

MAGNETO-OPTICAL EQUIPMENT FOR NONDESTRUCTIVE  
EXAMINATION OF METAL SURFACE.  
HARDWARE AND SOFTWARE SYSTEM FOR FORENSIC  
EXAMINATION OF FIREARMS AND AMMUNITION SERIAL  
NUMBERS REGULA 7517

## USER'S GUIDE





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## **INTRODUCTION**

The User's Guide refers to the hardware and software system Regula 7517 intended for forensic examination of firearms and ammunition serial numbers. The hardware and software system (hereinafter referred to as "HSS" or "system") includes:

- magneto-optical device Regula 7517A,
- eddy-current magnetographing device Regula 7517B,
- magnetizing equipment Regula 7517C.

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

Description of the system software is given in a separate document.

Personnel operating the device are required to:

- have higher or specialized technical education,
- pass special training and get clearance to perform expert examination in the field of trace evidence,
- be an OS Windows user,
- study techniques of authenticity verification of firearms and ammunition serial numbers and the User's Guide,
- pass practical training on the use of equipment supplied,
- pass training on safety measures observed when working with the system.

## **ATTENTION!**

**USB-devices of the system do not have dangerous voltage as they are powered by a secondary power supply source — a PC USB-bus with nominal voltage 5 V. However, the mains power source and PC peripherals (supplied optionally) can have life hazardous nominal voltage ~ 220 V 50 Hz. To avoid electric shock personnel are obliged to strictly observe the safety measures. The HSS is classified as Class I Equipment IEC 60950-1 regarding its electric safety properties.**

**The magnetic copying accessory set contains inflammable liquid (alcohol).**

**To ensure device proper operation it is strongly recommended not to change settings of the special software. The system should be operated, maintained, repaired, stored and transported in conformity with chapters 2-6 of this User's Guide. Violation of these requirements will result in the loss of the manufacturer's warranty.**

# 1 DESCRIPTION AND OPERATION

## 1.1 Equipment Function

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The HSS is intended for forensic examination of firearms and ammunition serial numbers with the following purposes:

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

The HSS Regula 7517 is a set of hardware and software products enabling visualization (video imaging) of relief and structural inhomogeneity of metal surface with magnetic or electroconductive properties (traces of mechanical processing, inclusion of non-ferromagnetic materials, surface flaws of welding seams), without removing the lacquer-and-paint coating (if applicable) by methods of magneto-optical visualization. A PC is used for capturing, collecting, processing, transferring and displaying information.

## 1.2 Area of Application

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The HSS is intended for use by forensic laboratories, law enforcement agencies, judicial authorities, customs and insurance companies. Regula 7517 can be used for express inspection (e.g. at customs or by highway patrol), as well as for advanced forensic examination of firearms and ammunition serial numbers in laboratory conditions due to the fact that the HSS provides high-quality results, visual evidence and uses non-destructive magneto-optical methods. In case any changes in serial numbers are detected, further investigations can be carried out using a special set of peripheral hardware tools (supplied optionally).

### 1.3 Storage and Operation Conditions

The system is to be used indoors.

#### **Climatic Conditions**

air temperature	+10 °C ... +35 °C
relative air humidity	up to 80 % at temperature of +25 °C
atmospheric pressure	from 84 to 107 KPa (from 630 to 800 mm mercury)

Operating temperature on the data carrier surface during magnetic copying: -20 °C ... +50 °C.

Operating temperature on the surface of the combination magnetic scanner during magnetic copying: -20 °C ... +50 °C.

Climatic conditions of storage (see paragraph 5).

Climatic conditions of transportation (see paragraph 6).

Avoid hitting and vibrations during system transportation and operation.

### 1.4 Technical Specifications

The HSS technical specifications are given in the user's guides of the system components, i. e. the user's guides to Regula 7517A, 7517B, 7517C.

### 1.5 Delivery Set

The HSS delivery set is given in Table 1.

The delivery sets of HSS components are given in the user's guides to Regula 7517A, 7517B and 7517C.

**Table 1**

Components	Quantity	Packaging	Figure №	Marking
Magneto-optical device Regula 7517A	1	box	1	Regula 7517A, serial number, year of production
Eddy-current magnetograph- ing device Regula 7517B	1	case	1	Regula 7517B, serial number, year of production
Magnetizing equipment Regula 7517C	1	case	1	Regula 7517C

## 1.6 Configuration and Operation

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The HSS is a set of hardware components and software products. Special equipment of the system allows non-destructive examination of objects.

The HSS is designed for desktop use. The general view of the system is given in fig. 1.

Examination of firearms and ammunition serial numbers starts with magnetic copying (making a magnetogram = magnetic copy) of the examined object surface. Different types of magnetic scanners are used for making a magnetogram. The choice of the scanner depends on object material and the condition of the examined number platform.

To examine residual relief of a ferromagnetic object, use *magnetic copying accessories set (MCAS)* which is a part of **magneto-optical device Regula 7517A** (fig. 1, pos. 1). The MCAS contains various kinds of magnetic scanners which locally magnetize the object, excite its magnetic stray fields and copy them to the intermediate flexible magnetic carrier (magnetic tape) without removing protective coating, the layer of corrosion or scale. The **eddy-current magnetographing device Regula 7517B** (fig. 1, pos. 2) is used for investigating internal stresses in ferromagnetic objects and for examining the surface of aluminum objects. To investigate internal stresses in thick-walled ferromagnetic objects, use **magnetizing equipment Regula 7517C** (fig. 1, pos. 3) together with the scanners mentioned above.

To visualize the obtained magnetogram, use the **magneto-optical device Regula 7517A**. The magnetogram is loaded into the USB-device for magneto-optical visualization (MOV) where information about object's surface layer is scanned. The MOV combines two functional components: optic-mechanical block and block of electronics.

The optic-mechanical block (OMB) contains a magneto-optical visualizer which converts magnetic stray fields of a magnetic copy into an image and a special tape drive mechanism which moves the magnetic copy relative to the visualizer.

A magnetic copy is loaded into the tape drive where it is automatically detected and introduced into the tape drive tract. Then it is scanned step-by-step by a sensor designed on the basis of a magneto-optical crystal. Magneto-optical visualization of magnetograms of the examined object is based on Faraday magneto-optical effect which occurs in crystalline films of Bi-containing ferrite garnets.

The block of electronics manages OMB resources (video camera, electric drive, inductor, illuminator, inductor, sensors and indicators).



Figure 1



**Figure 1.** HSS general view: 1 – magneto-optical device Regula 7517A; 2 – eddy-current magnetographing device Regula 7517B; 3 – magnetizing equipment Regula 7517C; 4 – PC (laptop).

A PC (fig. 1, pos. 4) operates the USB device for magneto-optical visualization via special software. The PC displays newly obtained and stored examination data which are processed, examined and documented.

**Peripherals Regula 7516** (supplied optionally) extend examination possibilities of the system by applying additional methods and means of investigation of examined objects. The HSS operates together with the following peripherals:

- USB-device for optical input,
- magnetic powder visualization device,
- eddy-current probe,
- electrochemical etching device.

Basic functions of VideoScope/NUCA (EYER) **software**: operating USB-devices; input and processing of images; automatic program correction and panoramic shots stitching of the MOV; image processing; comparison of images; measurements of linear and angular sizes; saving and printing of image files as illustrations to the photo charts.

A set of **operational documents** contains data on design, principles of operation, properties of the system and its components. It also contains instructions on correct and safe system operation and evaluation of its technical condition when deciding whether it is necessary to send it for repairs.

## 2 INTENDED USE

Operating limitations, safety measures, preparation of the system for use are described in the user's guides of the HSS components (see the user's guides to Regula 7517A, 7517B, 7517C).

Magnetic copying of the examined object consists of the following operations:

1) disassemble the examined object partially to prepare examined marking parts and assemblies for the magnetic copying process;

2) choose the initial scheme of magnetizing;

3) (*for ferromagnetic objects*) Place and fix the examined object in the magnetizing equipment Regula 7517C;

4) carry out magnetic copying using the magnetographing device Regula 7515B or a scanner from the set of Regula 7517A;

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 magnetizing scheme, to polish the examined surface or to complete the examination;

7) change the magnetizing scheme in order to increase or reduce the magnetic field. Repeat operations described in items (3–6);

8) polish the examined surface to improve surface contact conditions. Repeat the operations described in items (3–6).

### 2.1 Examples of the System Effective Use

An example of effective use of the HSS for examination of the number removed from a firearm is shown in fig. 2. The examined object is the Margolin (MCM) pistol. Its general view is given in the photo (a). The red circle shows the location of the area with the number.

The zoomed photo of the number platform (b) allows estimating the width of the slot in the area of the removed number ( $\approx 4$  mm) and its depth ( $\approx 0,5$  mm). The removal of metal in the marking area exceeds the depth of the marking. As a result the signs of the number are not recognized.

Magnetic copying was carried out in accordance with the methodology described in the user's guide to magnetizing equipment Regula 7517C after partial disassembling of the pistol (blot carrier was removed). The magnetizing scheme with the examined object based on the pivoted arms of the magnetizing bracket was used.

Magneto-optical visualization results allow recognizing the initial marking — the signs «K1609» are visible.

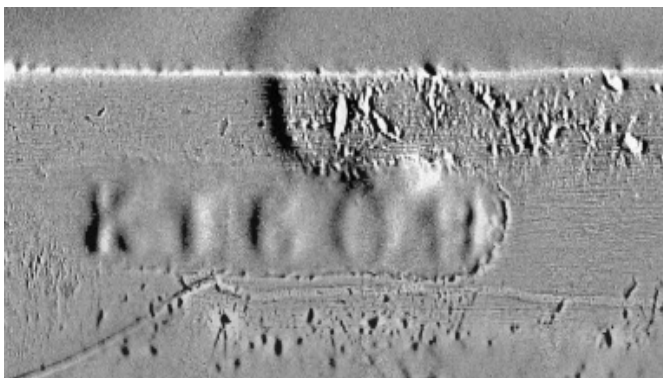
Figure 2



(a) Object photo — the MCM pistol with the removed number



(b) Photo of the number platform — elements of the number are not recognized



(c) Magneto-optical image of the area with the number — «K1609» marks are visible

**Figure 2.** Example of examination of the real object with removed relief marking.

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The other example of effective use of the HSS for examination of a corroded number is shown in fig. 3. The examined object is the Mosin rifle. Its general view (the bolt) is given in the photo (a). The red circle shows the location of the area with the number.

The zoomed photo of the number platform (b) allows estimating the degree of surface corrosion which resulted in number invisibility.

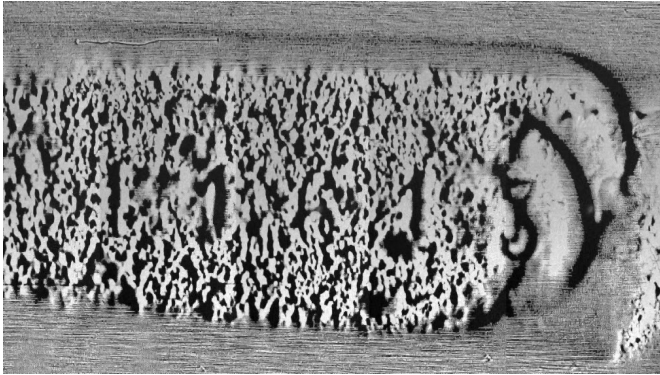
**Figure 3**



(a) Object photo — the Mosin rifle with corroded marking



(b) Photo of the number platform — elements of the number are not recognized



(c) Magneto-optical image of the number platform — The image is more informative than the optical one ("Д?1613" signs can be recognized).

**Figure 3.** Example of examination of the real object with corroded relief marking

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Magnetic copying was carried out using the rotary scanner from the set of the magneto-optical device Regula 7517A. It was impossible to partially disassemble the rifle because the bolt had been blocked by corrosion.

Magneto-optical visualization results allow recognizing the initial marking — the signs "Д?1613" are visible.

### **3 MAINTENANCE**

The required maintenance procedures are described in the user's guides to the HSS components (see the user's guides to Regula 7517A, 7517B, 7517C).

### **4 ROUTINE REPAIRS**

Instructions on system repairs are given in the user's guides to the HSS components (see the user's guides to Regula 7517A, 7517B, 7517C).



## 5 STORAGE

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

### **Climatic Storing Conditions**

<b>air temperature</b>	+5°C ... +40°C
<b>relative air humidity</b>	up to 80 % at temperature of +15°C
<b>atmospheric pressure</b>	100 +/-4 KPa (750 +/-30 mm mercury)

## 6 TRANSPORTATION

The HSS should be transported in the industrial packaging of the manufacturer (of the delivery set). Use also the transportation stopper of the device Regula 7517A.

Provide climatic conditions given in paragraph 5. Protect the system from impacts and vibrations.

## 7 RECYCLING

Recycling of the equipment should be carried out in compliance with general rules adopted at the User's enterprise.

**ACCEPTANCE CERTIFICATE**

(to be completed by the manufacturer)

Magneto-optical equipment for nondestructive examination of metal surface. Hardware and software system for forensic examination of firearms and ammunition serial numbers Regula 7517

Serial number \_\_\_\_\_ is produced and accepted in accordance with obligatory requirements of state standards, current technical documentation and considered serviceable.

Date of production \_\_\_\_\_

Seal:

Manufacturer: REGULA Ltd.

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

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Phone: +375 17 2862825

Fax: +375 17 2136897

e-mail: support@regulaforensics.com

<http://www.regulaforensics.com>

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## SALE CERTIFICATE

(to be completed by the seller)

Magneto-optical equipment for nondestructive examination of metal surface. Hardware and software system for forensic examination of firearms and ammunition serial numbers Regula 7517

Serial number \_\_\_\_\_

Is sold to:

Seller's name \_\_\_\_\_

Seal:

Date of sale \_\_\_\_\_



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