



Forensic examination of passport of republic of Ghana and its methods of forgery

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Abstract

Passport is an official document which proves the identity of the bearer and provides freedom of movement especially during intentional travels. Passports have been contentious and highly sought-after items over the years, as they are considered as the one of the most important forms of identification. This also explains why it is always a target for unscrupulous criminals and the dark web black market. The passport of Ghana is protected by a myriad of security features ranging from substrate protection, ink protection, protection by methods and types of printing etc. Although these security features do not entirely insulate passports from forgery, they do however ensure a considerable level of security from fraudsters who have access to advanced printers and technologies.

Keywords: Security features, protection of passport, counterfeit, passport forgery, forensic document examination.

Introduction

Documents are an integral part of people's lives and a means of recording any significant fact and event. Their relevance cannot be underestimated as they have long played an irreplaceable role in all spheres of society. Documents including passports have a number of specific properties - security features that are designed to prevent their unauthorized production. Passports contain a myriad of security features which are meant to limit opportunities for their fraud. Multiple security features are key to keep up with the capabilities and intent of fraudsters. Even sophisticated criminals will have difficulty duplicating documents prepared of several security features.

The protection of passports is laid in the process of their production; starting from the stage of development of the original layout, the choice of the manufacturing process, printing materials, type and method of printing, etc. To increase the security of passports against counterfeiting, additional security features can be introduced to the general technology during the manufacturing stage¹. The protection of passports can be grouped as: the protection of paper substrate, ink protection, protection by type and method of printing, image protection and special methods of protection^{2,3}.

Protection of paper substrate: The mechanical strength of the substrate of passports is of utmost important. It must have high tensile strength and abrasion resistance. It should be as thin as possible, but elastic and opaque. Additionally, the paper should neither fade nor change its colour over time and be resistant to aggressive environments⁴. In the production of paper for passports, optical brighteners are not used, therefore, under ultraviolet light, the paper should remain dark. However, the

glow of the paper under UV light does not mean that it is fake as it can be caused by accidental contact with optical brighteners, such as washing powder. In some cases, phosphors can be intentionally added to the paper as an additional security element, with a luminescence other than blue⁵. Security fibres of passports which appear randomly across the paper are added to the structure of the paper during their manufacturing and may contain both visible and invisible fibres to defeat counterfeiters and make passports more secured. Security fibres of passports have different colours, length and thickness and are introduced in different concentrations. Watermark, an identifying internal image made during the papermaking processes. It is carefully embossed in certain area(s) of passports causing such areas to appear to have a higher density of the paper pulp in relation to the total weight of the paper⁶. The thickness of the paper where the watermarks are located, as a rule, does not change.

Protection by inks: One of the important properties of printing inks is their colours. For the printing of passports and banknotes, special mixed inks of pastel colours meant to complicate the process of colour separation of images are used. Standard inks however, have high brightness, colour saturation and contrast. Images printed using these inks can be easily decomposed into components⁷. Magnetic inks are the magnetic properties which are provided by ferromagnetic additives. It is no less common protective element in passports and can be detected by special magnetic sensors or visualized by magneto-optical converters. Metameric ink, a diffractive optically variable image which contains elements that change their colour when rotating the image by 90° (the angle of observation is not changed). Metallic ink contains a fine-dispersed metal powder with a specific metallic gloss.

It leads to gloss intensity changes when changing the angle of observation with no significant changes in colour⁸.

Protection by type and method of printing: At least two different types of printings are used for passports. The more the types and methods of printings, the more they are protected from counterfeiting. Typically, these printing types are relief (letterpress), planography (offset lithography) and gravure printing (etching)⁹. Iris and Orlov prints are also widely patronized especially for the background designs. Screen printing, until recently, was not used as one of the protective elements of passports¹⁰.

Image protection: The graphic elements of passports are many and varied. The main ones are Guilloche elements, vignettes, rosettes, borders, etc., consisting of regularly or repeating intersecting wavy and other lines. Guilloche elements are made mechanically on a guilloche machine or using special software. Micro images as a rule, are repeating words or texts, with letters of heights up to 300 microns¹¹. Latent image KIPP is a security element, which is considered irreproducible and is visible only at an acute angle to light. When the document is rotated by 90° without changing the angle of observation, the latent image KIPP becomes either light, or dark compared to the background colour. Moire variable color (mvc) are said to be images formed by parallel lines (applied by blind embossing) which are located at an acute angle to multicolour parallel lines of the background pattern (applied by offset printing). When the document is rotated clockwise without changing the angle of observation, the moiré patterns appear and disappear from time to time¹².

Special methods of protection: Basically, these are various types of embossing: offset lithography or relief stamp. Offset lithographic stamping can be colourless (or blind) and colourful¹³. For colourful embossing, sheet or roll coloured or holographic foil, including translucent, is used. Embossing with a relief stamp is made possible using a counter stamp (relief stamping) and may also be colourless and colourful. Lamination of the pages and drawing on the laminate of passports are accomplished with transparent protective film that is hot-applied or glued onto the paper. Laminate protects the document from data changes. A pattern or image may be applied to the surface of the laminate facing the sheet of paper to be laminated. Drawings on the laminate are hardly distinguishable under normal lighting and, in this case, are visible only in oblique light or when exposed to UV rays¹⁴.

Types, methods and signs of imitation of security features: Criminals around the world hide behind fake documents of national identities including passports to conceal their real identities and to avoid detection and subsequent prosecution by law enforcement agencies. All Africa reports in an April 2013 article that, according to the Ghana Immigration Service (GIS), forging of documents is widespread in Ghana¹⁵. The acquisition of fake passports is made possible by various methods. For instance, complete falsification documents which implies total

imitation of security elements and technological processes. To achieve that, various technologies are used, depending on the financial capabilities, as well as the degree of awareness of the criminals about the elements of protection. Again, as practice shows, criminals also make partial changes to passports where changes are made to certain selected security features¹⁶.

Imitation of security elements of paper substrate: The surface of the paper is treated with various compounds so as to avoid the bright blue glow when exposed to ultraviolet radiation¹⁷. Imitation of protective fibers-are made possible by drawing, most often in places free from other images¹⁸. Such drawings are done with felt-tip pens, ballpoint or gel pens, etc. Simulation of watermarks is achieved by applying dye to the surface of the paper, drawing images on the inner surface of the glued layers of paper etc. Imitation of metallized ink is made possible by gluing or embossing metal foil on the substrate¹⁹. On the other hand, imitation of security elements of images are done using computer technologies and manual drawing which inevitably leads distortion of images.

The problem of securing security printing products is very urgent in Ghana because they often act as carriers of material traces of a crime, physical evidence, and serve as sources of information about the identity of criminals and therefore can be used as tools for solving crimes, searching for and exposing criminals. The effectiveness of the investigation of crimes of counterfeiting of protected printing products is greatly influenced by the availability of an appropriate scientific and methodological base necessary for a comprehensive and objective study by a forensic expert. For the above reasons, the forensic document examiner must clearly understand the manufacturing technology, means of protection of such documents, possible methods of forgery, their signs, various materials and equipment used.

Methodology

The method of determining the genuity or otherwise of security elements is dependent on the type and category of the security elements and the availability of requisite technology and instrumentations.

Watermarks are examined in transmitted light. The presence, location, compliance with the pattern, size of the watermarks are also studied in reflected light by changing the angle of its incidence. Imitations are made possible by drawing and through colourless embossing. Security threads can be studied in reflected and transmitted light, but more appropriately in visual spectral comparator (VSC). The study of background patterns, micro text and types of printings are carried out with help of stereo microscope of magnifying glass of magnification up to 10x. Furthermore, latent images (kipp effect) and OVI - effect (variable optical effect) are examined in oblique light with a change in the angle of illumination and orientation in relation to the light source.

Results and discussion

Security fibres: It was discovered during the forensic examination that, invisible fibres were incorporated into the special paper substrate to create additional hurdles in producing a counterfeit version of passport of Ghana (Figure-1).

Local tone watermarks: Laser watermarks of the Supreme Court building of Ghana are embedded in the middle portion of the passport. These laser watermarks are clearly visible when backlit but are not obvious when viewed in normal conditions (Figure-2).



Figure-1: Showing security fibres under UV light.



Figure-2: Watermark (Supreme Court) in the paper substrate of passport of Republic of Ghana.

Paint protection: These are following types.

Fluorescent inks: Under the influence of UV rays ($\lambda = 365-450$ nm), an image of Parliament house of Ghana and stylized “Adinkra” symbol which are invisible to the human eye without special lighting were seen. Set of Latin letters denoting the serial number of the passport is also seen to have been made by fluorescent inks with the help of visual spectral comparator (Figure: 3a -b).

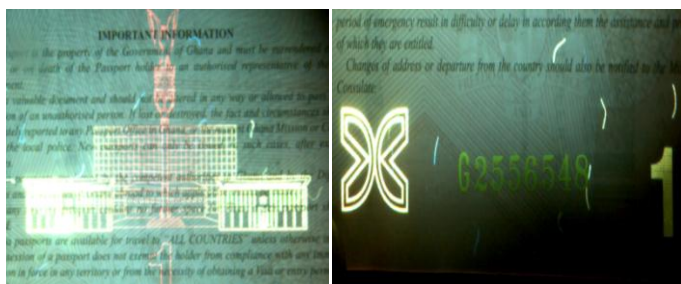
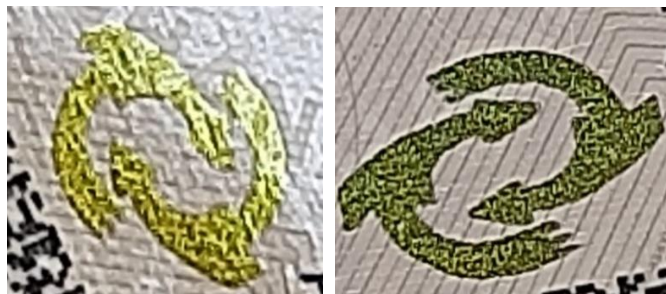


Figure-3(a, b): Embedded images of the Parliament house - Ghana and the beautiful “Adinkra” symbol under UV light.

Metameric ink pair: Special security inks (usually a pair of inks) which look similar in one type of illumination (e.g. in visible light) but show a noticeable difference in another type of illumination was observed during the examination of the passport (Figure- 4a-c).



(a) (b) (c)

Figure-4(a,b,c): A colour change observed while rotating the image without changing the angle of observation.

Protection by type and method of printing: Protection by type and printing methods are as follows

Letterpress printing: This method is used to print all serial numbers of the passport, as shown in the figure (Figure-5).

Planography printing - This method of printing was employed for the phrase "Republic of Ghana" on page 2 and some of the background images in the substrate of passport (Figure-6).

Intaglio printing – The black Star, an image of national pride as seen from the front and back endpapers of the passports of the Republic of Ghana, are made with the help of intaglio engraving. This produces a unique, textured feel that is difficult to replicate (Figure-7).



Figure-5: Zoomed fragment relief printing.



Figure-6: Offset printing.

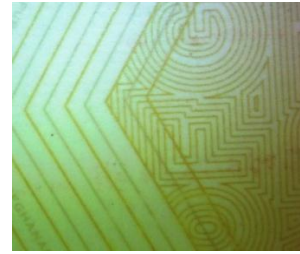


Figure-8: Background design pattern (Iris printing).

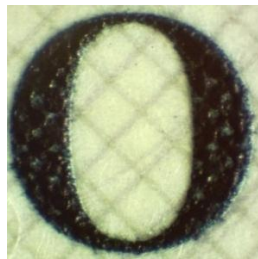


Figure-7: Zoomed fragment Intaglio printing.

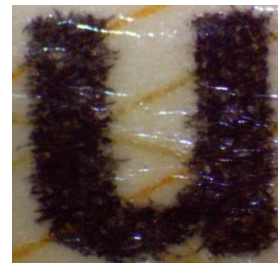


Figure-9: Inkjet printing on the bio-data page.

Iris printing- The examination of the studied object revealed that, Iris printing was used to make the background images and some ornamental elements to make the passport more secured and copying even more difficult, as well as improving its artistic appearance (Figure-8).

Inkjet Printing - This method of printing was adopted for the completion of the personal data in the data page of the passport (Figure-9).

Holder's portrait - The owner's portrait was printed by laser printer on photo paper to prevent counterfeiting (Figure-11).

Secondary Owner Image - A duplicate portrait of the owner is reproduced once, in the document. In contrast, the size is reduced and it is applied using the same printing technique as the portrait of the bearer (Figure-12).

Security nets - Regular and irregular background pattern of green and grey colours are carefully coordinated, complement each other and are applied by means of offset printing (Figure-13a - d).



Figure-10: Biodata page of the passport of Ghana issued in 2018.

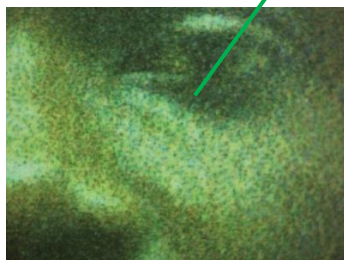


Figure-11: Holder's portrait. Laser-engraved portrait.

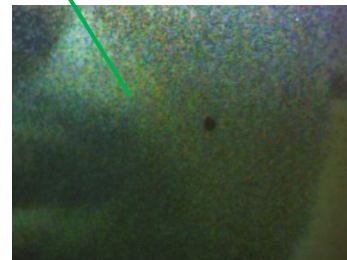


Figure-12: Secondary holder's portrait (smaller in size).

Microtexts - The front and back flyleaf of Ghana's passport depict two stylized towers. These towers have a repeating positive micro text "REPUBLIC OF GHANA" at the top

(Figure-14). Microtext of the same nature and wording is also depicted under the phrase "Ministry of foreign affairs" on the front endpaper of Ghana's passport (Figure-14a-b).

Latent images: Under the influence of ultraviolet rays ($\lambda = 365-450$ nm), visible yellow luminescence appears on the first page of the passport - a stylized image of the coat of arms of Ghana and one of the famous “kente” designs are also embedded. The

rest of the pages of the passport contain hidden expressions "Republic of Ghana" on a background grid of various shapes and patterns using offset printing methods (Figure-15a - b).

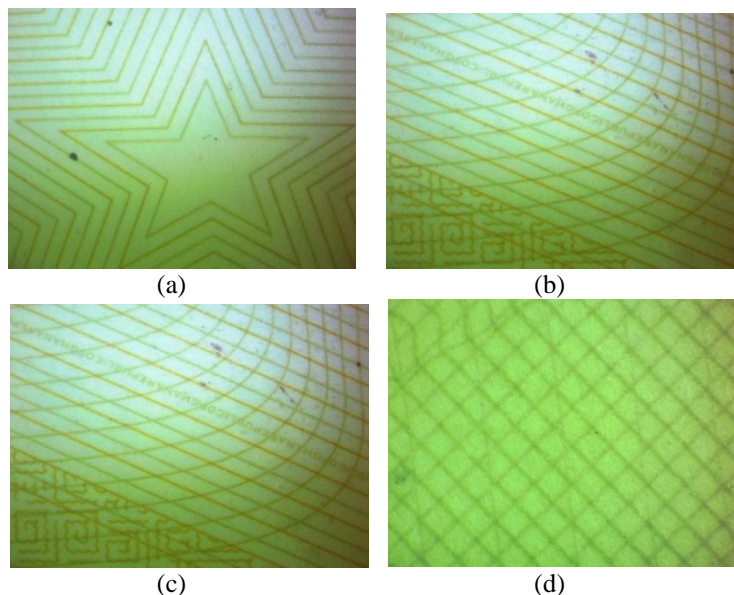


Figure-13(a,b,c,d): Anti-copy pattern forming the background of the passport of Ghana.

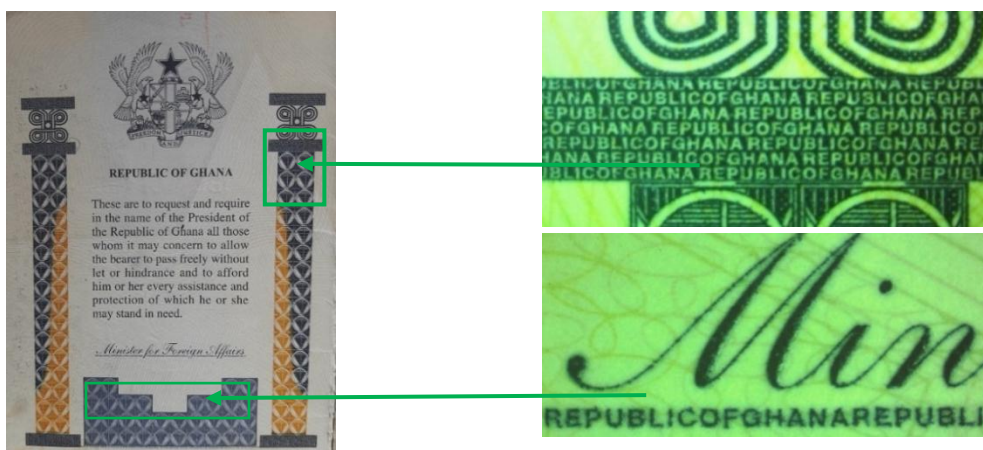


Figure-14: The flyleaf of the passport of Ghana. **Figure-14(a,b):** The expression Republic of Ghana on the flyleaf of the passport.

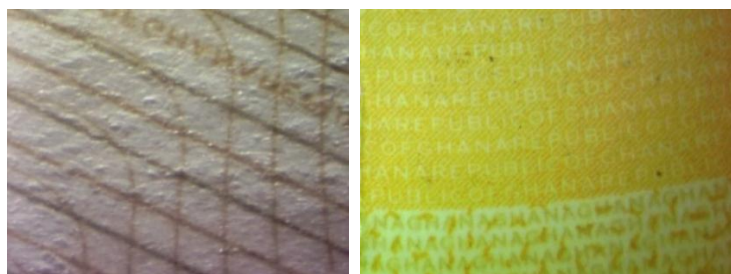


Figure-15(a,b): Areas with a latent images. Viewed at a right angle under incident light.

Latent image kipp- An image applied by intaglio printing which consists of parallel lines that are perpendicular to the

lines of the background. It can be visible due to the shadows cast by the raised lines of surface relief (Fig. 16).

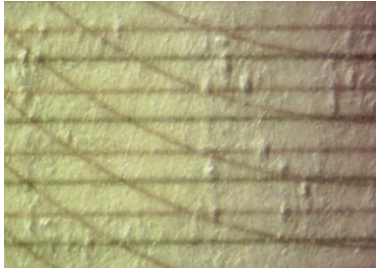


Figure-16: Areas with a latent images (viewed at a right angle under incident light).

Special protective equipment: Hot foil stamping- Gold foil embossing to create an additional feature and making the passport more secured and copying even more difficult could easily be seen on the front cover (Figure-17).



Figure-17: Front cover. Stamping with gold foil



Figure-18: stitching thread



Figure-19: Zoomed fragment of stitching thread under UV light.

Binding technique: The pages of passport of Ghana and cover are bounded together with a coloured string to form a booklet, which cannot be reassembled by hand without tell-tale signs that are visible under UV light from a VSC (Figure-18, 19).

Perforation of serial numbers in passports: Serial numbers indicated at the top end of the passport are perforated (Figure-20). Perforations are performed with a laser beam, hence burn marks left by the laser beam are visible along the edges of the holes (Figure-20).



Figure-20: Substrate indicating perforated serial number.

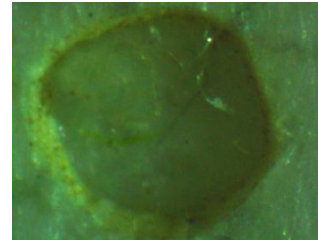


Figure-21: Laser perforation

Laminate and laminate overprint can be applied to the surface of the laminate facing the paper to be laminated. Laminate drawings are hardly distinguishable under normal lighting and, in this case, are visible only in oblique light or when exposed to UV rays (Figure-22-23).

Barcode - Graphic information in the form of a sequence of lines of different thickness and (or) rectangular geometric shapes. This information is intended to be read by special devices. The passport of the Republic of Ghana contains a UV-sensitive barcode (Figure-24).

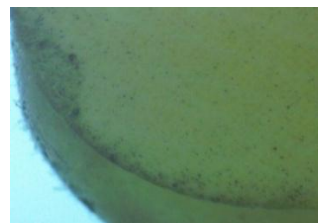


Figure-22: Lamination of paper substrate.



Figure-23: Laminate overprint viewed at different angles of observation.

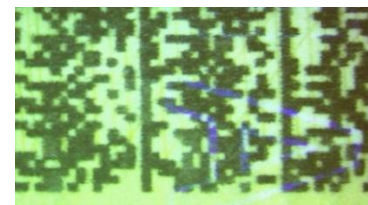


Figure-24: Zoomed fragment of barcode Laser printing.

Conclusion

Prosecutions for document related offenses show that, in the examination, investigation and trial of criminal cases, it is imperative to address issues that require special understanding and knowledge in the field of forensic document examination in order to facilitate the prosecution or acquittal of suspects based on careful analysis using all the necessary tools. Consequently, the document examiner plays a key role in the criminal court system especially in Ghana where crimes involving security documents are on the ascendency.

The forensic examination of the passport of Ghana led to the following conclusions: i. The analysis of the methods and types of protection used in the manufacture of passports of Ghana show that, the existing set of security features do not provide a 100% guarantee against forgery. However, they provide a sufficient level of protection against the illegal activities of criminals. ii. The thoroughly analysed and summarized various security features will lead to increase in the efficiency and effectiveness of the verification of the authenticity of passport of Ghana by the relevant government agencies and to help develop facts useful in the arrest and prosecution of suspects.

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References

1. Kaluzhskaya, N.O. (2018). Technical and forensic research of documents with special means of protection against counterfeiting (Unpublished thesis), St. Petersburg, Russia.
2. Belousov, A.G. (2011). Money tickets, forms of securities and documents. Determination of authenticity. Teaching aid / Otv. Editor Yu.M. Dildin. –M.: Inter Krim-press, Russia, pp 128.
3. Shashkin, S.B. (2002). Forensic studies of documents with special means of protection against counterfeiting (Unpublished thesis), Saratov, Russia.
4. Bobovkin, S.M. (2014). Forensic examination of documents: study guide. DGSK Ministry of Internal Affairs of Russia, Pp.209.
5. Lyapichev, V.E., Kozlov, M.O. and Seregin, V.V. (2013). Techno-forensic examination of documents: textbook: for students of higher educational institutions studying in the specialty "Forensic examination", Russia.
6. Kazakova, S.E. (2020). Techno-forensic examination of documents (Synopsis of lectures). Volgograd: VA Ministry of Internal Affairs of Russia.
7. Lyapichev, V.E., Kozlov, M.O. and Seregin V.V. (2003). Techno- forensic examination of documents. Textbook: for students of higher educational institutions studying in the specialty "Forensic examination" / M-in int. cases Ros. Federation, Volgograd Academy of Sciences - 2nd ed., St. - Volgograd: Volgograd Academy of the Ministry of Internal Affairs of Russia, pp 266.
8. Kolyamanov, R.A. (2015). Theoretical organizational and legal foundations application of the methods of technical and forensic examination of documents: dissertation for the academic degree of candidate of legal sciences. Moscow, Ministry of Internal Affairs of the Russian Federation Moscow University pp 179.
9. Pavlenko, S.D. (1985). Comprehensive Forensic Research of Documents Produced by Printing Methods. M., pp 5-9.
10. Gupta, G., Mazumdar, K., Rao, M. and Bhosale, R. (2006). The Paradigm Shift in Document Fraud: Characterization for the Development of a Non-Destructive Automated Document Printing System *Digital Investigation*, 3(1), 43–55.
11. Gazizov V.A. (2011). Forensic examination of documents: study guide. Volgograd: VA Ministry of Internal Affairs of Russia, pp 320-325.
12. Puzankov D.V. (2020). Technical and forensic support of investigation and prevention of counterfeiting. Unpublished thesis, Saratov, Russia.
13. Filippov, A.G. (200). Forensic science: Textbook. Ed - 2nd ed., revised and add. M.: Spark.
14. Nosal, E. and Wallace, N. (2007). Model (Threat) of Counterfeiting. *Journal of Monetary Economics*, 54(4), 994–1001.
15. All Africa. (2013). Immigration Service to Deal with Migrant Smuggling. (Factiva) URL: <http://irb.gc.ca>. Accessed 9 Sep. 2013.
16. Protkina, A.A. (2014). Technical and forensic examination of documents. Textbook / Ed. Honored Lawyer of the Russian Federation, Associate Professor, Ph. D. M.: Moscow University of the Ministry of Internal Affairs of Russia.
17. Volynsky, A.F. (1999). Forensic science: Textbook for universities. Ed. - M.: Law and Law, UNITY-DANA.
18. Shvedova, N.N. (2011). A short guide to the technical and forensic examination of documents: textbook - method. Manual, - Volgograd: VA Ministry of Internal Affairs of Russia.
19. Simonov, S.V. (2016). Forensic research of documents with biometric data of their owner: textbook. Allowance - Volgograd: VA Ministry of Internal Affairs of Russia.