

Automatic Slide Stainers EMCOSTAINER-AUTO (AFOMK8-G-01 AFOMK8-V-01): Technical Characteristics and Technological Capabilities

A.V. Bezrukov, M.E. Belanov, G.A. Bukharov, J.M. Raznatovsky

This document describes characteristics, the operating principle and technological capabilities of automatic devices for slide staining AFOMK8-G-01, AFOMK8-V-01 (EMCOSTAINER-AUTO). It provides variants of implementation for popular staining techniques (Romanovsky-Giemza, Pappenheim, Gram). Also, it offers some technological recommendations.

The morphological analysis of stained smears is one of the main diagnostic tools. It is recommended to use automatic staining to increase the process productivity, provide the uniformity and high quality of stain results, and ensure the operational safety for laboratory technicians.

EMCOSTAINER-AUTO automatic devices perform slide staining using a group method with placing of holders with slides in horizontal (**AFOMK8-G-01**) or vertical (**AFOMK8-V-01**) position. The working chamber of stainer contains 8 stations arranged in a circle. (Stations are operation desk sections equipped with the means of positioning used to arrange trays, vessels with technological liquids and holders with slides.)

Slides (smears) in automatic stainers are stained by consecutive programmed movement of holders with slides from initial parking stations with trays where the laboratory technician puts holders with slides to technological stations with vessels where preparations are processed (fixation, staining, rinsing, drying and so forth) according to the set technological program. Holders are moved by the manipulator with step drives. When all programmed technological processes are performed, holders with stained slides are returned to the initial parking station. The automatic programmed movement of holders between vessels provides the possibility to perform technological processes uniformly with the exact timing. The working chamber of the stainer is a closed ventilated space with the high safety of work. Two of the eight available stations are specialized: station No. 1 is used to dry plates, station No. 2 normally contains a flow vessel for rinsing with tap water. All stations, including the drying station, are combined (they can be used both for technological operations and for holder loading). Vessels, holders, trays and the surface of a working chamber desk are made of stainless steel. Slides are dried in the air stream; the air temperature can be programmed. A continuous flow vessel can be used for rinsing. During the staining process, you can load holders with slides. The kinematic sequence of the manipulator not only lifts the holder when taking out of a vessel, but also inclines it to ensure effective draining of the technological liquid. Management and programming are performed using the management block with a touch screen. During the execution of a technological

program, the station states and the technological progress are displayed on the touch screen and a mnemonic LED display. You can program the technological process up to 19 steps, store 20 technological programs and 50 names of technological liquids. Also, you can enter digital and alphabetic information. Automatic stainers **AFOMK8-G-01** and **AFOMK8-V-01** differ in the arrangement of slide plates in holders and overall device dimensions.

AFOMK8-G-01 provides horizontal arrangement of slides; holders and vessels can arrange 25 or 10 slides. Device dimensions: 600 x 535 x 340 mm.

AFOMK8-V-01 provides vertical arrangement of slides; holders and vessels can arrange 50 or 25 plates. Device dimensions: 600 x 535 x 400 mm.



Fig. 1 Appearance of the automatic slide stainer AFOMK8-G-01



Fig. 2 Working chamber of the automatic slide stainer AFOMK8-G-01 (cover is open, it is not shown) with the installed vessels, trays and holders. The manipulator used to move holders is shown in the center of the picture.



Fig. 3 Accessories for the automatic slide stainer AFOMK8-G-01, from the left to the right: a holder with slides, a tray, and a vessel.

Operating Principles and Function Characteristics of the Automatic Stainer.

After installation of a holder at a free tray, the stainer recognizes the presence of the holders by means of the presence sensor. Slides with smears are processed after the device cover is closed.

The stainer manipulator transfers the holder from a vessel to a vessel according to the set program. Vessels must be filled with technological liquids according to the selected program. The staining technological process finishes with drying in a stream of warm air. After that, the holder with slides is returned to the initial tray (parking station).

Automatic stainer can be suspended for a short time using the "STOP" button of the touch display. The processed holder can be taken out, and replaced with unprocessed ones. Manipulator movements are automatically stopped when the working chamber cover is opened. After the cover is closed (by pressing the "START" button), manipulator movement recommences. The working chamber is ventilated that prevents invasion of harmful substances into the laboratory air. At a sharp rise in the air temperature, the fire prevention blocking of ventilation is activated and the drying station heater is switched off in the working chamber.

The quantity of trays and vessels used depends on the technique applied. So, it is possible to perform a simple procedure with 3 vessels, for example: for a fixing agent, staining and rinsing. In this case, 4 trays will be reserved to arrange holders, i. e. it will be possible to load 4 holders with slides simultaneously (up to 200 slides).

On the other hand, when using a complex technique, you can use up to 7 stations for vessels with technological liquids. In this case a holder is loaded into the drying station (No. 1).

Modes of Movement and Parameters of Technological Process

An important feature of stainer is a possibility to program different modes of movement and processing.

Possible modes:

EXPOSURE. A holder with slides is put into a vessel with a technological liquid using 3 up-and-down movements for plate rinsing (replacement of the technological liquid layer from the previous vessel) with the subsequent exposure in a vessel for the specified time. After the specified time expired, the holder is slowly taken out from the liquid and then is sharply raised in the top position. In this position, the holder with slides is inclined for better draining of the technological liquid. In the top position, the device performs the **DELAY** of the specified duration followed by a single shaking, and then the holder is moved to the next programmed station. If the **EXPOSURE** duration is set to 0000 (0 s), up-and-down movements are not performed during the dipping phase. The exposure duration is set from 0 s to 99 min. 59 s.

ACTIVATION. This mode differs from the **EXPOSURE** mode with the periodic up-and-down movement of the holder with slides in the technological liquid – **ACTIVATION**. The interval between movements (activation) is set from 0 to 99 seconds.

DIPPING. The holder with slides is put into a vessel, and then immediately taken out from the technological liquid and raised in the top position. After that, it is put into a vessel again, etc., till all the set cycles are performed. Upon termination, the holder with slides is taken out like in the **EXPOSURE** mode with possibility of the top position holder with slides delay programming. In the **DIPPING** mode, the user specifies the number of the dipping cycles, not the processing time. You can select from 1 to 40 dipping cycles.

DRYING. The holder with slides is placed into the station No. 1 (drying station). Here, the air is blown through slides with a programmable **HEATING** parameter ("STRONG", "WEAK", "OFF").

Through programming of modes and their parameters you can perform different method operations, some of them is used in manual staining of preparations.

So, in the **DIPPING** mode, the user obviously can stain using accelerated **Diff-Quick** techniques.

To intensify the staining process in the technological liquid, **ACTIVATION** can be used.

Besides, to intensify the staining process, you can use evaporation of stain solvent during **DELAY** and using **DRYING** modes.

It is possible to apply mixing of technological liquid layers on slide plates: during the dipping in a vessel, there is no immediate full replacement of the previous technological liquid on a slide surface. By taking out a holder with slides after a short dipping (**EXPOSURE** with duration of 0 s) and using the **DELAY** mode, you can process in a mixture of two technological liquids. So, in addition to Pappenheim staining, you can stain in a diluted stain fixator (May-Grunwald, Leischmann, Wright stain): after fixation, a vessel with slides is for a short time dipped into a vessel with the buffer, taken out and exposed to the air (a perfect analogy with the fixing agent dilution at staining "on rails"). In other stain techniques, this method can be used to perform hydration, dehydration and differentiation of a preparations without big number of vessels.

Key technological process parameter is the duration that can be corrected before the program execution.

Programming of the Automatic Stainer.

The user can independently program the device. Management block with a touch graphic screen is used for management, control (monitoring) and programming. Program input, even for a complex technique, takes no more than several minutes. Input is performed either by selecting a value, or by entering digital or symbol (alphabetic) information.

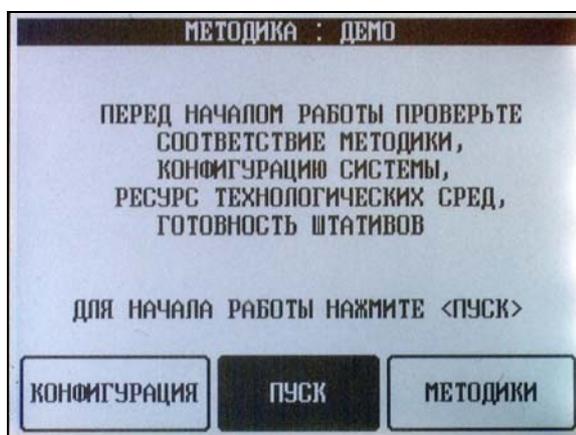


Fig. 4 Appearance of the touch screen: main menu.

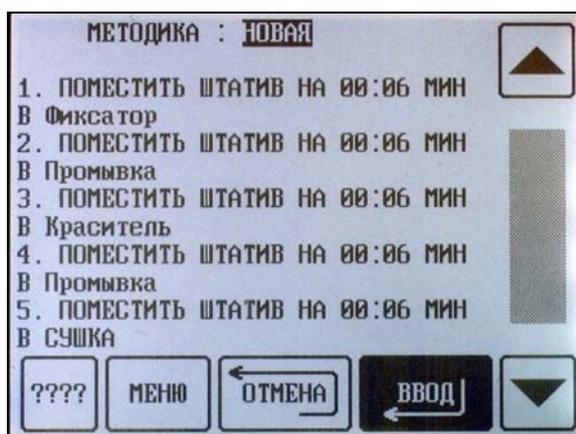


Fig. 5 Appearance of the touch screen: section of programming and technique selection.
(To enter the section, press "TECHNIQUES" in the main menu).

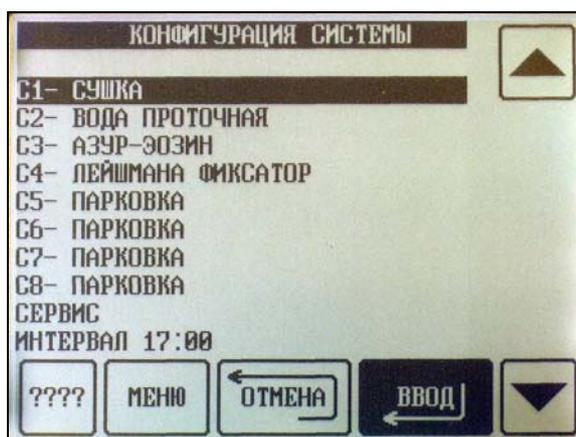


Fig. 6 Appearance of the touch screen: "Configuration" section
(To enter the section, press "CONFIGURATION" in the main menu).

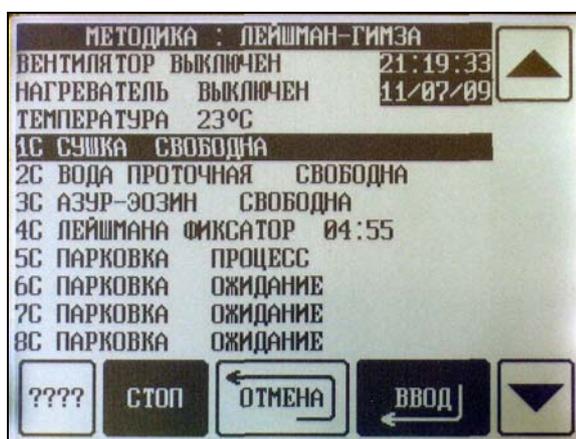


Fig. 7 Appearance of the screen during execution of the technological program.
(To enter the section, press "START" in the main menu).

The stainer controls the device system states and the conformity of the configuration to the chosen program. Also, it reminds of the working life of used technological liquids and issues prompts on user demand.

Examples of Implementation of Different Staining Techniques

The most popular and wide-spread staining methods were tested in this automatic devices. Below you can see examples of microphotos of the stained preparations on hematologic smear Pappenheim staining and microbiological smear Gram staining.

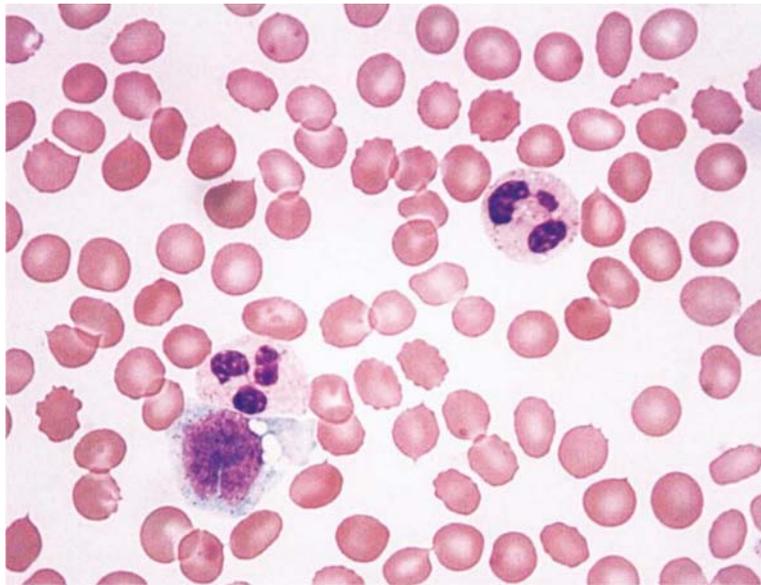


Fig. 8 Blood film Pappenheim's Stain

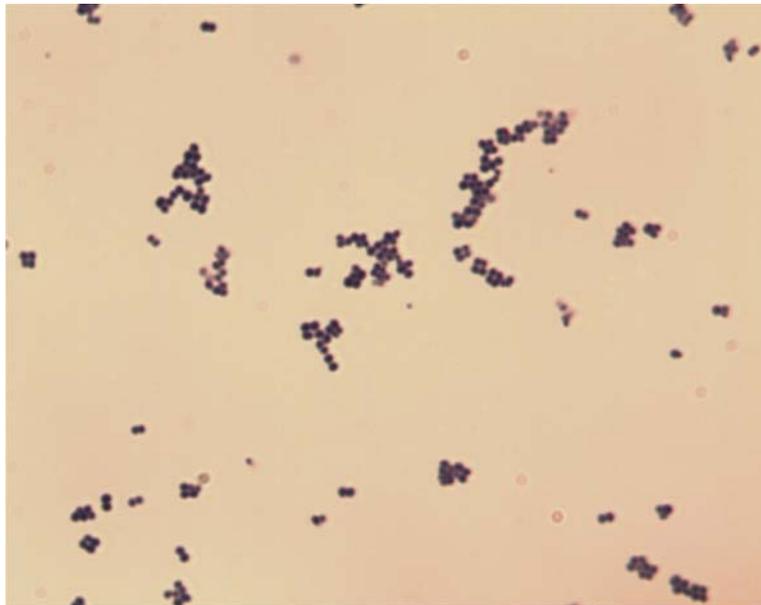


Fig. 9 Staphylococcus aureus with concentration of 10^9 [CFU/ML]. Gram's Stain