ink, laser print toner is not absorbed into the Paper, but melted into it. Fluid toners are now also available. See Toner.</td>
</tr>
<tr>
<td><strong>Latent Image</strong></td>
<td>Also known as Phantom Image. An image or text is latently present in the flat printing impression. It is visible when examining the document under oblique light. Depending on the angle of the oblique light, the image becomes lighter on a darker background or vice-versa. Due to the contrast, some images, figures or characters become visible. This is a very high-quality first-line authenticity characteristic, which, so far, cannot be well imitated.</td>
</tr>
<tr>
<td><strong>Letterpress Printing</strong></td>
<td>See Relief Printing.</td>
</tr>
<tr>
<td><strong>Line Watermark</strong></td>
<td>A Watermark applied on the long sieve machine, consisting of one or two greyscale values. Line watermarks with two greyscale values are also known as “multi-tone line watermarks”.</td>
</tr>
<tr>
<td><strong>Long Sieve/Four-drinier Machine</strong></td>
<td>A paper machine that can apply a Line Watermark.</td>
</tr>
<tr>
<td><strong>Loupe</strong></td>
<td>Magnifying glass.</td>
</tr>
<tr>
<td><strong>Luminescence</strong></td>
<td>The phenomenon of being invisible in daylight or lamplight, but becoming visible after exposure to UV Light. Fluorescence and Phosphorescence fall under luminescence.</td>
</tr>
<tr>
<td><strong>Machine-Readable</strong></td>
<td>A specially designed strip consisting of a special font in a specific order that can be applied to the bottom of documents. The font is called Optical Character Recognition type B (OCRB). This level of standardisation is necessary to make it possible to read all document types identified by the International Civil Aviation Organisation using a standard reader.</td>
</tr>
<tr>
<td><strong>Machine-Readable Zone</strong></td>
<td>See MRZ.</td>
</tr>
<tr>
<td><strong>Magnetic Ink</strong></td>
<td>Ink to which pieces of metal have been added to make it magnetic.</td>
</tr>
<tr>
<td><strong>Matrix Printer</strong></td>
<td>A printer with a printing head consisting of a block with pins driven by a program to create numbers or letters. Also called an impact printer because the pins press the Ink into the Paper, leaving a visible imprint. In order to get these points closer together, so as to improve the legibility of the text, another piece of software must be brought to bear, Near Letter Quality (NLQ). NLQ software determines where the points are to be placed.</td>
</tr>
<tr>
<td><strong>Metameric Inks</strong></td>
<td>Inks that appear to have the same colour, but, through the use of a red filter, one particular colour can be stimulated and made more visible.</td>
</tr>
<tr>
<td><strong>MicroPerf™</strong></td>
<td>Brand name of a method of applying microholes in a Substrate by laser as a security precaution against page splitting.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td>Microtext</td>
<td>A small piece of text with a maximum height of 1 mm. Today, this usually refers to Extra Small Printing, and it can happen that it has a maximum height of 0.22 mm. Used as an anti-copying security measure.</td>
</tr>
<tr>
<td>Microplex™</td>
<td>A security element that closely resembles Scrambled Indicia®. Using a special reader (lens), a hidden printed image in the Microtext will become visible.</td>
</tr>
<tr>
<td>MLI</td>
<td>Multiple Laser Image (with horizontal line matrix).</td>
</tr>
<tr>
<td>Moiré</td>
<td>Because an original four-colour print run is printed with different raster positions, this disturbing phenomenon will occur if the print is again rastered. Every colour should be printed at its own separate raster angle, usually 0º, 15º, 45º and 75º.</td>
</tr>
<tr>
<td>MRZ</td>
<td>Machine-Readable Zone. The zone at the bottom of a personal information page in a document. It is built up using OCRB (see OCR Text) and is suitable for being read by machine.</td>
</tr>
<tr>
<td>Multi-Layer</td>
<td>A card built up from several layers.</td>
</tr>
<tr>
<td>Multiplex</td>
<td>A security element with the same characteristics as Microplex. Using a special reader (lens), a second image printed with the special line pattern becomes visible.</td>
</tr>
<tr>
<td>Multi-Tone Watermark</td>
<td>See Two-Tone Line Watermark.</td>
</tr>
<tr>
<td>Neobond</td>
<td>Synthetic Paper consisting of cellulose, polyamide, polyester fibres and special binding agents. It is a very strong material, difficult to disjoint and resistant to temperature flows (up to 100°C).</td>
</tr>
<tr>
<td>OBA</td>
<td>Optical Bleaching Agent.</td>
</tr>
<tr>
<td>OCR Text</td>
<td>See Machine-Readable.</td>
</tr>
<tr>
<td>Offset Printing</td>
<td>An indirect printing technique, recognisable by the equal distribution of the printing ink across the whole image area. Bites may be present.</td>
</tr>
<tr>
<td>Optically Variable</td>
<td>The phenomenon where an image or object changes substantially in colour or image content when viewed from a different angle or under different lighting.</td>
</tr>
<tr>
<td>Orlov Printing (Stereotype)</td>
<td>A special method of printing where the multi-coloured print of the image on Paper is made through a printing cycle where all the colours are placed on a typographic plate. The specifics of this type of printing reside in the fact that during the sudden change of colour the lines of the multi-coloured elements maintain perfect coincidence, and are not sharp when switching from one paint to another.</td>
</tr>
<tr>
<td>OVD</td>
<td>Optically Variable Device (image). A term used to refer to all optically variable security characteristics.</td>
</tr>
<tr>
<td>OVI</td>
<td>Optically Variable Ink. Ink that changes colour. Also called “changing inks”. The rainbow effect produced is due to, primarily, mother-of-pearl (mica) additives in the Ink. Ink containing mother-of-pearl is also called Iriodin® Ink.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
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</tr>
<tr>
<td>Paper</td>
<td>Ground and split vegetable material distributed equally in a wet state which, after drying and pressing, results in a product. A number of additives, such as chemicals and colouring agents, can be added. The raw material for Security Paper is cotton.</td>
</tr>
<tr>
<td>PC</td>
<td>Polycarbonate. The most used material in the production of secure documents. PC is expensive, resistant to mechanical and thermic influences, difficult to process, breakable under pressure, and its deformation temperature is about 150°C.</td>
</tr>
<tr>
<td>Perforation</td>
<td>A tear-line created by sharp, regularly spaced cuts in the Paper, so as to make it easier to rip.</td>
</tr>
<tr>
<td>Perforation Number</td>
<td>A hole in Paper created by a hollow punch. Several holes together collectively form the number. A passport can be perforated during one or several sessions.</td>
</tr>
<tr>
<td>Phantom Image</td>
<td>See Latent Image.</td>
</tr>
<tr>
<td>Phosphorescence</td>
<td>A type of Luminescence. The part exposed to light continues to glow after the light source has been removed.</td>
</tr>
<tr>
<td>Photocopy</td>
<td>An image applied by electrostatic or Xerographic techniques. The original is placed on a glass surface and illuminated. By means of polygon mirrors (analogue copy machine) or a scanner (digital copy machine), the illuminated image is transferred to a bi-electric drum. This means that the drum alternates between a positive and negative charge. The drum is sprayed with a very fine powder, called Toner. The Toner attaches to the surface of the drum when it has been statically charged. The drum puts the Toner on the Paper, and the Toner is then heated into the Paper. See Xerography.</td>
</tr>
<tr>
<td>Pictogram</td>
<td>Information or representation in image writing.</td>
</tr>
<tr>
<td>Pin Method</td>
<td>A method for checking an embossed image. When a letter is pierced, the needle should come out the other side of the Paper at exactly the same place in the image. This is a destructive method of examination and is therefore only allowed to be performed by the Expertise Forensic Institute.</td>
</tr>
<tr>
<td>Planchettes</td>
<td>Small geometrical shapes of different sizes, pressed into the Paper during the paper production process. May have the shape of discs (hexagons), be coloured or colourless, be placed randomly or at different depths.</td>
</tr>
<tr>
<td>Plastic Binding</td>
<td>Binding by melting plastic thread into the Cover.</td>
</tr>
<tr>
<td>PMS</td>
<td>Pantone Matching System. A colour-matching system in which colours are named, protected and standardised, using the CYMK colour scheme. The blue in the Dutch flag, for example, is PMS 300 (100% cyan and 40% magenta).</td>
</tr>
<tr>
<td>Polymer</td>
<td>A synthetic resin, used for stamps. By exposing it to UV light through a negative, this material becomes hard in places. Everything is then washed off, with the result that the unilluminated parts disappear and only the illuminated parts remain. This results in a stamp print with a raised image.</td>
</tr>
<tr>
<td>Positioned</td>
<td>Always occurring in the same place; having a fixed position. A Watermark can be positioned, in which case its location will be the same on every page of the document.</td>
</tr>
<tr>
<td>Press Mark</td>
<td>A Line Watermark applied by an Egoutteur (Dandy Roll).</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Print Number</td>
<td>The number indicating the print run during which the document was produced. May include the year of production.</td>
</tr>
</tbody>
</table>
| Printing Techniques | Methods of printing. The various techniques are:  
- Letterpress: a relief printing technique;  
- Offset: a flat printing technique;  
- Plate printing: a deep-printing technique;  
- Deep raster printing: a deep-printing technique;  
- Screen printing: a flat printing technique. |
<p>| PVC                 | Polyvinylchloride. The polymer material easiest to process; cheap and resistant to wear, its deformation temperature is about 65-70°C. |
| Rainbow Printing    | Also called “Iris printing”. Allows a very gradual transition from one colour to another. May consist of several transitions. Applied during the first print run. Can be used in Offset Printing, Letterpress Printing or Screen (Silk Screen) Printing. Different inks are mixed in a tray with several compartments. The back and forth movement of the ink rolls results in a smooth transition between colours. Not possible in Intaglio Printing because in that technique each colour has its own tray, so that mixing does not take place. Rainbow printing is mostly used for background printing to make erasures more quickly visible. |
| Rainbow Effect      | Changes in colour when the angle of light changes. |
| Raster              | An image created from points in a pattern, made by using an electronic process to break down the image into dots. These dots can vary in size or spacing, making a specific lineature with different angles. They are too small for the human eye to perceive them as individual dots without magnification. Instead, due to the varied size-spacing, they are perceived as tonal variations. |
| Raster Printing     | An engraving printing technique in which the image is etched or engraved into a large copper cylinder and printed in four-colour. The Ink used is quite fluid and the printed result gives almost the same effect as Offset Printing. |
| Rasterless Offset Printing | Offset Printing without Raster. Also known as “line offset” or “full area” printing. |
| Reacting Agents     | Materials included in the Substrate to make erasures more easily and more quickly visible. |
| Register            | Positioning the front and pack of a page so that they match each other. Not to be confused with Simultaneous Printing. |
| Relief              | The image in the depth of, for example, an embossing stamp. The Watermark will also have relief. It is palpable and visible in low-angle lighting. |
| Relief Printing     | Also called Letterpress Printing. Direct printing technique. The impression is created from an inked, raised press image. It can be recognised by the presence of a somewhat darker printer contour, called Haloing. Sometimes also visible from the impression of the paper on the reverse side, called the indentation. An ink stamp is a form of relief printing. |</p>
<table>
<thead>
<tr>
<th><strong>Reproduction</strong></th>
<th>The technique of reproducing something; make a copy from an original. See False.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Retouching</strong></td>
<td>Manually, or with the help of a computer, changing text or images applied by reproduction methods.</td>
</tr>
<tr>
<td><strong>Retroreflector</strong></td>
<td>Foil developed by 3M. Also called “confirm”. Small glass bubbles are positioned in the foil in such a way that, by using a light with a mirror called a “retro-viewer”, one can see whether an image or logo becomes visible.</td>
</tr>
<tr>
<td><strong>SAM</strong></td>
<td>Screen Angle Modulation. An anti-copying security measure developed by Joh. Enschedé. The process works by changing the lines in the background printing so that they are unreadable and unrecognisable by scanners. After copying a document treated with SAM, a text block or image appears on the page indicating that it is not an original document. MuSam is an improved version of this technique.</td>
</tr>
<tr>
<td><strong>Sans Serif</strong></td>
<td>Letters without serifs.</td>
</tr>
<tr>
<td><strong>Scanner</strong></td>
<td>A machine that scans a surface area with a laser beam and processes it into the four main colours (CYMK). The scanned image can be printed using a reproduction technique, such as a photocopying or Inkjet Printing.</td>
</tr>
<tr>
<td><strong>Scrambled Indicia®</strong></td>
<td>A line pattern created by computer where the lines are broken. These images or inscriptions are not visible to the human eye; using a specially designed reader/lens, the line pattern can be brought together to show the text or image. Can usually be applied with the use of software to create an Integrated Passport Photograph. Usually includes the name, date of birth and passport photograph and is readable with the special reader. In this case, it is not called Scrambled Indicia® but IPI.</td>
</tr>
<tr>
<td><strong>Screen (Silk Screen) Printing</strong></td>
<td>A direct printing method characterised by the fact that the printed elements of the printing form (thin metallic or silk screen) facilitate the transfer of the ink and the non-printed areas remain inaccessible. The printing is done by pressing the inks through the characters, through the screen, with a rubber tool. Recognisable by the powerful, strong colours and the image’s frayed or serrated edges.</td>
</tr>
<tr>
<td><strong>Second-Line Control</strong></td>
<td>Control using limited aids, such as a Loupe or UV Light.</td>
</tr>
<tr>
<td><strong>Security Fibres</strong></td>
<td>Synthetic or natural fibres, coloured or uncoloured, integrated into the suspension used for the paper production or randomly interspersed, on different depths and pressed into the wet, raw paper. Fibres added to paper tend to be: 1. Visible in normal light. 2. Visible after exposure to UV Light. 3. Of different colours. 4. Not positioned, but scattered randomly in and throughout the paper. 5. Visible or invisible hairs (see Filaments).</td>
</tr>
<tr>
<td><strong>Security Paper</strong></td>
<td>Paper used for documents, made of cotton. The optical whiteners are removed by a chemical process so the Paper does not react to exposure to UV light; the Paper remains optically dead. During preparation of the paper, a Watermark can be applied and Filaments or Planchettes added.</td>
</tr>
<tr>
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</tr>
<tr>
<td><strong>Security Thread</strong></td>
<td>Polyester or metal-faced thread, applied to the Paper during manufacture. May be made of plastic and perhaps contain Microtext or rainbow colours, UV, magnetised ink, be coloured or colourless, and be fully or partially integrated.</td>
</tr>
<tr>
<td><strong>See-Through Register</strong></td>
<td>See Transparent Register.</td>
</tr>
<tr>
<td><strong>Self-Destroying Slits</strong></td>
<td>Cuts or holes made in a surface such as paper or foil, to make the Paper or Laminate (foil) split when subjected to pulling forces.</td>
</tr>
<tr>
<td><strong>Selvage</strong></td>
<td>A page or part of a page held together by means of a line of perforated holes. Examples include a sheet of postage stamps. The tear-off portion on a postage stamp is also called the selvage.</td>
</tr>
<tr>
<td><strong>Serial Number/Letter</strong></td>
<td>The number or letter indicating a particular series.</td>
</tr>
<tr>
<td><strong>Serif</strong></td>
<td>Letter decorations consisting of lines or curls.</td>
</tr>
<tr>
<td><strong>Shadow Watermark</strong></td>
<td>An authenticity identification method that may be found in Security Paper. Gives a higher level of security than a line watermark. The image is more detailed and will show a gradual transition from light to dark. Line watermarks show the difference between light and dark poorly. Added at the wet-end stage of papermaking.</td>
</tr>
<tr>
<td><strong>Sieve</strong></td>
<td>A metal or wooden frame across which a brass gauze has been stretched for making paper, or a very fine plastic gauze used in Screen (Silk Screen) Printing.</td>
</tr>
<tr>
<td><strong>Signature</strong></td>
<td>A section of pages created by folding a single piece of paper in a particular way. One sheet can have as many as eight pages. A passport with 32 pages could consist of four signatures.</td>
</tr>
<tr>
<td><strong>Signature Slip</strong></td>
<td>A loose strip on which the passport holder writes their signature, which is then placed in the document. Signature strips will usually be authorised by means of an embossing or ink stamp.</td>
</tr>
<tr>
<td><strong>Simultaneous Printing</strong></td>
<td>Register printing where part of the image is visible on one side of the page and the other part is visible on the other. When light is shone through the page, the two parts will match up and show a complete image. Can only be done in Offset Printing on a simultaneous press. When examining the document under transparent light, the fragments will make a perfect match, creating an integral, logically-finished image.</td>
</tr>
<tr>
<td><strong>Single Layer</strong></td>
<td>A card consisting of a single layer.</td>
</tr>
<tr>
<td><strong>Skimming</strong></td>
<td>Illegally topping up the value of a bank pass or copying information from a magstripe.</td>
</tr>
<tr>
<td><strong>Smart card</strong></td>
<td>A card containing a microprocessing chip and read-only memory (ROM). Can think independently, in contrast to a chip card.</td>
</tr>
<tr>
<td><strong>Source Document</strong></td>
<td>Document showing where someone is from, such as a birth certificate.</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Spine</strong></td>
<td>The edge of a book or passport where all the pages are fastened by means of glue, staples or thread.</td>
</tr>
<tr>
<td><strong>Stamp</strong></td>
<td>Impression in the Substrate.</td>
</tr>
<tr>
<td><strong>Stamp Printing</strong></td>
<td>Making an impression in a Substrate using relief printing without using Ink.</td>
</tr>
<tr>
<td><strong>Staple</strong></td>
<td>A piece of red copper or zinc-coated material used for Binding, with sharp points at either end.</td>
</tr>
<tr>
<td><strong>Stereotype Printing</strong></td>
<td>A technique usually used in flat printing. Appearance is similar to Rainbow Printing, but the colours are separate and do not flow into one another. See Orlov Printing.</td>
</tr>
<tr>
<td><strong>Stitching</strong></td>
<td>A specialised form of bookbinding using thread or staples. See Binding.</td>
</tr>
<tr>
<td><strong>Stitching Holes</strong></td>
<td>Holes in the paper through which a Binding Thread is brought to bind the pages with the Cover.</td>
</tr>
<tr>
<td><strong>Substrate</strong></td>
<td>The untreated material to which the printing will be applied. See Base Material.</td>
</tr>
<tr>
<td><strong>Subtractive</strong></td>
<td>Mixing the colours cyan, yellow and magenta (CYM) as materials (in contrast to additives which mix light), results in the colours red, green and blue.</td>
</tr>
<tr>
<td><strong>Synthetic Paper</strong></td>
<td>Produced from polymers or a mixture of polymers and natural fibres, usually by means of traditional paper production. Possesses the features of special paper (cellulose) as well as the specifics of polymer materials.</td>
</tr>
<tr>
<td><strong>Teslin</strong></td>
<td>Synthetic paper, made of glass dust mixed with polyethylene foam, of a specific microporous structure (65% air) that is strong and water-resistant.</td>
</tr>
<tr>
<td><strong>Thermal Transfer</strong></td>
<td>A digital printing technique. A colouring agent is heated and melted into the Paper. Closely resembles the procedure of Dye Sublimation, except that the colours are not transformed into a gas. Usually used for one-colour text. Produces Haloing around the letters.</td>
</tr>
<tr>
<td><strong>Thermochromic Thread®</strong></td>
<td>Security thread that changes colour when the temperature changes.</td>
</tr>
</tbody>
</table>
| **Thermography**    | A printing refinement technique. Can be done in two ways:  
1. Using special inks (raised ink). These inks swell up after being applied to the Paper and are therefore tangible.  
2. Using normal inks applied after having been put in a tray with fine, transparent resinous balls. The resinous balls cling to the wet ink, after which they go through an oven and swell up. |
<p>| <strong>Tip-In</strong>          | A loose page, usually made of Paper, or an endleaf with a laminate, bound into a document, with a small lip for binding purposes. |</p>
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T.L.I®</td>
<td>Tilted Laser Image. A security measure patented by Joh. Enschedé Security Solutions. By changing the position of the laser, the laser burns at a different angle, applying text or images in plastic. By changing the angle of examination, another image or text block appears.</td>
</tr>
<tr>
<td>Toner</td>
<td>A black or colour substance with the ability to attach itself to a Substrate after heating. Toner is used in all laser techniques, in both printing and photocopying.</td>
</tr>
<tr>
<td>Transparent Register</td>
<td>Used in security printing, transparent (or see-through) registers are applied using a simultaneous press (an offset machine that prints the reverse side at the same time as the obverse side). On the obverse side, one half of an image is printed, and on the reverse side the other half of the image is printed in the same place. When illuminated, the two halves create a single image. Very high level of security.</td>
</tr>
<tr>
<td>Triptych</td>
<td>See Gatefold (Triptych).</td>
</tr>
<tr>
<td>Tweezers Test</td>
<td>Using a pair of tweezers to check the impression of an embossed image. By putting one of the points at a specific place on one side of the embossing, the other point must rest at the exact same spot in the embossing on the other side of the paper. This is not a destructive technique like the Pin Method (where a needle is pushed through the embossing to check both its front and back sides). See Pin method.</td>
</tr>
<tr>
<td>Two-Tone Line Watermark</td>
<td>A Line Watermark with lighter and darker sections. Also known as a Multi-tone Watermark.</td>
</tr>
<tr>
<td>UV Light</td>
<td>Ultraviolet Light. Light that is invisible to the naked eye, with a wavelength of 220 to 360 nm. Using an aid (a blue UV lamp), the light can be made visible.</td>
</tr>
<tr>
<td>Variable Information</td>
<td>Personal details in a document are called variable details because they are different in every document and are not present in the document during printing.</td>
</tr>
<tr>
<td>Variable Laser Image</td>
<td>Used as security features in polymer documents and realised at the time of personalisation. Two different laser-engraved images are located at the same place. Depending on the viewing angle, the images alternate.</td>
</tr>
<tr>
<td>Visa</td>
<td>From the modern Latin “charta visa” or “verified paper”, literally “paper that has been seen”, from the feminine past participle of “videre” (“to see”). The approval of a country allowing someone to visit that country. Access is not assured, however, and the visa will be checked by immigration officials on the spot. Visas come in three forms: stamps, stickers and loose in the form of a sheet of paper.</td>
</tr>
<tr>
<td>Watermark</td>
<td>An image visible when light is shone through it. Security feature created by a thickening or thinning of the paper fibres during the manufacture of the Paper. More fibres are present in the dark sections, and fewer in the light sections.</td>
</tr>
<tr>
<td>Xerography</td>
<td>An example of electrography. Powder-formed pigments (toners) are used and applied to the Paper electromagnetically or electrostatically and affixed by heating. Another name for a Photocopy.</td>
</tr>
</tbody>
</table>
Travel Documents: Security Features, Production Technologies and Examination

Textbook for state officials of the Republic of Azerbaijan

International Centre for Migration Policy Development, 2018

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