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Guide for the development of
**forensic document
examination capacity**

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Guide for the development of forensic document examination capacity



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Introduction

Fraudulent identity and security documents are integral prerequisites for the smuggling of migrants, trafficking in persons, terrorist mobility, to facilitate the smuggling of drugs, weapons and other goods, and to commit fraud. Fraudulent documents are the grease that eases cross-border crime of all types. They include fraudulently obtained, illegally issued, forged and counterfeit documents.

Security documents refer to documents containing incorporated security features within the document to protect the value of the document. Many identity documents contain security features such as passports, identity cards, and driving licences. Other examples of security documents include currency, social security cards, travel visas and lottery tickets, etc.

Identity documents are any documents which may be used to verify aspects of a person's personal identity. Some countries require individuals to carry a government issued identity card, while other countries may accept a driver's licence as an effective means of proof of identity.

Many countries in the world recognize that forensic document examination is vital to immigration and border control security and have a forensic document examination facility. Although the ability to detect and disseminate intelligence about fraudulent documents is vital to border security, there are still countries lacking this capacity. Moreover, there is a lack of awareness among relevant criminal justice practitioners of the benefits that forensic document examinations may provide to assist border control security and immigration facilities.

Traditionally, forensic document examination units are part of a forensic science laboratory. These units examine and compare handwriting, typewriting, printing processes, inks, and other document characteristics which may or may not include document security features. To respond to the detection of fraudulent identity and security documents specifically, many countries have established additional specialized structures. These structures are often under the immigration service and border control agencies and are housed in port-of-entry facilities.

Some countries have a sophisticated forensic document examination capacity both in their national forensic science laboratory and under immigration or border control services. Other countries have a more limited forensic capacity under their immigration and border control services and more advanced document examinations are done at the national forensic science laboratory. Still others rely entirely on their national forensic science laboratory for the examination and analysis of all documents.

Purpose, scope and organization of the Guide

The current Guide is intended to be used by officials in both donor and beneficiary countries in their efforts to design, build and strengthen forensic document examination and intelligence dissemination capacities.

The intention is to present a holistic approach to document examinations encompassing identity, security and other types of documents without security features.

The Guide aims to provide practical assistance for the establishment or upgrading of forensic document examination capacities in two categories of service providers: (a) immigration and border control agencies and (b) forensic science laboratories. Several levels of infrastructure development ranging from basic to advanced capacity are covered. The focus is on the staff skill and educational requirements needed to perform forensic document examinations and to provide court testimony, intelligence alerts and training. Recommendations on forensic equipment, reference collections and databases as well as general guidance for designing, establishing and maintaining a forensic document examination facility are included. This Guide should not be used as a simple checklist of equipment and materials to be obtained but rather as an aid for developing capacity in the area of document examinations.

This Guide complements an existing UNODC manual *Staff skill requirements and equipment recommendations for forensic science laboratories*¹ which covers all forensic disciplines and contains more detailed information on document examinations

The information contained within this Guide will have the greatest impact if a careful assessment of existing resources and equipment is carried out prior to developing capacities; a step-by-step approach is applied to the purchase of new or upgraded equipment; and adequate resources are made available to maintain the acquired equipment and databases. Moreover, forensic staff should be encouraged to develop their skills (e.g., membership of scientific societies, attending professional meetings, provide training, research and publication) and participate in relevant proficiency testing.

¹United Nations Office on Drugs and Crime, *Staff skill requirements and equipment recommendations for forensic science laboratories*, ST/NAR/1/Rev.1, 2010

Lastly, the combination of education, training, on-the-job training and experience cannot be overstated in the field of document examinations. No amount of self-study can replace proper training and practical experience gained by working side-by-side with a recognized qualified document examiner. The importance of best practices should also be highlighted. Even where laboratories are not planning to apply for accreditation, quality assurance measures are an integral part of their work and should be encouraged at every phase.

The Guide is organized into four main sections followed by four annexes. Though many of the underlying theories, equipment and examination techniques mentioned are used in all forensic document examination contexts, the material has been organized in a way that reflects the difference between examinations of identity and security documents and examinations of other documents without security features (non-security documents).

Section 1 provides an overview of the forensic document examination process;

Section 2 presents the four phases of the document examination process detailing staff, scope of services and limitations;

Section 3 includes staff skill requirements and equipment recommendations for the four phases (this section is complemented by annex 1 through 4);

Section 4 covers general guidance when designing, establishing and maintaining a forensic document examination facility.

Annex 1 provides details about equipment for the four phases;

Annex 2 provides a list of equipment providers;

Annex 3 provides training course outlines for strengthening capabilities at the four phases;

Annex 4 suggests books, reference materials, and databases.

1. Overview of the forensic document examination process

This section presents an overview of the document examination infrastructure, the four phases of the examination process, and document examination methodologies and approaches.

1.1. Document examination infrastructure

The delivery of forensic document examinations is mainly provided by two types of service providers:

- Immigration and border control agencies (this information follows the European Union recommended approach)
- Forensic science laboratories

There are differences in the priorities of these two types of structures: while the mission of an immigration and border control is to determine the authenticity of identity and security documents, a forensic science laboratory has a wider range of activities that varies depending on the requirements of each individual case and the mission or scope of services of the document examination unit. Forensic science laboratories examine identity and security documents as well as other non-security documents. Despite this division, it is important to establish and maintain good communication between the two service providers.

The order in which a questioned document goes through the document examination process can be described in terms of four phases. The following figure describes the four phases and the division of forensic document examinations by the two types of service providers.

Figure 1. Phases of forensic document examination and types of service providers

	Immigration and border control-type settings	Forensic science laboratory settings
PHASE 4		
PHASE 3		
PHASE 2		
PHASE 1		

- The relative volume occupied by each phase in each type of structure reflects the relative number of staff working in that phase;
- “Basic” refers to initial examinations;
- “Advanced” refers to more detailed examinations involving more sophisticated equipment;
- “Specialist” refers to a complete analysis of a document.

1.2. Phases of the examination process

While forensic examinations of documents are useful to guide and support criminal investigations and border control activities, they also have the potential to generate useful data on the means of forging/altering documents. Compiling and analysing these data can generate intelligence on new trends and threats in areas of crime evolving very rapidly. Based on this intelligence, adequate and relevant countermeasures and prevention strategies can be designed (e.g., introducing new security features to better protect official documents).

The process of a document examination can be summarized as follows:

Identity and security documents in immigration and border control agencies are screened in phase-1 (basic) where the authenticity of these documents is determined based on primary security features. If the authenticity of the identity/security document cannot be confirmed, further review would occur at phase-2 (advanced). Phase-2 personnel provide greater scrutiny of the examination of primary and advanced security features. Phase-3 personnel (specialist) involves confirming the authenticity of the document based on primary and advanced security features, and other further details.

A document, be it an identity document, security document or a non-security document, entering a forensic science laboratory follows a similar path: the document enters the laboratory at what is characterized as phase-2 (basic) in the above figure, where an initial examination is conducted by a basic-level forensic document examiner. Phase-1 screening is not done in a forensic science laboratory since the submitted document has already been identified as being suspect outside of the laboratory. If further examination of the document is needed, the document is sent to phase-3 (advanced) examination involving more sophisticated equipment. In phase-4 (specialist), forensic document examiners use specialized equipment to help render an opinion or extract information for investigative or intelligence purposes.

The scope of services of the four phases is presented in detail in section 2.

1.3. Document examination methodologies and approaches

The examination and analyses performed on fraudulent identity documents, security documents and non-security documents aim to:

- Detect fraudulent documents (both altered and counterfeited documents);
- Determine authenticity of security features;
- Determine authenticity of documents by comparing with known standards;
- Determine the author of signatures;
- Identify methods used to alter documents and to produce counterfeit documents;
- Provide intelligence information;
- Provide advice for the development of new security features for identity and security documents;
- Provide other relevant information related to the content of the document.

A forensic document examiner relies on a range of scientific instruments and specialized forensic equipment (from basic to advanced) to aid in these examinations. Many examinations involve a comparison between questioned documents and genuine documents, referred to as reference standards. Common reference standard collections include those of passports and other identity and security documents, watermarks, inks and typewriting standards. Databases which contain information about the characteristics of standard documents can also be helpful for general examinations but should not be considered an adequate replacement for the standards themselves. For the purpose of comparison, reference standards should be used as opposed to databases

containing images of the documents. Regular updates of reference standard collections are essential since countries are continually changing the features and methods of production of these documents.

During the course of forensic examinations of identity and security documents, various characteristics are analysed, compared and evaluated, mainly:

- Substrate characteristics (paper and polymer)
- Ink characteristics
- Printing processes and features
- Primary and advanced security features (overt and covert)
- Physical characteristics of the document (assembly and production characteristics)
- Personalization techniques/bio-data
- Electronic media (smart chips, magnetic strips, machine readable zones)

These characteristics are inspected and compared against reference standards to distinguish similarities and differences. Different techniques may be required to examine or analyse the different characteristics. Many characteristics can be examined with basic as well as more sophisticated equipment.

Many other types of physical evidence are potentially present on documents, such as fingerprints, biological materials (e.g., saliva), traces of drugs or shoe marks. This evidence should be preserved and analysed by specialized forensic experts. Depending on the organization of forensic services in a given country, fingerprint analysis is done by specialized staff either in the document examination unit, in another unit of the same agency/laboratory, or in a separate service. This Guide does not cover the sets of skills, materials and equipment required for fingerprint analysis. General guidance on skill requirements and equipment recommendations for the examination of fingerprints and biological material can be found in the UNODC manual *Staff skill requirements and equipment recommendations for forensic science laboratories*.²

² United Nations Office on Drugs and Crime, *Staff skill requirements and equipment recommendations for forensic science laboratories*, ST/NAR/1/Rev.1, 2010

2. Characteristics of the four phases

The following is a brief description of the four phases in terms of staff, scope of services and limitations/prerequisites.

2.1. Phase-1

Phase-1, which concerns the initial recognition and detection of suspect documents, is only included in immigration and border control agencies.

Staff

Front-line immigration officers; front-line border control officers; police officers and other administrative staff who deal with the control of identity and security documents (e.g. airport or land/border/port-of-entry facilities; identity and security document issuing offices). Document examinations comprise only part of the duties of these posts/positions (other duties relate to verifying the identity of the document holder on the basis of characteristics of the person compared to the picture and entries such as date of birth, height, etc).

Scope of services

- Determining the authenticity of identity and security documents on the basis of their primary security features (features which require only visual and tactile examination, including UV and low magnification);
- Recognizing and referring suspicious documents to phase-2 officers;
- Checking the validity of documents (expiry date and visa) and bio-data using visual examinations and/or a document reader;
- Provision of testimony and report writing depending on legislation and regulations;

Limitations

The major limitation for document examinations is time constraints. Staff have a short time period to review and examine documents (e.g. 30 seconds to 2 minutes).

2.2. Phase-2

For identity and security documents

Staff

Secondary, back-office immigration personnel; supervisors of other phase-1 staff. Document examination comprises only part of the duties of these posts/positions.

Scope of services

- Establishing the status of documents on the basis of primary and advanced security features (covert and overt), production methods, and personalization features (bio-data);
- Distinguishing between different printing processes;
- In case of doubt, referring the documents to phase-3 officers, if this capacity is available;
- Provision of testimony and report writing, depending on legislation and regulations;
- Depending on requirements, providing training to phase-1 officers;
- Compiling and composing appropriate intelligence materials for in-house sharing. If no phase-3 capacity exists, phase-2 personnel are encouraged to collect and share basic information for national and international intelligence applications.

Limitations

Relatively short time period available for the examination of each document (hours to days).

For other documents, depending on the mission and responsibilities of forensic document examination units

Staff

Basic level laboratory forensic document examiners.

Scope of services

- Basic physical characterization of ink and substrates;
- Distinguishing between printing processes;
- Collecting comparison material for handwriting and signature comparisons.

Limitations

Relatively short time period available for examination of each document (hours to days).

2.3. Phase-3

For identity and security documents

Staff

Full-time document examiners and third line, specialist level immigration and border control officers. In addition, staff with specific education and experience, such as printing press specialists, can also contribute to this phase.

Scope of services

- Confirming document status and determine their authenticity on the basis of primary and advanced security features and other details;
- Providing technical support and advice for the development and testing of new security features;
- Identifying trends in means used to forge and counterfeit documents; providing intelligence information (in-house, nationally and internationally);
- Providing training for phases-1, 2 and 3 personnel (in-house and/or externally);
- Providing expert testimony and report writing.

Limitations/prerequisites

The provision of those services will depend on the availability of high quality, authentic reference documents for comparison purposes.

For other documents, depending on the mission and responsibilities of forensic document examination units

Staff

Advanced level laboratory forensic document examiners.

Scope of services

- Examining and identifying additional physical and basic chemical characterization of ink and substrates;

- Distinguishing the source of printed documents (as possible within printing processes, including typewriters);
- Performing handwriting and signature comparisons.
- Providing expert testimony and report writing.
- Providing training for phases-1, 2 and 3 personnel (in-house and/or externally);

Limitations/prerequisites

The provision of those services will depend on the availability of high quality, authentic reference documents for comparison purposes.

2.4. Phase-4

In phase-4 all types of documents are examined, using sophisticated equipment. Phase-4 is only performed in the forensic science laboratory-type setting.

Staff

Full-time forensic document examiners (specialist in an immigration and border control agency or in a forensic science laboratory).

Scope of services

- Performing advanced chemical characterization of ink and paper, using specialized techniques;
- Performing handwriting and signature comparisons;
- Providing advice on innovations and new technologies, and researching new security documents and features;
- Validation of examination procedures used in phases-2 to 4;
- Identifying, using advanced scientific equipment/methods, trends in means used to forge and counterfeit documents; providing intelligence information (in-house, nationally and internationally);
- Providing expert testimony and report writing;
- Providing training for phases-1 to 4 personnel (in-house and/or externally).

Limitations/prerequisites

The provision of those services will depend on the availability of high quality, authentic reference documents for comparison purposes.

3. Staff skills, educational requirements and equipment recommendations

This section provides staff skills, educational requirements and equipment recommendations for the establishment or upgrading of document examination capabilities. It is designed to focus on the current capacity of the facility while keeping in mind future developments.

Requirements for education, skills to perform forensic examinations, preparation of court testimony, the dissemination of intelligence alerts and the delivery of training courses are included. Considerations for the proper handling of evidence and documentation of chain of custody are also included. The skills listed are required for staff working at the different phases—these are not application prerequisites. These skills do not reflect an exhaustive list of all of the tasks undertaken by phase-1 and phase-2 personnel, they only concern the document examination-specific tasks.

Three terms qualifying skill requirements are used in this Guide:

- *Knowledge* means a theoretical understanding of the scientific approach and the principles behind the analysis itself. It implies an understanding of the underlying theory of the particular analysis/examination (e.g. mechanisms, reactions, limitations, etc.). Knowledge is acquired through a formal and informal learning process.
- *Ability* means a practical ability to carry out an analysis/examination properly. Ability is acquired through practice.
- *Awareness* means to be aware of or familiar with a particular issue. It implies the need to know certain information in order to be able to take it into account.

Recommendations are made for equipment and materials for forensic document examinations, preparation of court testimony, preparation and dissemination of document intelligence alerts, and preparation of training courses.

3.1. Skills, educational requirements and equipment recommendations for the four phases

Phase-1

Skills and educational requirements

Level of education recommended

For personnel screening identity and security documents, specific educational requirements for entry and induction training depend on the agency or organization under which the document examination unit is housed. Technical colleges, such as police academies and/or immigration service schools, are preferable in most situations. Prior learning experience and exposure should be considered in conjunction with any educational requirements.

Skills

- Ability to distinguish colours, shapes, depth, and to observe details;
- Awareness of different characteristics and components of security documents: International Civil Aviation Organization (ICAO) standards, substrates, inks, assembly, production methods and bio-data;
- Awareness of overall threats and relevant intelligence information;
- Knowledge of the various types of primary security features (e.g. watermarks, optical variable inks);
- Knowledge of the different kinds of fraudulent documents (how they are falsified and counterfeited);
- Knowledge and ability to use available equipment commensurate with training;
- Ability to detect and identify the various types of primary security features.

Equipment recommendations

- Visible light source, including transmitted light
- Ultra-violet light source
- Magnifier
- Basic reference collection
- Document reader and computer where applicable

Phase-2

Skills and educational requirements

General skills for both identity and security documents, and other, non-security documents

- Awareness of the influence of environmental factors on document characteristics (e.g. sunlight, humidity, etc.);
- Knowledge and ability to properly collect, handle, preserve, package and store materials for submission to further phases (e.g., not writing on an envelope with a document inside);
- Knowledge of the different printing methods and processes (e.g., offset, intaglio, inkjet);
- Knowledge of the physics of light (theory of colour, light and optics);
- Knowledge and ability to use available equipment and reference materials.

Identity and security documents

Level of education recommended

In addition to the requirements listed for phase-1, phase-2 personnel in immigration and border control agencies should also have at least 1 to 2 years of phase-1 officer experience.

Skills (in addition to the above phase-2 skill requirements)

- Knowledge of primary and advanced level security features (covert and overt) in substrates, inks and personalization components (bio-data);
- Knowledge of overall threats and relevant intelligence information;
- Basic knowledge of intelligence concepts and processes;
- Knowledge of innovations in authentic identity and security documents;
- Ability to identify and communicate possible threats and risks to security.

Other, non-security documents

Level of education recommended

A minimum of a bachelor degree with an emphasis on science, i.e., chemistry, forensic science or a related subject, is recommended for entry level of

professional personnel in a laboratory setting. Additional staff with specific education, such as printing technician is recommended. It is recommended that document examination units planning on seeking accreditation in the future should consider any specific requirements of the accrediting body in the initial recruitment of personnel.

Skills (in addition to the above phase-2 skill requirements)

- Knowledge and ability to distinguish physical characteristics of writing inks (e.g. gel pen, ball point, etc.) and substrates (e.g. vellum, glossy and recycled types of papers).

Equipment recommendations

Identity and security documents

- Light sources from basic to multi-spectral imaging
- Flexible intense visible light source (e.g. fibre optics)
- Stereomicroscope
- Decoder and other filters
- Compact camera or scanner and computer
- Comprehensive reference standard collections/databases

Other, non-security documents

- Light sources from basic to multi-spectral imaging
- Stereomicroscope
- Single-lens reflex camera with a set of filters
- Scale and micrometer/measuring devices
- Electrostatic detection device
- Scanner and computer

Phase-3

Skills and educational requirements

General skills for both identity and security documents, and other, non-security documents

- Awareness of phase-4 capabilities and the availability of other relevant, related disciplines;

- Awareness of technological/scientific innovations in the field;
- Knowledge of examination procedures;
- Knowledge of procedures and limitations to examine damaged documents (e.g. charred, moldy, water soaked, and chemically treated);
- Knowledge and ability to comply with evidence handling procedures in accordance with applicable procedures, protocols and accreditation requirements;
- Knowledge and ability to use available instrumentation and equipment;
- Knowledge and ability to distinguish physical and chemical properties of paper and other substrates;
- Knowledge and ability to verify the authenticity of documents based on mechanical impressions (e.g. stamps, seals);
- Knowledge and ability to distinguish writing instruments and writing inks;
- Knowledge and ability to distinguish printing and specialized inks (e.g. fugitive inks and OVIs);
- Knowledge and ability to determine all types of alterations (e.g. obliterations, erasures);
- Knowledge and ability to classify and identify sources of printing processes if possible (e.g. typewriting, toner, inkjet and thermal, etc.);
- Knowledge and ability to classify the style of type and recognize typeface defects present on typewritten information (e.g. non-print areas, alignment and typeface defects).

Identity and security documents

Level of education recommended

In addition to the requirements listed for phase-2, phase-3 personnel in immigration and border control agencies have 5+ years of experience of phase-2 officer experience.

Skills (in addition to the above phase-3 skill requirements)

- Awareness or knowledge of electronic processes/new technologies concerning identity and security documents;
- Knowledge of international accreditation standards for identity and security documents;
- Knowledge and ability to generate high quality information for intelligence applications.

Other non-security documents

Level of education recommended

A minimum of a bachelor degree with an emphasis on science, i.e., chemistry, forensic science or related subject, is recommended for entry level professional personnel in a laboratory setting. Additional staff with specific education, such as printing technicians is recommended. It is recommended that document examination units planning on seeking accreditation in the future should consider any specific requirements of the accrediting body in the initial recruitment of personnel.

Skills (in addition to the above phase-3 skill requirements)

- Knowledge and ability to distinguish between physical and general chemical characteristics of writing/printing inks (e.g. gel pen, ball point, inkjet, etc.) if thin layer chromatography (TLC) is used;
- Knowledge and ability to generate high quality information for investigative applications;
- Knowledge and ability to collect relevant evidence at a crime scene.

Equipment recommendations

Identity and security documents

- Advanced multi-spectral imaging with image capture and superimposition capability
- Stereomicroscope
- Comprehensive reference collections/databases including access to standard reference exemplars
- Single-lens reflex camera with a set of filters
- Scanner and computer

Other documents

- Advanced multi-spectral imaging with image capture and superimposition capability
- Scanner and computer
- Stereomicroscope including transmitted light
- Measuring grids and devices e.g. test grids and calipers
- Basic chromatographic techniques, e.g. thin layer chromatography

- Comparison microscope (where typewriter comparisons are done)
- Where spectroscopic equipment is available, basic analyses can be incorporated into phase-3

Phase-4

Skills and educational requirements

General skills and educational requirements for both identity and security documents, and other non-security educational documents

Level of education recommended

A minimum of a bachelor degree with an emphasis on science, i.e., chemistry, forensic science or a related subject, is recommended for entry level professional personnel in a laboratory setting. Phase-4 personnel would be expected to have a significant amount of experience at the phase-3 level. It is recommended that document examination units planning to seek accreditation in the future should consider any specific requirements of the accrediting body in the initial recruitment of personnel.

Skills

- Knowledge of technological/scientific innovations in the field;
- Knowledge and ability to use available advanced instrumentation and equipment;
- Knowledge and ability to publish relevant articles, etc;
- Ability to develop and design new methodologies/research projects;
- Advanced knowledge to distinguish chemical and physical characteristics of writing/printing inks;
- Knowledge of international accreditation standards for identity and security documents.

Participation in proficiency tests and the establishment of external partnerships are strongly encouraged for phases 2 through 4.

Equipment recommendations

The list of equipment for phase 4 is not exhaustive and will change according to advances in the document examination field. This equipment is in addition to the equipment listed for phase-3.

Chromatographic/spectroscopic techniques including:

- Gas chromatography mass spectroscope (GC-MS)
- High performance liquid chromatograph (HPLC)
- Fourier transform infrared spectroscope (FTIR)
- Raman spectroscope
- X-ray fluorescence spectroscope (XRF)
- Scanning electron microscope energy dispersive x-ray spectroscope (SEM-EDX)

3.2. Skills specifically required for report writing and court testimony

- Knowledge of procedures and protocols related to the judicial process;
- Knowledge of adjudication systems;
- Knowledge and ability to objectively explain and demonstrate (e.g. charts) assessments and findings in a clear and logical way (understandable for non-scientific people);
- Ability to provide assistance and educate legal counsel concerning the field of questioned documents;
- Ability to communicate in an effective and concise way;
- Ability to explain training and experience acquired in the field of expertise;
- Ability to detail questioned document methodology, standards, and all facets of the examination process;
- Ability to prepare and use available software for sophisticated demonstrative exhibits.

3.3. Skills and education specifically required for forensic document examination training

Education/training requirements

At least 5 years of full-time post-training experience as a forensic document examiner and successful completion of a course or seminar in instructor development

Skills

- Ability to effectively communicate basic and more advanced concepts of document examination;
- Ability to develop and provide an examiner training syllabus, training materials, books and references for instruction, practical problems, and supervise work on actual cases;
- Ability to demonstrate and communicate questioned document concepts in a detailed manner.

3.4. Skills specifically required for handwriting and signature examinations³

(Phase-3 or Phase-4)

- Awareness of the various factors that can interfere with handwriting (e.g., position of the writer, physical condition, influence of alcohol, writing surface and writing instruments);
- Knowledge and ability to distinguish forgery methods in handwriting;
- Ability to collect known/reference handwriting exemplars suitable for comparison;
- Ability to observe handwriting detail⁴ (pattern recognition);
- Ability to analyse, compare, and evaluate handwriting characteristics of letters/words;
- Ability to compare individual characteristics in questioned handwriting with known handwriting specimens and properly evaluate concordances and discordances.

³Phase 3 equipment is sufficient for handwriting and signature examinations

⁴The term “handwriting details” is used instead of the term “graphological details” in order to avoid any confusion between graphology and forensic document examination.

4. General guidance when designing, establishing and maintaining a forensic document examination facility and the role of management

This section outlines various aspects related to designing a new document examination facility as well as maintaining a pre-existing space.

4.1. Building a forensic document examination facility

Planning

Before new construction begins or when a laboratory facility is reconfigured, a needs assessment is to be used to create a successful plan. An assessment documents user requirements, evaluates the existing facility, defines spatial and technical needs and provides project cost data.⁵ The assessment is translated and expanded into a form that will be used by architects and engineers in the design process.

Design

There is no single universally correct plan for the design of a forensic document examination facility. Forensic document examination facilities have functional requirements and certain equipment or reference standard collections that can dictate space requirements. Instrumentation such as a multi-spectral imaging system or an electrostatic detection device need sizable rooms. An electrostatic detection device also requires a humidifier and fume hood. Many document laboratories house most of their scientific equipment in one large room that can be accessed by all document examiners. Large workstations should be considered in order to accommodate cases

⁵UNODC (2010), “Forensic Infrastructure and Services”, Criminal Justice Assessment Toolkit.

involving a large number of documents. Extensive standard reference collections require adequate space and storage and must also be configured to make samples easily accessible to examiners or intelligence officers. The handling of hazardous materials and preservation of evidence are just two of the many additional variables that need to be considered. A forensic document examination facility must be designed with the flexibility to change along with the needs of its occupants, technology or scientific methodologies.

Construction

Construction of a new laboratory facility and/or forensic document examination facility can only begin following acceptance of bids and contract negotiation. Changes at this stage may prove costly and have financial consequences. Unforeseen issues can affect construction and must be dealt with in a speedy manner. Fixtures, furnishings, and equipment will also need to be budgeted for and purchased. An evaluation process and criteria must be established to ensure that the contractors are qualified to complete the job as specified.

General guidance for building a forensic document examination facility

- Basic components to be considered include appropriate electrical supply, water source, lighting (including a dark room area), temperature control, humidity control, access control and fire suppression capability.
- Individual work stations for phase-2 and phase-3 examinations should have enough table space to accommodate a number of exhibits, non-porous working surfaces and floors to minimize contamination, ergonomic positioning for the examiner and the strength to support any existing equipment.
- If additional equipment is required, special attention should be given to purchasing (including competitive bidding and tender procedures), after-sales services, service contracts, warranty requirements, compatibility with existing equipment, trained personnel and/or training facilities, and the availability of operating and maintenance manuals in local languages.
- It is critical to ensure the availability of ongoing financial allocations sufficient for repair and maintenance of equipment and purchase of consumables. As an estimate, laboratory instrumentation should be considered on a ten-year replacement cycle. Therefore, the annual budget should include approximately 10 per cent of the start-up costs each year in order to attain the replacement funds at the end of the suggested 10-year cycle, with rollover of unspent, accrued funds into each following financial year.

- Standard reference collections, case files and evidence require secure storage and access control. These three must be kept separately and enough space should be allocated to allow for expansion. In addition, reference standards, files and computer data should also be backed up off-site.

4.2. Management's role

Once a forensic document laboratory is physically established, senior management is responsible for promoting professionalism through the assessment of individual ability and overall work quality in the field of document examination. Quality assurance and proficiency testing measures should be in place to provide objective standards by which the quality of work produced can be judged. Document laboratories should also periodically review policies and procedures and make adjustments as necessary. These and other best practices, when effectively implemented, form the basis of sound forensic science services even without formal recognition through accreditation. Thus they should be implemented and followed both where accreditation is not being sought and where accreditation is planned for.

One way of promoting professionalism in the forensic document laboratory is by attending meetings and participating in special working groups. These societies prove their worth to forensic science, benefiting both the employee and employer, through basic training as well as continuing educational opportunities. Personal contacts with security document manufacturers, personalization offices and other agencies and laboratories with similar interests are also beneficial for professional growth. Research opportunities should be encouraged to support data in the field. Proper methodology and statistical information bolsters the science and adds to the empirical data in the field.

Professional ethics provide the basis for the examination of evidence and reporting of analytical results by blending scientific principles and statutory requirements with guidelines for professional behaviour. Managers must strive to ensure that forensic science is conducted in accordance with sound scientific principles and within the framework of the statutory requirements of forensic professionals.

General guidance about management issues

- Managers must be knowledgeable of administrative and legislative policies as well as basic document examination procedures and processes;
- Managers should encourage the recruitment and retention of trained and qualified staff;
- Managers must provide appropriate supervision, mentoring, on-the-job training and refresher training to maintain best practices in all phases;

- Managers should provide briefings on current threats especially to phase-1 personnel;
- Managers should encourage phase-3 and phase-4 personnel to network and share information with their peers as well as to join and participate in professional organizations;
- Managers must promote the implementation of quality assurance measures. Even where laboratories are not planning to apply for accreditation in the short term, quality assurance measures are an integral part of the work and should be encouraged at every phase;
- Management should require that standard operating procedures for examinations and maintenance of the chain of custody be written down. Mechanisms should be in place to ensure that these practices and procedures are being followed. Also, strategies should be in place for addressing and correcting any detected issues;
- Managers should emphasize the importance of competency/proficiency testing, particularly for phases 2 through 4. If standardized tests cannot be obtained, in-house testing should be implemented, such as the examination of a single, challenging case to be worked on by all examiners;

4.3. Developing reference collections

It is a challenge for any document examination facility to collect and store authentic up-to-date identity and other security documents. Every attempt should be made to have access to: (i) original, hard copies of reference standards for comparison purposes, and (ii) an up-to-date inventory of reference standards available in-house and from external sources.

General guidance for developing reference collections

- Start collecting identity and security documents at national level and in contiguous neighboring countries using diplomatic channels. It is important to get issued documents (not blank), different exemplars of the same document, different versions of the same document as well as documents required for the issuance of identity and security documents (e.g., birth certificates).
- The reference collection room should include a space for document examination and review. It is recommended to have basic equipment (e.g., stereomicroscope, multi-spectral imaging system) in the reference collection room to avoid having to remove the specimens.

- Databases containing information about document characteristics exist and should be considered in addition to in-house reference collections. Some examples are the Edison travel document system and Keesing reference system.⁶

Reference collections can be completed with forged/altered documents from casework (generally needs court's permission).

It is important that every country designs, establishes and maintains a document examination facility that works well within the country's overall infrastructure. Forensic document examination laboratories should have defined duties to avoid duplicating efforts of the national laboratory. The best forensic laboratories are designed in a way that allows for flexibility to adapt to changing law enforcement directions and technological developments, and a forensic document examination facility is no different.

⁶ Additional information is provided in annex 4

ANNEX 1 Techniques used in document examination

This Annex provides descriptions of techniques used for document examinations⁷ for phase-1 through phase-3. Only short explanations are provided for techniques used in phase-4. More detailed documents available from UNODC and other resources (annex 4 provides regional professional bodies and recommended books) should be studied and consulted for additional information.

Portions were extracted from the UNODC Manual “Staff skill requirements and equipment recommendations for forensic science laboratories”.

Techniques used from Phase-1 through Phase-3

Multi-spectral imaging techniques

Multi-spectral imaging techniques use a combination of a camera, specialized light sources and filters that cover the visible, ultraviolet and near-infrared range of the electromagnetic spectrum.

The ability to observe and capture document features non-destructively makes this system beneficial for document examinations. Oblique lighting may be used to detect indented impressions and mechanical erasures or distinguish printing processes. Examination in near infrared (NIR) allows for differentiation of inks and, thus, for recognition of alterations (e.g. wet stamps, signatures, etc.) as well as chemical erasures. Security features can be analysed using transmitted, UV, visible, or infrared light both with and without magnification. Advanced security features such as holographic overlays, optical variable inks and security fibres embedded in the paper may be detected using magnification and a combination of specific light sources and filters.

⁷It focuses on document examinations and not on other forensic applications.

Image enhancement software enables the examiner to digitally record images of the document being examined and also allows the user to rotate, flip and render negative the pictures for easier viewing. The examiner is also capable of maneuvering the stored digital images, enabling distinct images to be superimposed or compared side by side. Related skills which would benefit the user of this equipment include understanding the theory of light and its interaction with matter, e.g., absorption and luminescence phenomena when observing ink and paper characteristics. Multi-spectral imaging systems can be purchased as an “all-in-one” system or the components, including light sources, magnifiers, camera, lenses, filters, computer and image enhancement software, can be purchased separately.

Electrostatic detection systems

Electrostatic detection systems are used to visualize indented impressions on paper or other substrates. Indentations occur when a writing instrument, typewriter, or impact printer transfers impressions from the surface of the paper to the substrate below. Information contained in indented impressions can provide information valuable to investigations or intelligence. On occasion, handwriting examinations of recovered handwriting impressions may be performed.

The electrostatic detection systems use a humidifier, toner, plastic film and archival sheets to capture results. It is beneficial to have an awareness of humidity conditions (optimal and destructive) and the need for adequate ventilation or the use of a fume hood if prolonged operation is envisaged.

Photography

An important aspect of document examinations is the need to carefully document all items received for examination and all relevant observations that are made. Photographs help capture details to support and demonstrate the handwriting, printing and security characteristics observed. They are also useful in reports and as demonstrative evidence in court. Microphotography, the combination of photography with microscopy, can be used to capture small details of a document including characteristics of security features, paper and printing processes. Moreover, photographs can be used in intelligence information to demonstrate characteristics referred to. Related skills which would benefit the user of this equipment include knowledge of light and photographic theory as well as the knowledge and ability to use the equipment and accessories available.

Stereomicroscopy

Stereomicroscopy provides magnifying powers lower than standard microscopes and presents the advantage of offering a 3D image of an object. When used in combination with various lighting options, fine details on a document can be observed (e.g. micro-

printing, security fibres, printing anomalies). Other characteristics that can be examined include printing processes, inks, watermarks, paper, handwriting and security features. A camera may also be mounted on a stereomicroscope to help document and capture images. Additional accessories for the stereomicroscope include illumination options such as UV, fibre optics and replacement lamps. Document supports and optical micrometers to conduct measurements are also beneficial.

Comparison microscopy

Comparison microscopy involves the use of two compound microscopes that provide a split screen (with a variable demarcation line) to view images side-by-side, with the possibility of superimposing the two images. The comparison microscope is useful when examining typewritten documents (e.g. defects and non-printed areas), superimposing images such as watermarks and security features and for general document examinations that would benefit from a detailed side-by-side microscopic examination.

Thin-layer chromatography

Thin-layer chromatography (TLC) is one of the simplest and oldest forms of chromatography that uses a solid stationary phase and a liquid mobile phase. It is employed to compare questioned inks against known ink standards found in writing instruments and to determine if the same inks were possibly used in preparation of two or more documents. While it lacks the sensitivity and resolving power of more sophisticated analytical separation techniques, it is beneficial because of its ease of use, low cost (minimal materials required) and portability.

Related skills which would benefit the user of this equipment include a theoretical understanding of the knowledge and principles of TLC and separation methods, a practical ability to use TLC equipment and associated operating procedures and extensive experience with preparative techniques.

Techniques used in Phase-4

High performance liquid chromatography (HPLC)

Also known as high pressure liquid chromatography, HPLC is a separation technique used frequently to separate, identify and quantify compounds based on their idiosyncratic polarities and interactions with the column's stationary phase. Common HPLC applications in document examination include the analysis of dyes in writing inks and inkjet inks.

Gas chromatography mass spectrometry (GC-MS)

GC-MS is a separation technique using a solid stationary phase (the so-called column) and a gas mobile phase. Preparation of the sample to be examined can be performed by extraction, thermal desorption or pyrolysis. Components of the samples (ink, paper, toner) are separated in the column. Different detectors are available to be coupled onto the GC system. One of the most efficient and commonly used detectors is the mass spectrometer (MS), allowing reliable identification and quantification of components. This equipment is used to examine photocopy toners and inkjet inks.

Fourier transform infrared spectroscopy (FTIR)

When IR radiation of the proper energy strikes a molecule, absorption will occur and chemical bonds within the molecule will start to vibrate. Each different bond within a molecule will have its own characteristic vibration frequency, and an arrangement of bonded atoms can undergo a number of different kinds of vibrations (e.g. symmetrical and asymmetrical stretching, scissoring, rocking, wagging and twisting). The energy source to provoke these vibrations is the irradiated IR-beam. The absorption of characteristic wavelengths is measured. This is a powerful technique for the comparison and identification of toners.

Raman spectroscopy

This is a vibration technique that is complementary to IR analysis. While results also depend on the vibrations that bonds undergo within a molecule, it is scattered radiation rather than absorbed radiation that is studied. Document examination applications include the comparison and identification of writing inks and inkjet inks. It is also a good complementary technique to FTIR and XRF for comparing and identifying toners.

X-ray fluorescence spectroscopy (XRF)

XRF involves the detection of the characteristic X-rays that are emitted by a sample following X-ray excitation. XRF analysis provides both qualitative (i.e. what elements are present in a sample) and quantitative information (i.e. relative concentrations of each element), as the intensity of each characteristic emission is directly related to the amount of each element in the material. Analyses are non-destructive, and limits of detection down to ppm levels can generally be achieved for most elements. XRF is useful in the forensic examination of paper. It is also a good complementary technique to FTIR and Raman for comparing and identifying toners.

Scanning electron microscope energy dispersive x-ray spectroscopy (SEM-EDX)

SEM-EDX is used to obtain the elemental profile of a sample by the detection of characteristic X-rays that are emitted by a sample following excitation by a high-energy electron beam. SEM-EDX tends to be more effective for lighter elements, while XRF shows better sensitivity for heavier elements. SEM-EDX is used for the forensic examination of paper and pencil marks. SEM (without the need of EDX) can be used where magnification of optical microscopy is at its limit. The main application in document investigation is the sequencing of intersecting lines.

ANNEX 2 Equipment providers

The following section lists (in alphabetical order) a few equipment providers that the Expert Group Meeting recognized as having name recognition in the field of forensic document examination. The list is in no way comprehensive and does not imply an endorsement by UNODC or expert group members. The web addresses listed are correct at the time of printing.

Attestor Forensics: a supplier of equipment, tools and instrumentation for forensic science applications.

www.attestor-forensics.com/English/index.html

Aven: a supplier of tools and optical inspection systems for industrial, scientific and research applications.

www.aventools.com

ChemImage: a supplier of hyperspectral imaging products, chemical imaging technologies, interpretive software solutions and advanced laboratory services.

www.chemimage.com

Carl Zeiss: a supplier of a range of products from microscopes to cameras for industry, science and education.

www.zeiss.com

Foster and Freeman: a supplier of forensic science equipment including multi-spectral imaging systems and electrostatic detection devices.

www.fosterfreeman.com

JVC: a supplier of a complete line of cameras, monitors and video equipment, and a host of other products.

www.jvc.com

Leica: a supplier of microscopes and imaging equipment for medical, scientific and industrial use.

www.leica-microsystems.com

Pikaso Software, Inc.: a supplier of custom software development services specializing in the development of engineering, mathematical modelling and forensic investigative software.

www.pikaso.com

Projectina Ltd.: a supplier of optical as well as optic and electronic components and systems in the field of computation, development and manufacture.

www.projectina.ch/welcome_e.htm

Regula Ltd.: a supplier of special equipment and solutions to immigration authorities and airlines for travel documents control, immigration and border control agencies for questioned document examination, and banks and private companies for document and currency verification.

www.security-int.com/companies/regula-ltd.asp

Zarbeco LLC: a supplier of digital microscopes and imaging software for education, industry and science.

www.zarbeco.com/index.shtml

ANNEX 3 Training course outlines

The following are outlines of training courses for the four phases and the different types of fraudulent documents. They cover the recommended initial, theoretical portion of the course. The recommended minimum duration does not include time spent on on-the-job training, mentoring and casework experience. This theoretical training is only a small part of the total qualification requirement for a document examiner. On-the-job training, experience and mentoring are vital components that also require a significantly longer time period. The level of theoretical and technical detail to be included under each of the topics listed will depend on the previous level of knowledge of the target audience and the specific scope of services they will be expected to provide.

Definitions⁸

Education

Study based on learning in a school-type environment. Education includes the reading and study of relevant articles, journals, textbooks and testing of key concepts and principles.

⁸United Nations Office on Drugs and Crime, *Staff skill requirements and equipment recommendations for forensic science laboratories*, ST/NAR/1/Rev.1, 2010

Training

Training builds on education and provides specific knowledge and abilities directly associated with document examination. Training should take place before or at the very beginning of employment.

On-the-job training

On the job training builds on education and training and provides the specific skills, knowledge and experience acquired by participation in events or in a particular activity. It is training received on-site under the guidance of a more experienced individual such as a mentor.

Mentoring

A person charged with the instruction and guidance of another, less experienced individual. Mentoring is a key factor in becoming properly trained in document examination.

Experience

Practical knowledge, skills and abilities derived from direct observation of or participation in a particular activity. Experience in document examination comes from working on practical cases and solving problems.

Identity and security documents

Training concerning identity and security document should focus on characteristics and features of genuine documents. There are innumerable ways of counterfeiting and forging documents but only a limited and well defined set of genuine document features. The content of the courses below follows the European Union recommended approach.

Phase-1

Target group: front-line immigration officers; front line border control officers; police officers and other administrative staff who deal with the control of identity and security documents (e.g. airport or land/border/port-of-entry facilities; identity and security document issuing offices). Document examinations comprise only part of the duties of these posts/positions.

Recommended minimum duration: 5 days.

Recommended curriculum to include an overview of:

- Security documents (what they are, why they are used) and international standards (ICAO)
- Substrates
- Printing techniques
- Primary security features
- Assembly/production methods
- Personalization techniques/bio-data
- Document holder assessment
- Basic equipment and reference materials
- Overview of e-documents, biometric systems, document reading equipment
- Fraudulent documents (definitions and types)
- Document examination process and practical exercises

Phase-2

Target group: Secondary, back-office immigration personnel; supervisors of other phase-1 staff. Document examination comprises only part of the duties of these posts/positions.

Recommended minimum duration: 10 days (includes recapitulation of phase-1 information).

Recommended curriculum to include an overview of:

- Security documents (what they are, why they are used) and international standards (ICAO)
- Substrates
- Theory of colour and physics of light
- Substrates
- Printing techniques
- Primary and advanced security features
- Assembly/production methods
- Personalization techniques/bio-data
- E-documents, biometric systems, document reading equipment
- Overview of optically variable devices and diffractive optically variable devices
- Field trips to printing houses/paper mills, etc as possible

- Compact equipment and reference materials
- Digital image manipulation
- Photography
- Fraudulent documents (definitions and types)
- Document examination process and practical exercises
- Basic introduction to intelligence processes
- Report writing and testimony where included in responsibilities

Phase-3

Target group: full-time document examiners and third line, specialist level immigration and border control officers.

Recommended minimum duration: 10 days (includes recapitulation of phase-2 information).

Recommended curriculum to include an in-depth presentation of:

- Security documents (what they are, why they are used) and international standards (ICAO)
- Substrates
- Theory of colour and physics of light
- Substrates
- Printing techniques
- Inks
- Overlays
- Optically variable devices and diffractive optically variable devices
- Primary and advanced security features
- Personalization techniques/bio-data
- e-documents, biometric systems, document reading equipment
- Laboratorial techniques regarding document production
- Laboratory equipment and reference materials
- Field trips to printing houses/paper mills, etc. as possible
- Guest lecturers from industry specialists as available
- Digital image manipulation
- Photography
- Commercial and security software

- Training and presentation skills
- Report writing and testimony

Other non-security documents

Phase-2

Target group: basic level laboratory forensic document examiners.

Recommended minimum duration: 10 days minimum recommended.

Recommended curriculum to include an overview and introduction to:

- Security documents (same as phase-1 in the identity and security documents)
- Theory of colour and physics of light
- Characteristics of non-secure paper (substrates) and inks
- Physical non-destructive examination of paper and other substrates
- Physical characteristics of substrates, inks and printing processes
- Introduction to printing defects
- Limitations of document examinations and identifications (class and individual characteristics)
- Use of laboratory equipment and reference materials
- Photography

Phase-3

Target group: advanced level laboratory forensic document examiners.

Recommended minimum duration: 15 days minimum recommended (includes recap of phase-2 info).

Recommended curriculum to include an overview and introduction to:

- Security documents (same as phase-2 in the security and identity documents)
- Theory of colour and physics of light
- Characteristics of substrates, inks and printing processes

- Physical characterization of substrates, inks and printing processes
- Basic chemical characterization of inks
- Distinguishing the source of printed documents (as possible within printing processes, including typewriters)
- Limitations of document examinations and identifications (class and individual characteristics)
- Photography
- Use of laboratory equipment and reference materials
- Field trips to printing houses/paper mills, etc. as possible
- Training and presentation skills
- Report writing and testimony

Phase-4

This Guide does not elaborate on phase-4 training as it will depend on which instrumentation is involved. Laboratories at this phase of capacity typically determine required training courses for their personnel independently. However, a training outline is provided for other disciplines such as the handwriting and signature examination at phase-4.

Target group: advanced level laboratory forensic document examiners.

Recommended minimum duration: 15 days minimum recommended.

Recommended curriculum to include:

- History of handwriting including development of handwriting and landmark cases
- Interior and exterior influences on handwriting
- What is needed for a meaningful examination
- What can and cannot be determined from handwriting
- Basis for identification, elimination or qualified opinions
- Characteristics considered by a handwriting examiner
- Exemplars/known writing
- Distortion and disguise
- Obliterated writing and alterations
- Conclusions and qualified opinions

ANNEX 4 Book, reference material and database recommendations

The following periodicals, books and articles are recommendations for a forensic document examination library. This list is not exhaustive and it is recognized that handwriting references will be language-specific and too numerous to list. It is not the intention of this Guide to insist that all forensic document facilities acquire every book or article included below. Equally importantly, it should be emphasized that no amount of self-study can replace adequate education, training and on-the-job experience.

UNODC

- United Nations Office on Drugs and Crime, *Staff skill requirements and equipment recommendations for forensic science laboratories*, ST/NAR/1/ Rev.1, 2010

REGIONAL PROFESSIONAL BODIES (list not exhaustive)

- American Society of Questioned Documents Examiners. www.asqde.org
- American Society for Testing and Materials Standards. www.astm.org
- Australasian Society of Forensic Document Examiners (ASFDE). www.asfdeinc.org
- European Documents Experts Working Group of the European Network of Forensic Science Institutes (ENFSI/EDEWG). www.enfsi.eu
- Scientific Working Group for Forensic Document Examination (SWG-DOC), including representatives of U.S law enforcement agencies
- Special Advisory Group on Document Examination of the Senior Managers of Australian and New Zealand Forensic Laboratories (SMANZFL). www.nifs.com.au/SMANZFL/SMANZFL.html?index.asp&1

PERIODICALS

- *Australian Journal of Forensic Sciences* (Australian Academy of Forensic Sciences), Biannual, ISSN: 0045-0618
- *Canadian Society of Forensic Science Journal* (Canadian Society of Forensic Science, Ottawa), Quarterly, ISSN: 0008-5030
- *Forensic Science International* (Limerick, Ireland), Monthly, ISSN: 0379-0738

- *Forensic Science Communications* (FBI Laboratory), Quarterly, ISSN 1528-8005, Free on internet at the time of printing: www.fbi.gov/hq/lab/fsc/current/descript.htm
- *Journal of Forensic Identification* (International Association for Identification) Bi-monthly, ISSN: 0895-173X
- *Journal of Forensic Sciences* (American Academy of Forensic Science, Philadelphia, USA), Quarterly, ISSN: 0025-1198
- *Journal of Police Science and Administration* (Gaithersburg, MD, USA), Quarterly, ISSN: 0090-9084
- *Journal of the American Society of Questioned Document Examiners*
- *Medicine, Science and the Law* (British Academy of Forensic Sciences), Quarterly, ISSN: 0025-8024
- *Police Science Abstracts* (Amstelveen, Netherlands), Bimonthly, ISSN: 0166-6282
- *FORSight: The Forensic Abstracts Journal* (Forensic Science Service), Monthly, ISSN 1476-0231
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- Seydn, M.J. *Introduction à l'examen objectif des écritures manuscrites*, Fovéa, Meyreuil, 1999

Printing processes

- Anderson, D. *Experience Printmaking*, Worcester, MA, Davis Publications, 2009. ISBN 9780871929822
- Bann, D. *The all new Print Production handbook*, Rotovision, SA, Route Suisse 9, CH-1295, Mies, Switzerland. ISBN 978-2-940361-38-0
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DATABASES

- Informationssystem Urkunden (Document Information System) German database administered by Federal Police of Germany.
- False and Authentic Documents Online (FADO): a classified restricted access system for the exchange of information between EU document experts on travel and identity documents.
- Public Register of Travel and Identify Documents Online (PRADO): contains information on security features of authentic identity and travel documents. The information is selected and provided by the Member States

of the European Union, Iceland, and Norway. It is selected by European document experts and taken from FADO, a classified, restricted system.

- Edison Travel Documents: this computerized system stores a vast collection of sample travel documents and residence permits. Edison is owned and developed by the Dutch National Police Services Agency (KLPD) National Criminal Intelligence Department, and is organized with international cooperation.
- Keesing reference system: a specialist provider of verification tools and solutions that allows international organizations to authenticate identity documents and banknotes. Products cover a variety of inspection and verification tools, reference manuals, and reference databases. Keesing's Glossary of Document Security: ISBN 99059130456.



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