Regula
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HARDWARE AND SOFTWARE SYSTEM
FOR FORENSIC EXAMINATION OF FIREARMS
AND AMMUNITION SERIAL NUMBERS REGULA 7517.

MAGNETIZING EQUIPMENT
REGULA 7517C

User's Guide

Regula Ltd.
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CONTENTS

INTRODUCTION 4
1 DESCRIPTION AND OPERATION 5
1.1 Equipment function 5
1.2 Technical specifications 5
1.3 Delivery set 6
1.4 Configuration and operation 6
1.5 Means of operation control, tools and accessories 8
1.6 Marking 9
1.7 Packaging 9
2 INTENDED USE 10
2.1 Operating limitations and safety measures 10
2.2 Preparation for use 11
2.3 Equipment use 11
3 EQUIPMENT MAINTENANCE 25
3.1 General instructions 25
3.2 Safety measures 25
4 ROUTINE REPAIRS 25
4.1 Safety measures 25
4.2 General instructions 25
4.3 Instructions on repairs 25
5 STORAGE 26
6 TRANSPORTATION 26
7 RECYCLING 26
8 MANUFACTURER'S WARRANTY 26
9 ACCEPTANCE CERTIFICATE 27
10 SALE CERTIFICATE 27

INTRODUCTION

This User's Guide (hereinafter referred to as the Guide) is the main operational document for the magnetizing equipment Regula 7517C (hereinafter referred to as the ME or the equipment). The ME is a part of the hardware and software system for forensic examination of firearms and ammunition serial numbers Regula 7517. As a part of the system, the device is used together with the magneto-optical device Regula 7517A and eddy-current magnetographing device Regula 7517B.

The User's Guide contains information on the equipment design, specifications and principles of operation. The Guide also provides instructions on the correct and safe use of the equipment (intended use, maintenance, routine repairs, storage and transportation) and on its technical condition evaluation when deciding whether it is necessary to send the equipment for repairs.

1 DESCRIPTION AND OPERATION

1.1 Equipment function

The ME is intended for producing magnetic stray fields in thick-walled ferromagnetic objects and their mechanical fixing during the examination process. The ME is viewed as an add-in module for the magneto-optical device Regula 7517A intended for magneto-optical visualization of serial numbers when carrying out forensic examinations and for the eddy-current magnetographing device Regula 7515B intended for highly sensitive magnetic copying of weak signals in surface layers of ferromagnetic objects (e.g. residual (internal) stresses left after a relief number was removed).

Area of application — forensic examination of weapon and ammunition serial numbers with the purpose of:

- authenticity verification of serial numbers;
- recovering initial numbers in case of any damages of their relief (corrosion, scale, wear, etc.);
- recovering initial numbers in case of their removal;
- general trace evidence examinations and non-destructive testing of the relief and stresses in the surface layer of metal objects.

1.2 Technical specifications

The main technical specifications of the ME are given in Table 1:

Table 1

Type of permanent magnets	Fe-Nd-B alloy
Pole distance: • magnetizing bench • magnetizing staple • magnetizing plank	 0–330 mm 0–270 mm 20–40 mm
Pull-out force (at maximum pole distance): • magnetizing bench • magnetizing staple • magnetizing plank	 120 N 40 N 60 N
Magnetic field strength in the middle of a 40 mm air gap (tangential component): • magnetizing bench • magnetizing staple • magnetizing plank	 200 A/cm 180 A/cm 190 A/cm

Table 1 (continued)

Dimensions (in a plastic case)	460×370×180 mm
Weight (in a plastic case)	7.8 kg
Dimensions (in the operating mode)	380×200×120 mm
Weight (in the operating mode)	4.5 kg

1.3 Delivery set

The ME delivery set (Figure 1):

Table 2

Magnetizing bench: frame — pos. 1, support (2 psc.) — pos. 2	1 pcs.	pos. 1, 2
Magnetizing staple	2 pcs.	pos. 3
Magnetizing plank	2 pcs.	pos. 4
Angle connector	4 pcs.	pos. 5
Polar tip	4 pcs.	pos. 6
Magnetic polarity indicator	1 pcs.	pos. 7
Spare parts of magnetic joints	4 pcs.	not shown in the figure
Case	1 pcs.	not shown in the figure
User's Guide	1 pcs.	not shown in the figure

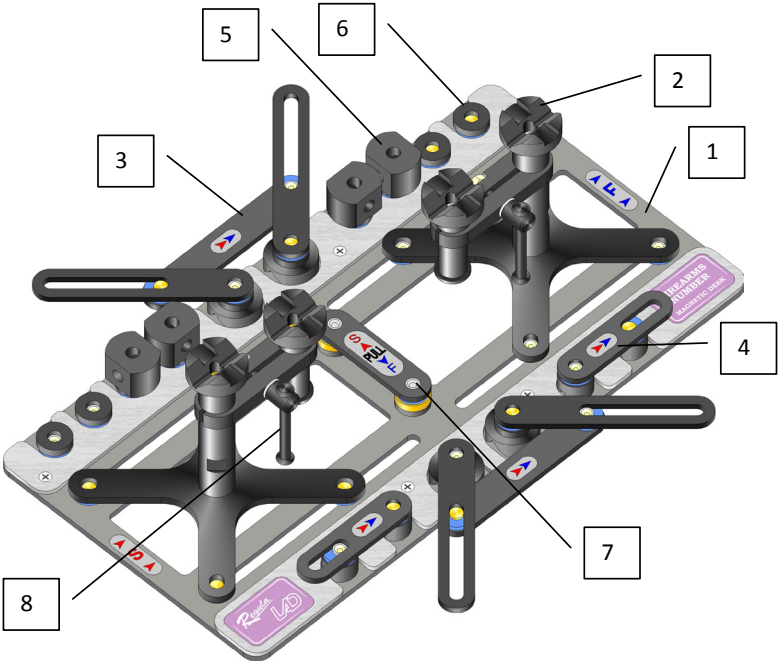
1.4 Configuration and operation

The ME is a set of tools used independently or in different variations. It is intended for effective magnetization of ferromagnetic objects which are subject to further magneto-optical examination. The ME includes 3 types of magnetizing tools based on permanent magnets. They differ in construction and have different magnetic and geometrical parameters (Figure 1):

1. The magnetizing bench is based on the frame (1). The supports (2) installed on the magnetic bases move along the guides of the bench. The supports (2) have fixed polar tips and pivoted arms with movable (vertically) polar tips and screw-type stoppers (8). The above mentioned elements are movable in order to adjust the position of the polar tips to the size and shape of the examined object.

2. The magnetizing staple consists of 3 pivoted arms placed on joints in the form of permanent magnets. The pivoted arms of the staple contain guides which let them move forward and backward. It helps to adjust the effective length of the arms. The magnetizing staples (3) are fixed in the corresponding slots of the frame (1) during transportation and storage of the ME.

Figure 1



General view of the ME:
1 — frame of the magnetizing bench;
2 — support of the magnetizing bench; 3 — magnetizing staple;
4 — magnetizing plank; 5 — angle connector; 6 — polar tip;
7 — magnetic polarity indicator; 8 — screw-type stopper.

3. The magnetizing plank (4) is also based on joints in the form of permanent magnets. It contains 2 movable polar tips and a guideway which lets one the polar tips move forward and backward. It helps to adjust the distance between the poles. The magnetizing planks (4) are fixed in the corresponding slots of the frame (1) during transportation and storage of the ME.

All the above mentioned magnetizing tools are assembled using standard magnetic joints which allow transforming the tools (alternative assembly) and combining them. In particular, it is possible to install angle connectors (5) to rotate polar tips by 90°. Moreover, rearrangement of polar tips (different in shape and size) is possible including the use of additional polar tips (6) for flat surfaces.

To check the polarity of the assembled magnetizing tools, the magnetic polarity indicator (7) should be used. Its marking allows identifying the direction of the magnetic excitation field (it is essential when using Regula 7517B for magnetographing).

To indicate the direction of scanning (corresponding to the direction of the magnetic excitation field) when using Regula 7515B for the magnetographing process, all magnetizing tools of the ME are provided with the «S» (Start) and «F» (Finish) marks or the arrow-pointers «>>».

Examination of ferromagnetic objects using the ME is possible only in combination with the magneto-optical device Regula 7517A and the eddy-current magnetographing device Regula 7517B. In this case the ME performs the function of optimal magnetization of thick-walled ferromagnetic objects (to the state of magnetic saturation of the material in the examined area) and excitation of magnetic stray fields over the examined area as well as object fixation during the examination process. The eddy-current magnetographing device Regula 7517B performs magnetographing, i.e. recording of the magnetic stray fields of the object on a temporary magnetic carrier (magnetic tape). Then the magneto-optical device Regula 7517A carries out magneto-optical visualization of the object magnetogram. As a result, an expert gets a visual image of the magnetic field in the examined area where the direction of the magnetic field and its amplitude are expressed in the brightness of image pixels.

Object positioning and adjusting the magnetizing process using the ME are described in details in paragraph 2.3 of this Guide. Magnetographing operations using the eddy-current magnetographing device Regula 7517B and magnetogram visualization using the magneto-optical device Regula 7517A are described in the corresponding user's guides of the devices.

1.5 Means of operation control, tools and accessories

The ME belongs to auxiliary equipment that extends the functionality of observation devices Regula 7517A and Regula 7517B which are not related to the category of measuring tools. That is why the ME as a component of this system does not require any metrological examination using means of operation control.

ME accessories: a magnetic polarity indicator (Figure 1, pos. 7) and spare parts of the magnetic joints. The magnetic polarity indicator is used for checking the polarity of the assembled magnetizing tools of the equipment. The spare parts of the magnetic joints are used for their replacement in case of any damage.

1.6 Marking

The ME marking is executed in the form of a label on the back side of the equipment base and provides the following information:

- manufacturer's name and/or trade mark;
- manufacturer's model identification;
- serial number of the equipment according to the manufacturer's numbering system;
- month and year of production;
- certification mark.

1.7 Packaging

The ME is packed in a plastic case with polyurethane foam filling.

The equipment is transported and stored in special shipping containers (a cardboard box or a wooden container).

2 INTENDED USE

2.1 Operating limitations and safety measures

ATTENTION!

— As firearms marking is the object of examination, IT IS NECESSARY TO OBSERVE COMMON SAFETY MEASURES WHEN HANDLING FIREARMS.

— REMOVE FOREIGN FERROMAGNETIC OBJECTS (TOOLS, EQUIPMENT, ETC.) FROM THE WORKING PLACE TO AVOID THEIR ACCIDENTAL ATTRACTION BY THE ME MAGNETS AND POSSIBLE INJURY OF THE OPERATOR.

— RARE-EARTH MAGNETS USED IN THE ME HAVE SIGNIFICANT ATTRACTIVE FORCE. WHEN PLACING OR REMOVING EXAMINED OBJECTS AND WHEN ASSEMBLING OR DISASSEMBLING MAGNETIZING TOOLS, IT IS NECESSARY TO WATCH OVER THE POSITION OF THE POLAR TIPS TO AVOID PINCHING HANDS.

— Significant effort is required for moving the supports of the magnetizing bench along the guides. WHEN MOVING THE SUPPORTS, AVOID PINCHING FINGERS IN THE GUIDES OF THE BENCH.

OPERATING LIMITATIONS AND SAFETY MEASURES

- Climatic operational conditions are described in paragraph 1.1.1. of the User's Guide to Regula 7517A. In case water gets (or condensation forms) appears on the equipment components, stop the equipment operation and proceed with it only after drying.
- Protect the equipment against shock and vibration during transportation and operation.
- Be careful when assembling/disassembling magnetizing tools. Magnetic joints can be damaged as a result of an abrupt attraction to the metal slots.

VIOLATION OF THE OPERATING LIMITATIONS GIVEN IN PARAGRAPH 2.1 BY THE USER LEADS TO THE LOSS OF THE MANUFACTURER'S WARRANTY.

ATTENTION!

The ME is used for examination of objects made of ferromagnetic materials only. The AI-scanners of Regula 7517B are used for examination of objects made of nonferromagnetic electroconductive materials (non-ferrous metals and their alloys). The ME is not used in this case.

2.2 Preparation for use

Preparation of the working place: take the ME out of the plastic case and put it on the working place. Remove foreign ferromagnetic objects (tools, equipment, etc.) from the working place to avoid their accidental attraction by the ME magnets and possible injury of the operator.

The magneto-optical device Regula 7517A and the eddy-current magnetographing device Regula 7517B should be placed at a distance of at least 0,5 m from the ME, except the Fe-scanner which has direct contact with the examined object during magnetic copying.

2.3 Equipment use

To carry out magnetic copying of the examined object using the ME as a part of the hardware and software system Regula 7517, perform the following steps:

1. Partially disassemble the examined object to prepare marking parts and assemblies for the magnetic copying process.
2. Choose the initial scheme of magnetizing using the ME.
3. Place and fix the examined object in the magnetizing equipment.
4. Carry out magnetic copying by means of the magnetographing device Regula 7517B.
5. Carry out visualization of the magnetic copy using the magneto-optical device Regula 7517A.
6. Analyze the visualized results and decide if it is necessary to change the ME magnetization scheme, to polish the examined surface or to finish the examination.
7. Change the magnetization scheme in order to increase or reduce the magnetic excitation field. Repeat steps 3–6.
8. Polish the examined surface to improve surface contact conditions. Repeat steps 3–6.

2.3.1 Partial disassembling of the examined object

This operation is carried out to prepare serial number parts and joints of the examined object for magnetic copying.

The operation has two goals:

1. It is advisable to exclude object components irrelevant for the examination of the removed serial number and therefore irrelevant for the magnetization process. This is useful for energy reasons: it allows using lighter and more compact magnetizing tools. Moreover, separation of the object into its components simplifies the choice

of the initial magnetization scheme, as the magnetized fragment of the object surface becomes more obvious in the area where the serial number is situated.

2. Remove detachable elements of the examined object which limit the access to the area with the marking. Usually these are projecting parts, such as: a safety thumb catch, an optical sight mount, handle covers, etc.

2.3.2 Choosing the initial magnetization scheme using the ME

This operation provides rough estimation of cross-sectional area of metal in the area where serial number is situated. Then a corresponding magnetization scheme of the ME should be chosen. The scheme should ensure the magnetic flux strength which is close to saturation.

As it was mentioned in paragraph 2.1, the ME contains 3 types of magnetizing tools. They are based on permanent magnets but differ in construction, magnetic parameters and geometrics. Depending on the construction of the examined object (cross-sectional area, shape and position of adjoining surfaces (areas of contact with the polar tips) and length of the area to be magnetized (the base between the polar tips)) the following initial magnetization schemes are recommended:

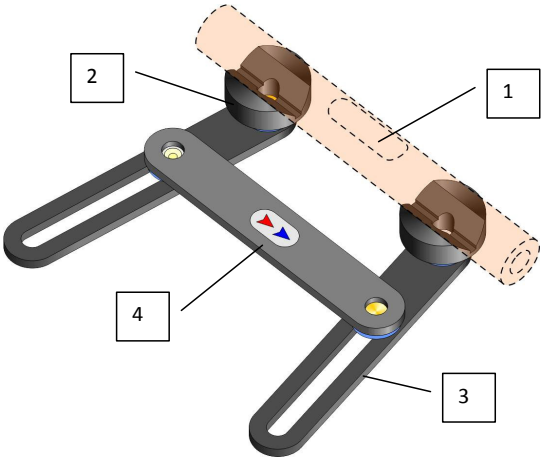
A. The magnetizing bench should be used for large parts and assemblies (barrels of submachine guns, rifles, scatterguns, solid constructions of pistols and revolvers) where the cross-sectional area of metal is more than 100 mm^2. In this case, the examined object is placed on the right and left supports (Figure 1, pos. 2) of the magnetizing bench using from 2 to 4 polar tips. If only 2 immovable polar tips are used, the magnetization is reduced to 80 %, if 4 polar tips (both immovable and movable) are used, the magnetization is 100 %.

B. The polar tips of the magnetizing staple (Figure 2) should be used for relatively thin-walled parts and assemblies (breech mechanism and it parts, magazine cases, barrels of pistols) where the cross-sectional area of metal is not more than 100 mm^2.

C. The pivoted arms of the magnetizing staple (Figure 3) should be used for thin-walled flat parts (e.g. cut-out fragments of the number plate) where the cross-sectional area of metal does not exceed 50 mm^2.

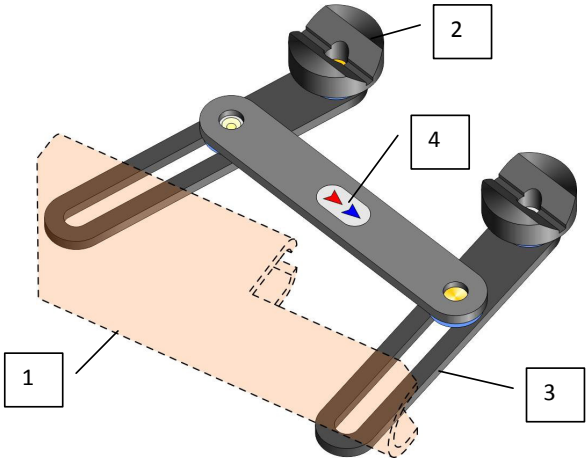
D. The polar tips of the magnetizing plank (Figure 4) should be used for parts with internal cavities (breech mechanism) where the cross-sectional area of metal is more than 100 mm^2. For large parts and assemblies, schemes (A), (B) and (D) should be used simultaneously taking into account the polarity (the magnetizing tools should be joined so that they magnetize in the same direction).

Figure 2



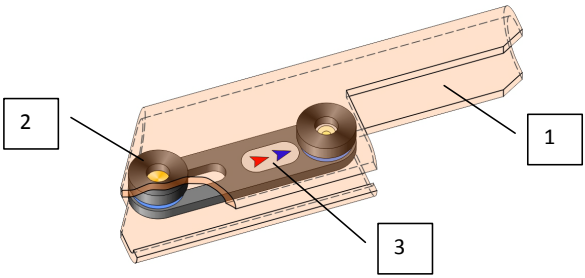
Magnetization scheme of the object placed on the polar tips of the magnetizing staple:
1 — examined object; 2 — polar tip; 3 — pivoted arm;
4 — arrow indicating scanning direction.

Figure 3



Magnetization scheme of the object placed on the pivoted arms of the magnetizing staple:
1 — examined object; 2 — polar tip; 3 — pivoted arm;
4 —arrow indicating scanning direction.

Figure 4



Magnetization scheme of the object placed on the polar tips of the magnetizing plank: 1 — examined object; 2 — polar tip; 3 — arrow indicating scanning direction.

It is evident that this simplified approach to choosing a magnetization scheme does not guarantee optimal conditions for examination. Therefore, further optimization of the magnetization scheme will be carried out in accordance with the recommendations mentioned in paragraphs 2.3.4–2.3.7.

2.3.3 Positioning and fixing of the examined object in the magnetizing equipment

The examined object should be placed relative to the magnetizing tools, i.e. it should be placed so that the examined marking area is available for magnetic copying. As a rule, the examined object is placed horizontally with the marking area oriented upwards.

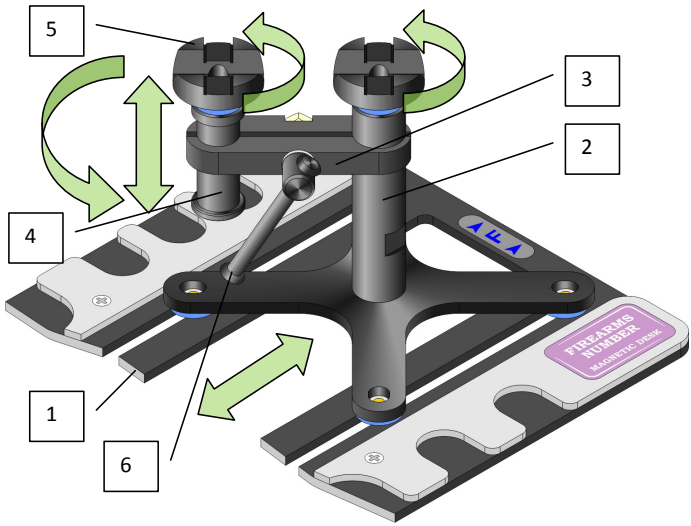
The examined object is fixed by ponderomotive forces of magnetic interaction. The attractive force of the object to the polar tips characterizes the degree of object magnetization (direct relation, i.e. the stronger the attraction, the higher the magnetization level).

As a high level of magnetization is usually required, it is important to provide good contact between the examined object and the ME poles (large area of the contacting surface) as well as a small distance between the poles. It is obvious that the shape and the position of the polar tips of the magnetizing tools should be adapted to the surface geometry of the examined object.

The following elements of the magnetizing bench have the maximum mobility level (the direction of movement is pointed by the arrows in Figure 5): the support (2) can be moved forward/backward along the guides of the frame (1), the pivoted arm (3) can be rotated relative

to the support stand (2), the retractable rod (4) allows controlling the height of the polar tip (5) and the polar tips (5) rotate freely on the magnetic joints.

Figure 5



Positioning the polar tips of the magnetizing bench:
1 — frame; 2 — support; 3 — pivoted arm; 4 — retractable rod;
5 — shaped polar tip; 6 — screw-type stopper.

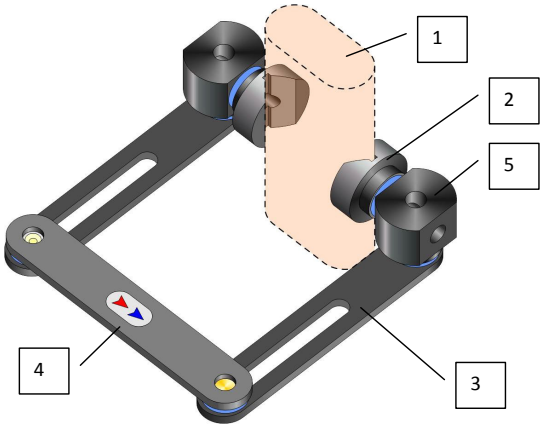
It is recommended to move the supports (Figure 5, pos. 2) to the required distance before installing and fixing the object. Then release the stoppers (6) and set the appropriate position of the pivoted arms (3), rods (6) and polar tips (5). Fix the selected position of the magnetizing bench elements by tightening the stoppers (6).

As it was mentioned above, all polar tips of the ME are interchangeable. Thus, the most appropriate shape of the polar tip can be chosen in accordance with the geometrics of the contact area.

In addition, it is possible to install angle connectors for rotating polar tips by 90° for examining objects with the markings on their side surfaces (e.g. handles in some revolver models) (Figure 6).

When performing operations connected with disassembling of the magnetic joints, such as the above mentioned installation of angle connectors, control the polarity of the magnets in the assembly.

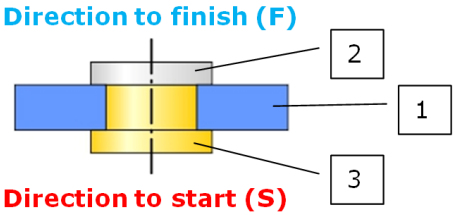
Figure 6



The use of angle connectors for rotating polar tips by 90°:
1 — examined object; 2 — polar tip; 3 — pivoted arm;
4 — arrow indicating scanning direction; 5 — angle connector.

There are two ways to control magnet polarity: using the magnetic polarity indicator (Figure 1, pos. 7) and using the coloured marks on the magnetic joints (Figure 7). It means that magnetic joints in the magnetizing equipment form series circuits and each magnet is directed towards the starting point (S) with the yellow mark (3), and toward the finishing point (F) — with the white mark (2).

Figure 7



The use of the coloured marks on the magnetic joints
for controlling magnetic polarity:
1 — permanent ring magnet of the Fe-Nd-B alloy;
2 — white mark (directed towards the finishing point);
3 — yellow mark (directed towards the starting point).

To check the polarity of assembled magnetizing tools, the magnetic polarity indicator may also be used (Figure 1, pos. 7). Its marking allows defining the direction of the magnetic excitation field by assessing the attractive force of the marked indicator arrowheads.

2.3.4 Magnetic copying using the eddy-current magnetographing device Regula 7517B

Magnetic copying using the eddy-current magnetographing device Regula 7517B is carried out in accordance with the instructions given in the user's guide of the device.

When carrying out magnetic copying with the use of the ME, make sure that the direction of the magnetization produced by the ME magnetizing tools and the direction of scanning carried out by the Fe-scanner of Regula 7517B coincide. The direction in which the Fe-scanner should be moved during magnetic copying of the object is indicated by the arrows of the magnetizing staples and planks (Figures 2–4, 6), or by the marks «S» (Start), «F» (Finish) of the magnetizing bench (Figures 1, 5).

2.3.5 Magnetic copy visualization using the magneto-optical device Regula 7517A

Magnetic copy visualization using the magneto-optical device Regula 7517A is carried out in accordance with the instructions given in the user's guide of the device.

2.3.6 Analyzing visualization results and taking a decision on changing the ME magnetization scheme, polishing the examined surface or finishing the examination

After the analysis of visualization results, one of the following decisions should be taken:

- To continue the examination after changing the conditions of the experiment (optimization of the magnetization scheme, adjustment of the Regula 7517B scanner signal or polishing the surface of the examined object).
- To finish the examination if sufficient data about the initial marking is obtained or in case the initial marking cannot be identified.

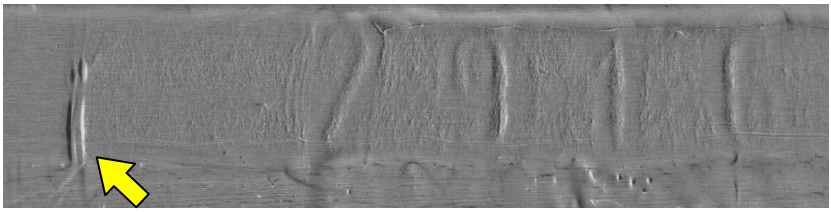
As we know from the theory of magnetic examination methods, optimal object magnetization is achieved by magnetizing the examined area to the state of magnetic saturation. Lack or excess of the magnetic excitation field worsen visualization results. It is recommended to define optimal magnetization experimentally by analyzing the magneto-optical images (MO images) of the obtained magnetograms.

Figure 8 shows a number of examples illustrating the influence of the ME magnetization on the quality of magneto-optical

visualization. The standard test object № 1 of the eddy-current magnetographing device Regula 7517B is used as an examined object (with the removed relief marking).

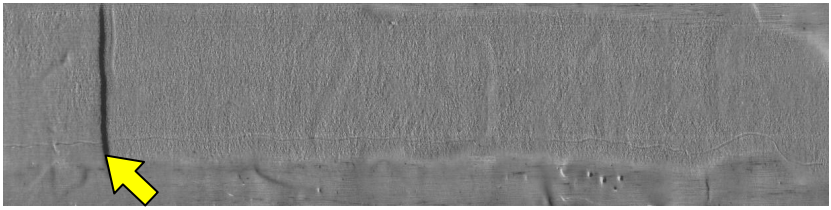
Figure 8a shows the result of magnetic copying by the Fe-scanner Regula 7517B with the minimum signal level (without additional magnetization by the ME tools). Since the cross-sectional area of the object is small (S ≈ 45 mm^2) in this case, the magnets built in the Fe-scanner are enough to obtain informative results — all digits of the removed number are clearly visible.

Figure 8

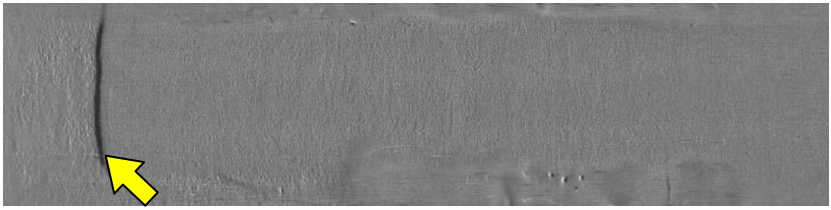


(a) Without additional magnetization by the ME tools

(b) Additional magnetization of the object placed on the pivoted arms of the magnetizing staple (according to the scheme given in Figure 3)



(c) Additional magnetization of the object placed on the polar tips of the magnetizing staple (according to the scheme given in Figure 2)



(d) Additional magnetization of the object placed on the polar tips of the magnetizing bench

Influence of the ME magnetization on the quality of magneto-optical visualization

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An experiment with increased magnetization of the object (b) was conducted to test optimal magnetization. According to paragraph 2.3.2, the magnetization scheme of an object based on the pivoted arms of the magnetizing staple (Figure 3) is recommended for this cross-sectional area. The analysis of the MO image (b) shows that the result gets more informative. All digits of the removed number become more distinct and small image details appear.

Let's consider the influence of further increase in magnetization of the object on the results of magneto-optical visualization. Figure (c) shows the result of using the magnetization scheme where the examined object is based on the polar tips of the magnetizing staple (Figure 2). The analysis of the MO image (c) shows that the result gets less informative. The digits of the removed number are hardly seen, the noise level of the image increases. Thus, variant (b) of the 3 examined magnetization schemes (a–c) is the closest to the optimal.

For complete examination of possible deviations from the optimal value of magnetization, let's consider the case of higher magnetization (d). In this case, magnetization is carried out according to the scheme when the examined object is based on the polar tips of the magnetizing bench (2 polar tips are placed on the pivoted arms). The analysis of the magneto-optical image (d) shows that the result is less informative. The digits of the removed number are not visible, the noise level of the image is high.

The mark left by the starting impulse in the magnetogram recording (marked by the yellow arrow in Figure 8) can be used as an additional, quite precise indicator of optimal magnetization. This impulse is generated around the wire emitter of the Fe-scanner Regula 7517B at the beginning of the recording.

The starting impulse looks bipolar (both poles are present: black and white vertical stripes) for acceptable magnetization results (Figures 8a, b). Furthermore, there is no signal in the magnetogram area to the left of the starting impulse (there are only weak noise of the demagnetized carrier), and to the right there is a high-quality copy of the examined magnetic fields (if the scanning was directed from left to right). At the same time, in case of insufficient magnetization (a) the starting impulse mark is wider than for (relatively) optimal magnetization (b).

The starting impulse looks unipolar (there is only one pole: black vertical stripe) for the results of excess magnetization (Figures 8c, d). In addition, there is a record in the magnetogram area to the left of the starting impulse (instead of the expected weak noise of the demagnetized carrier), and to the right there is a low-quality copy of the examined magnetic fields (c) or exceeding of the record operation range (d) which is similar to demagnetization of the tape.

Note that the results in Figure 8 are obtained with the minimum signal of the controller 7517B. It is recommended to start with the minimum controller signal when preparing the equipment for examining real objects. After the ME magnetization is optimized (case (b)), adjust (increase) the amplitude of the controller Regula 7517B signal. It usually improves the magnetographing quality and makes the obtained magneto-optical image more informative.

If, despite any attempts of optimizing the magnetization flow and amplitude of the controller 7517B signal, informative images cannot be obtained, it is recommended to polish the examined object surface (see paragraph 2.3.8).

2.3.7 Changing the magnetization scheme in order to increase or reduce the magnetic excitation field

This operation means a more delicate adjustment of the magnetization process within the selected basic magnetization scheme.

Measures to increase magnetization:

- the use of additional magnetizing tools, e.g. simultaneous use of the magnetizing bench and staple and/or plank. In this case the magnetizing tools should be joined so that they magnetize in the same direction (scanning direction indicators should be placed in the same direction). This approach provides the highest magnetization increase;
- changing the polar tips in order to enlarge the area of magnetic contact;
- reducing the distance between the polar tips in order to make the magnetizing base smaller.

Measures of reducing magnetization are opposite to the above mentioned. In addition, magnetization can be gradually reduced

using non-ferromagnetic layers between the object and the ME polar tips (e.g. using strips of paper or cardboard as separating elements).

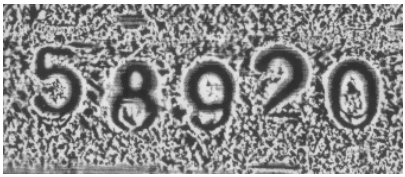
2.3.8 Polishing the examined surface in order to improve contact conditions

This operation is carried out to improve the magnetic contact between the examined object, the magnetic tape and the scanner. It results in the increase of the recording signal and the reduction of noise. The necessity of this operation may occur in case of narrow (less than 4 mm) and deep (more than 1 mm) slots in the area of the removed number as well as in case of high roughness of the marking area.

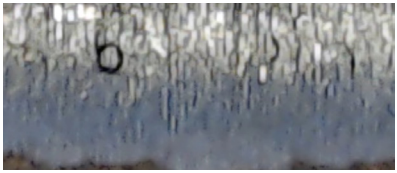
The effectiveness of the approach can be evaluated according to the example shown in Figure 9. A steel tube ½'' with a relief marking applied by a 3 mm font is used as the test-object. The photo of the marked surface in Figure 9a had been taken before the number was removed. It is as informative as the MO image (b) of the surface.

Figure 9

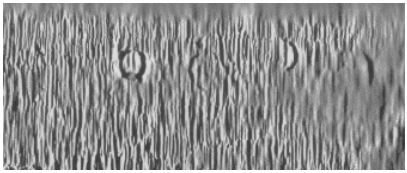
(a) Photo of the test object with the relief marking



(b) MO image of the test object with the relief marking

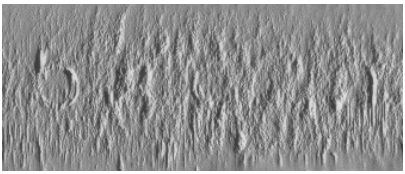


(c) Photo of the test object after the number was removed using a rough abrasive disk



(d) MO image of the test object after the number was removed using a rough abrasive disk

(e) Photo of the test object after polishing the surface



(f) MO image of the test object after polishing the surface

Examination of a test object with the removed relief marking

Then the surface of the marking was processed with a rough abrasive disk in order to remove the marking relief. The photo of the test object (c) taken after the number had been removed using a rough abrasive disk, contains some data about the residual relief of the removed number. Thus, elements of the digits «8», «2», «0» are distinguished. The MO image of the test object (d) taken after the number had been removed is a little more informative than the optical image (except for the elements of the digits «8», «2», «0» which are optically visible, it is possible to distinguish an element of the digit «9»). However due to the high roughness of the surface, the image has a high noise level and the digits are not detailed enough for clear identification.

In order to reduce the surface roughness of the marking area, the latter was polished by a fine abrasive strip. As a result, the residual relief became more indistinguishable. Thus, after polishing the test object surface, only the digit «0» is barely distinguishable in the photo (e). However, the MO image (f) became more informative after polishing — the digits «5», «8» and «0» are clearly visible.

2.3.9 Example of effective use of the ME

Figure 10 shows an example of effective use of the ME for examination of the number removed from a firearm. The Margolin (MCM) pistol is examined (see Figure 10a). The red circle in the picture shows the location of its serial number.

The zoomed photo of the marking area (b) allows estimating the width of the slot in the area of the removed number (≈4 mm) and its depth (≈0,5 mm). The removed metal layer in the marking area exceeds the depth of the marking. As a result the symbols of the number are not recognized.

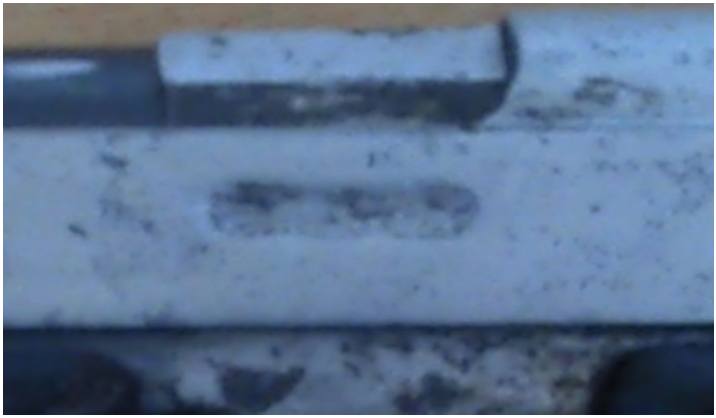
Magnetic copying was carried out in accordance with paragraphs 2.3.1–2.3.7 of this Guide after the pistol was partially

disassembled (the breech mechanism was removed). The magnetization scheme with the examined object based on the pivoted arms of the magnetizing staple was used (Figure 3).

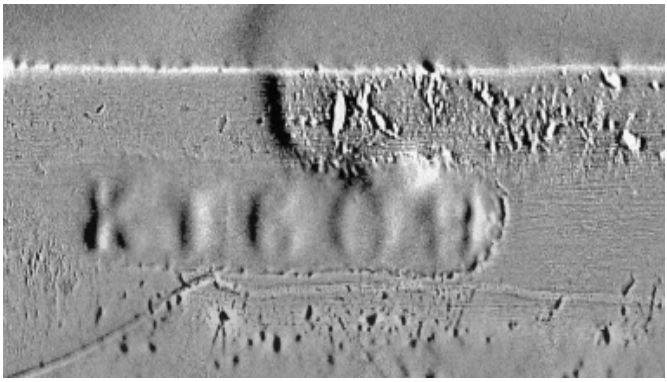
MO visualization results allow recognizing the initial marking — the symbols «K1609» are visible.

Figure 10

(a) Photo of the object — the MCM pistol with the removed serial number



(b) Photo of the marking area — elements of the serial number are not recognized



(c) MO image of the marking area — «K1609» symbols are visible

Examination of a real object with the removed relief marking

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3 EQUIPMENT MAINTENANCE

3.1 General instructions

Daily maintenance of the ME includes the following procedures:

- visual examination (visually check the integrity of magnetic joints and check all the tools in the ME set);
- wipe off dust and oxidants (fatty and oily spots, ferromagnetic suspension, etc.) from the ME surface with an oiled cloth.

Packing and preparing the ME for storage:

- make sure that the working surfaces have no corrosion and they are coated with a thin layer of corrosion-preventive grease;
- pack all equipment components, put them into the transportation packaging.

3.2 Safety measures

Observe safety measures described in paragraph 2.1 when performing the ME maintenance.

4 ROUTINE REPAIRS

4.1 Safety measures

When carrying out routine repairs, observe safety measures in accordance with the requirements of paragraph 2.1.

4.2 General instructions

According to this Guide, the User is allowed to carry out only one type of repairs — the replacement of damaged magnetic joints.

4.3 Instructions on repairs

The replacement of damaged magnetic joints is carried out when cracks or splits in the ring magnet (Figure 7, pos. 2). The damaged magnet joint should be replaced by a similar one taken from the set of spare parts. When the replacement is carried out, observe the initial magnet polarity (see paragraph 2.3.3).

5 STORAGE

The equipment should be stored in the manufacturer's packaging.

Climatic conditions of storage

Table 3

air temperature	from +5 to +40°C
relative air humidity	up to 80 % at the temperature of +15 °C
atmospheric pressure	100±4 kPa (750±30 mm Hg)

When preparing the equipment for storage, carry out maintenance as described in paragraph 3.2.

Maximum number of packages to be stacked is 10.

6 TRANSPORTATION

The equipment should be transported in the manufacturer's packaging (included in the delivery set). Observe the climatic conditions given in paragraph 5. Protect the equipment against shock and vibration.

7 RECYCLING

The equipment must be recycled in compliance with the rules adopted at the customer's enterprise.

8 MANUFACTURER'S WARRANTY

8.1 The warranty period makes 24 months from the date of sale provided that all terms of the given User's Guide are observed.

8.2 Storage period makes ___ months from the date of manufacturing.

8.3 Mean lifetime makes 5 years.

9 ACCEPTANCE CERTIFICATE

(to be completed by the manufacturer)

Hardware and software system for forensic examination of firearms and ammunition serial numbers Regula 7517. Magnetizing equipment Regula 7517C

№ _____ is produced and accepted in accordance with
(serial number)

obligatory requirements of state standards, current technical documentation and considered serviceable.

Responsible for acceptance

_____ _____

(signature) (first and last name)

_____

(year, month, date)

Seal

Manufacturer — Regula Ltd.

Address for mailing claims with regard to the quality of the device:

220036, Republic of Belarus
1 Volokha Street, Office 314, Minsk
Phone: +375 17 2862825
Fax: +375 17 2136897
e-mail: support@regulaforensics.com;
http://www.regulaforensics.com

10 SALE CERTIFICATE

(to be completed by the seller)

Hardware and software system for forensic examination of firearms and ammunition serial numbers Regula 7517. Magnetizing equipment Regula 7517C

№ _____ is sold to:
(serial number)

Seal

Seller's name _____

Date of sale _____

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Phone: +375 17 2862825, Fax: +375 17 2136897
support@regulaforensics.com; http://www.regulaforensics.com