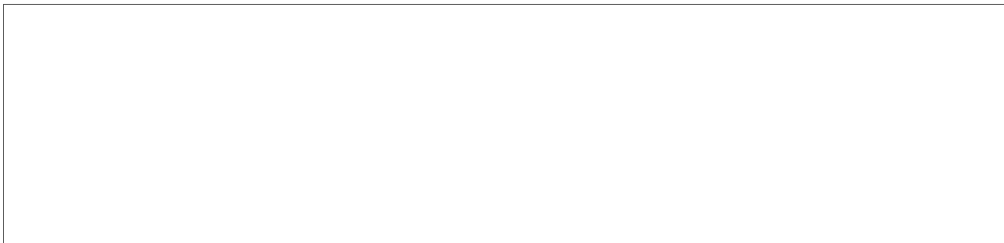


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The Establishment of a Training Materials Base  
for Special Training in Missile Regiments

The modern missile weapon is a complex of diverse and complicated equipment, mechanisms, and assemblies, created as a result of the latest achievements in a whole series of scientific and technical fields.

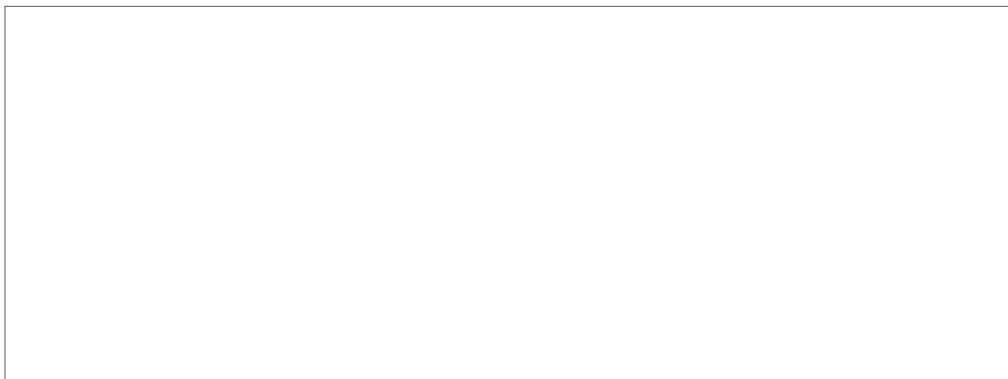
The complexity of the equipment, the high demands for precision in its manufacture, and the great stability of the parameters, given by the basic instruments -- all this has a definite impact on the operation of missile complexes.

The process of preparing missiles for launching is very complicated, protracted, and completely taken up with different operations, the performance of which demands great skill and attentive and laborious work by the personnel. The slightest negligence by any member of the crew who does not possess sufficient skill at his work may lead, at best, to a delay in the launching of the missile. Therefore, the designers are confronted with the task of simplifying to the maximum the technology of preparing missiles for launching.

The inadmissibility of a violation of the instructions during the performance of technological operations, and even more, of breakage of material and of the putting out of commission of expensive instruments and assemblies, and, at the same time, the demands for high speed in the work of preparing missiles for launching, imposes great responsibility for his own sector of the work on each member of a crew. Therefore, the operation of missile equipment, which constitutes most of the everyday combat work of subunits, is impossible without the appropriate special training of the personnel.

In many cases, missile units are reinforced with officers who have no previous training in missile specialties. Officers who have completed courses of short duration at higher educational institutions and at industrial enterprises must constantly renew and increase their

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knowledge directly in missile regiments.

Thorough knowledge of the materiel, of the physical nature of the processes and phenomena which take place during the work of the instruments, units, and assemblies and a knowledge of the procedure and rules for preparing them for work are needed, not only by the officers, but also by the enlisted men and noncommissioned officers. The latter must have the requisite knowledge, both of their own sector of work and of those allied to it. These requirements are imposed because, first of all, an officer is not able to check the correctness of all the technological operations carried out by the crew members constantly; and secondly, because in the organic structure of subunits it is sometimes necessary to replace engineers by technicians and technicians by enlisted men and noncommissioned officers (in secondary sectors of work). In addition, enlisted men and noncommissioned officers who have not acquired thorough knowledge and experience in working with the equipment may quickly lose these skills after their demobilization from the army, which will undoubtedly have an adverse effect on the preparedness of reserve cadres. Therefore, missile units, even in peacetime, must become a school for the special training of personnel.

This task can only be accomplished by having a complete training materials base in missile regiments which fully supports the normal course of combat training.

Experience shows that a good training materials base, even if it has no organic equipment (vocruzheniye) at all, allows the training of personnel in the use of equipment in a sufficiently short period of time (this is very important in the formation of military units before they receive new types of missile equipment).

The training base ensures deeper study of the materiel by personnel, and helps them to acquire practical skills in work with materiel. In turn, work with training equipment excludes the possibility of the premature exhaustion of resources of equipment and also of breakages and faults and of the putting out of commission of the various assemblies of a combat missile.

What should the nature of a training materials base for specialized training in a missile regiment be?

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First of all, beginning with the stages of training personnel, a training materials base should provide:

-- the preliminary training of personnel in applied subjects, such as electrical engineering, radio engineering, mechanics, chemistry, optics, etc., regardless of the fact that these subjects may have been studied before or during familiarization with missile equipment; the study of applied subjects is essential for thorough understanding of the principles for setting up instruments and assemblies and of the physical nature of the processes and phenomena which occur during the work of the personnel;

-- complete and thorough study of the mechanism and workings of the separate instruments, components, systems, and assemblies of the missile and of the whole complex of ground equipment;

-- the thorough perfection by the personnel of methods and of practical skills in the execution of each technological operation specified in the Technical Conditions for the Operation of a Missile (Tekhnicheskiye usloviya na ekspluatatsiyu rakety);

-- the coordination of combat subunits through the carrying out of an entire complex of training work in the preparation (or simulated preparation) of a missile for launching, checking that technological operations are performed correctly;

-- the working out of problems of the storage and preservation of material, the carrying out of technical inspections, of preventive (profilakticheskiy) work, and of routine maintenance work (reglamentnaya rabota);

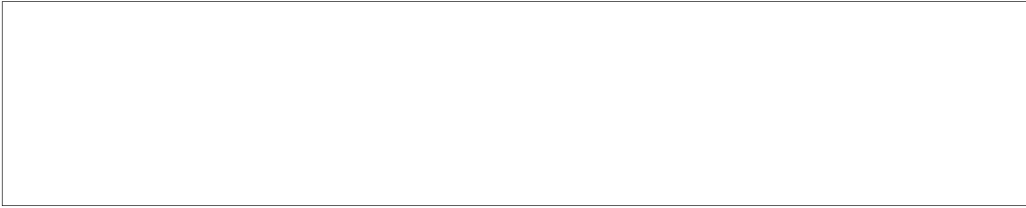
-- the firm mastery by personnel of all the rules of the safety techniques in work with materiel.

The training aids and equipment of a training materials base are divided into the following main groups.

Technical documentation and literature. The constitution of this group of training aids is determined by the complexity of the equipment available as armament. Besides classified (grifovanny) technical documentation and literature about missile equipment, an adequate quantity

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of regular and universally available textbooks on electrical engineering, radio engineering, and on other applied technical subjects should be held in a regiment.

Training posters. Posters should occupy one of the most important places in a training materials base, because the use of visual educational aids is a very important factor which helps in the study of equipment. Furthermore, the availability of posters helps those who are directing studies but who lack adequate experience to carry out the studies correctly, according to methodology, and frees them from the unnecessary expenditure of time in drawing complicated sketches and diagrams on the blackboard. Posters allow the internal mechanism of devices and assemblies to be shown.

Posters depict the most important diagrams, schedules, tables and complicated instruments and mechanisms, and their separate parts, details, and components. Posters should be prepared in several colors. The use of several colors, as a rule, increases the clarity of the training aids and simplifies assimilation of the training material.

It is necessary to have posters showing the structure of all the assemblies of the missile complex, and-- when organic equipment is not available-- the general appearance of the separate assemblies, control panels (pult), etc., as well.

Electrified diagrams (stands). In order to simplify the study of complex electric, electronic, kinematic, hydraulic, or pneumo-hydraulic diagrams of instruments and systems, electrical lighting of the basic elements of a diagram is normally used. The switching of the lighting in order, as the elements are worked through, may be carried out both manually and automatically by means of time mechanisms and relays incorporated in the lighting circuit.

By improving the lighting circuit and by introducing additional automatic units, it is possible to achieve the visual representation of the workings of such processes as the flow of liquids in pipelines, the movement of mechanisms, burning, etc. Although the production of electrified stands is difficult and takes up a lot of time, they justify themselves, because they help with the better assimilation of the material which is being studied.

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Mock-ups and models. In order to demonstrate the structure and working principles of the main instruments, mechanisms and assemblies of missile equipment, mock-ups and models are prepared. These may be in one plane, built up on panels, or three-dimensional (obyemnyy), and static or working.

Mock-ups and models are indispensable in the absence of cross-sections of actual elements of equipment. It is probably impossible to give a better demonstration of how a type of mechanism works, or of the coordination of its parts while it is working with any equipment other than working mock-ups and models.

Working mock-ups and models may be used not only to show the work of individual instruments and mechanisms, but also to demonstrate coordination in the work of several assemblies (for example, the coordination of the pad (stol), carrier (teleshka), and erector (ustanovshchik) in the installation of the missile on the launching pad, etc.).

Specialized training aids (trenazher). Training aids are constructed for the carrying out of separate technological operations and to impart practical working skills to personnel.

In their purpose, construction, and complexity, training aids may vary quite widely. Training aids range from the very simple (for example, the device for training in the plugging in of connectors (podklyucheniye shtepselnykh razyemov) and fueling hoses) to the very complicated (for example, the trainer for  $\sqrt{5}$  to 7 words missing/ pad).

Training aids should be created for the mastery of such operations and work as the adjustment (nastroyka) of pressure regulators (reduktor davleniya), the adjustment of the throttles (drossel) of the system for emptying the tanks, the installation of the powder charge ignition (pirozazhigatelnyy) device, checking the resistance of the insulation, checking the powder squibs (pirozapal), checking the pressurization (germetichnost), adjusting the automatic range controls (avtomat upravleniya dalnostyu) checking the gyroscope devices (giropribor), laying the cable network (razvertyvaniye kabelnoy seti) at the technical and launch sites, etc.

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Actual instruments, components, and parts of missile equipment assemblies. The availability of cross-sections of instruments, components, and other elements of missile equipment considerably enriches a training materials base and facilitates its establishment to a certain extent. Thus, for example, the need for the preparation of certain posters giving a general view and cross-sections, and of certain mock-ups, etc., disappears. In addition these elements can be widely used for the preparation of stands, models, and training aids.

Training sets of missiles and ground equipment assemblies are used to perfect the practical skills of personnel in their use of missile equipment, to bring the methods for carrying out technological operations to the point where they are performed automatically and primarily for the coordination of the operations of combat subunits.

The correct distribution of equipment to training classes is of great significance in the organization of special training. A list of these classes has already been given to the troops.

For the special training applicable to intercontinental (mezhkontinentalnyy) ballistic missile units, the following list of equipment is recommended for training classes.

The class on missile construction and propulsion systems (there are two classes to a regiment):

-- a set of training posters on the construction of a missile, of the propulsion system (dvigatel'naya ustanovka) and of the auxiliary equipment and on operation and safety techniques;

-- working mock-ups and models which demonstrate the coordination of parts when the pressure regulators, the electro-pneumatic valves (elektropnevmoکلapan), the pressure relays (rele davleniya), and other automatic elements in the propulsion system are working;

-- a working mock-up showing the nose cone separation process of the missile;

-- a working mock-up of the system for emptying the tanks;

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- an electrified pneumo-hydraulic diagram of the missile;
- an electrified assembly diagram (blok-skhema) of the system for regulating the apparent speed;
- a training aid to carry out the pneumatic testing of the missile;
- training aids for the adjustment of the pressure regulator and of the throttle of the system for emptying the tanks;
- a set of cross-sections of the instruments, components, and assemblies of the missile and of the propulsion system;
- a set of samples of the tools, accessories, and devices used during operation.

The class for complex testing of the missile (one class to each battalion):

- a set of training posters showing overall views and the front panels of the NIPEO control consoles (in the absence of organic equipment), overall views and the layout of the elements of the electrical equipment, and of operating and safety techniques;
- posters showing the pneumo-hydraulic system of the missile, a general diagram of the missile-borne (bortovaya) guidance system, the system of the cable connections of the technical and launch sites;
- working models to demonstrate the work of the timing mechanism, the relay, the programmed current distributor (programmnyy tokoraspre-delitel) and others;
- an electrified diagram of the complex testing of the missile guidance system (with a simulation of the preparation for a launch and of a firing.);
- an electrified stand simulating the movement of the missile in trajectory;
- a training aid for carrying out self-contained and complex tests on a missile;

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-- training aids for work on the plugging in of connectors and for the laying of the network of cables at the technical and launch sites;

-- a set of the components of the missile-borne electrical equipment and NIPEO (cables, connectors, relays, timing mechanisms, programmed current distributors, switches, and others).

The class on the self-contained guidance system (one class to each battalion):

-- a set of posters showing overall views and the arrangement of the main instruments of the guidance system (when actual samples are not available), filmed and electrified diagrams of the principles of the missile-borne instruments, of sources of power, and of elements of the commutation apparatus;

-- working mock-ups and models demonstrating the work of the gyroscope, of the control actuator (rulevaya mashinka), of the speed regulator gear (privod regulatora skorosti), of the gyroscope-stabilized platform (girostabilizirovannaya platforma), of the programmed impulses gauge (datchik programmirovannykh impulsov), and others;

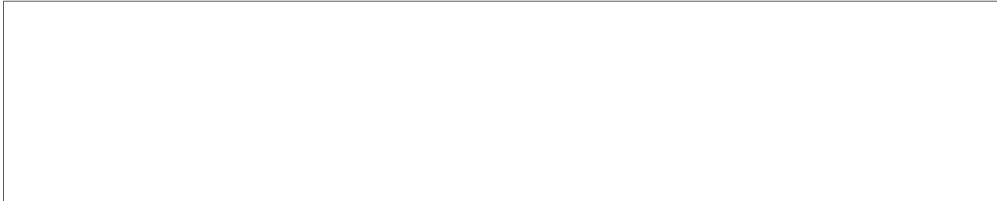
-- electrified diagrams of the automatic stabilizer (avtomat stabilizatsii) of the normal and lateral stabilization systems (normalnaya i bokovaya stabilizatsiya), of the programmed impulses system, of the system for regulating the apparent speed of the automatic range control (avtomat upravleniya dalnostyu), of the system for emptying the tanks and of the emergency destruct system of the missile (avariynyy podryv rakety);

-- training aids for checking the gyroscope-stabilized platform, the tuning of the automatic range control, and for checking the resistance of insulation, and of the powder cartridges (piropatron);

-- a collection of cross-sections of the instruments and elements of the electrical circuits.

The class on launching equipment and on the aiming of the missile (two classes to a regiment):

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-- a set of posters on the launching equipment materiel, and on operating and safety techniques;

-- a set of posters on the aiming instruments;

-- a stand display window on "The Transport, Storage, and Transshipment of Missiles";

-- a mock-up of a launching platform with equipment disposed on it in one of the degrees of readiness;

-- mock-ups of ground equipment assemblies (in the absence of organic equipment);

-- an electrified diagram of the electrical equipment and hydraulic system of the erector (ustanovshchik);

-- an electrified diagram of the electrical equipment of the crane (kran);

-- a training aid stand for the operator of the hydraulic system of the erector, on the erection of the missile on the launch pad;

-- a training aid stand for the mechanic-crane operator on the transshipment of the missile;

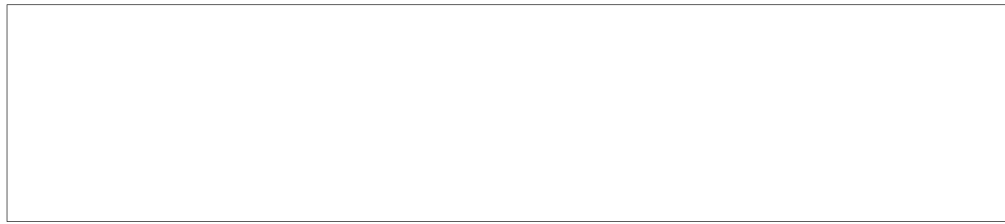
-- a collection of cross-sections of the assemblies, instruments, and other elements of the launching equipment;

-- a training set of ~~aiming~~ instruments.

The class on fueling equipment and missile fuel (one class to a regiment):

-- a set of posters on the fueling equipment and missile fuel material, and on the operation of assemblies and safety techniques;

-- a working mock-up demonstrating the work of the level gauges (datchik urovnya) and of the devices for signalling filling limits (signalizator predelnogo napolneniya);



-- an electrified stand on "The System for Controlling Fueling from a Distance";

-- electrified diagrams of the electrical equipment and hydraulic systems of the fuel and oxidizer servicers (zapravshchik);

-- a training aid stand on the fuel servicer;

-- a training aid stand on the oxidizer servicer;

-- a training aid for instruction in the connecting of hoses;

-- a chemical laboratory training set;

-- a panel on "Samples of Missile Fuels in Use";

-- a collection of cross-sections of instruments, components, assemblies, and other elements of the fueling equipment.

The class on compressor and nitrogen-extracting stations and diesel electric stations (one class to a regiment):

-- sets of posters on each type of material equipment, on operational and safety techniques;

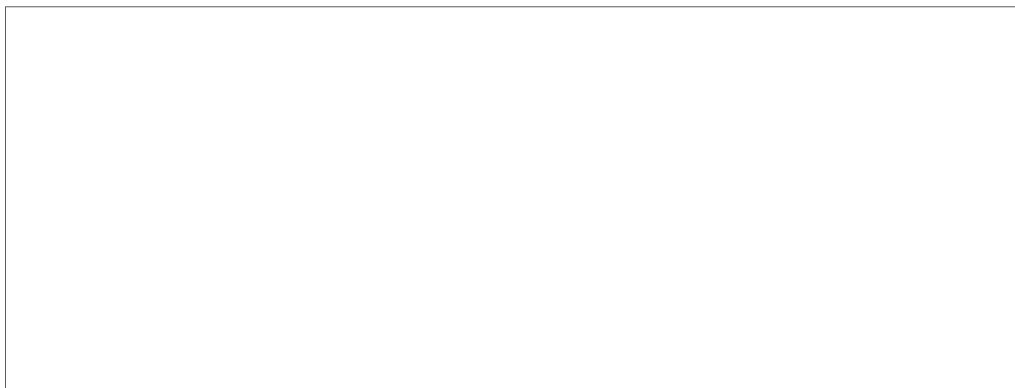
-- an electrified diagram of the electrical equipment of a compressor station;


-- an electrified assembly-diagram of the air system of a compressor station;

-- an electrified diagram of the electrical equipment of a nitrogen extracting station;

-- an electrified stand on "The Work of the Technological System of a Nitrogen Extracting Station";

-- electrified diagrams of the electrical equipment of a diesel electric station and of an electrical transformer assembly;



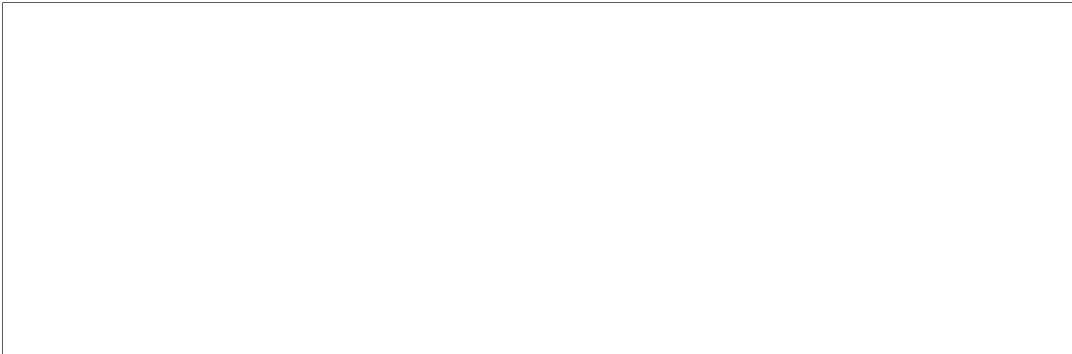
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- training aid stands on each type of equipment (with control panels, simulating the work processes);
  - training instruments for the analysis of special fuels;
  - collections of cross-sections of the assemblies, instruments, and mechanisms for each type of equipment;
  - working models and mock-ups demonstrating the work of individual elements of the equipment.

The class on radio-telemetering equipment (one class to a regiment):

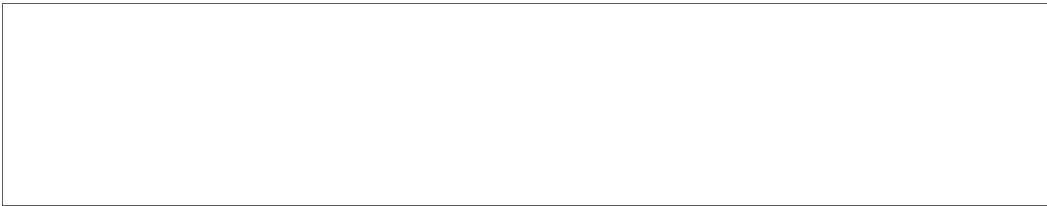
- a set of posters and diagrams about the structure of the radio-telemetering equipment, its operation and safety techniques;
- a set of working mock-ups and models, demonstrating the work of separate elements and instruments of the radio-telemetering equipment (an electronic tube, an electronic amplifier, a multi-vibrator, a generator, the simplest receiver, and others);
- an electrified assembly-diagram of the equipment of the radio-telemetering station;
- a set of electrified diagrams of the most distinctive assemblies of the radio-telemetering equipment;
- a collection of the elements, instruments, and mechanisms of the radio-telemetering equipment.

A similar list of equipment for the training of classes, with some changes, is also quite suitable for intermediate range missile (raketa sredney dalnosti) units. However, the proposed list should not in any way hinder the showing of initiative locally. On the contrary, such initiative will help to improve the equipment of the classes, and will stimulate the personnel to a better understanding of their specialty.

Here the minimum necessary number of training classes for the



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special training of a regiment of intercontinental ballistic missiles is reviewed. The equipment of classes in each individual case depends on a whole series of factors -- the organic structure of the subunits, for example, on the availability of training equipment, on the number and size of rooms set aside for the classes. The number of training classes must always provide for the normal progress of the combat training of all subunits.

Diagrams, posters, tables, and panels must be of such a size that the parts and texts shown on them are visible from all the seats in the classroom. Sketches drawn on paper should be pasted on cardboard or on cheesecloth for durability. Posters which are to be hung must be equipped with special loops or rings.

In all training classrooms it is advisable to arrange devices for hanging posters on the walls or on stands.

For the demonstration of small elements, for example, electrical circuits, automatic equipment of a propulsion system, or of flat models, panels are prepared. Large or heavy instruments, assemblies, and mock-ups are stored in the classrooms on stands or supports.

In the preparation of training equipment (regardless of its type), the possibility should be considered that some changes in its structure without basic rebuilding, may be necessary, as should the feasibility of partial disassembly for transportation, and of building the equipment from available (not scarce) materials.

Training equipment must not only completely represent the subject, but should also be attractively and well made up, because well produced stands, posters and training aids increase the interest of the pupils in the subject being studied. However, improving the standard of preparation does not at all mean that it is necessary to install massive stands and supports finished in rare varieties of wood. Expensive construction in equipment may be justified to a certain extent for study rooms and auditoriums in institutions of higher learning, but not for classes in units. Such stands need a great expenditure of forces and means, which often far exceeds the cost of the mock-up or diagram itself.

The basic requirement made of training equipment is that it should ensure the maximum intelligibility of the material being studied. When preparing the equipment, this requirement should not be forgotten. If, for example, in an automatic electrified diagram, the possibility of stopping it at a given operation is not foreseen, or the possibility of independent (separate) illumination of its elements, if a diagram is prepared on a dark background, without clear listing of the elements using added terminology, then the diagram may lose its value as a training aid to a significant degree.

The greatest difficulty in setting up a training materials base will be presented by the development and preparation of working models, electrified diagrams and training aids. Technical guides to the preparation of this equipment consist mainly of technical and operating documentation, describing and directing the work of the respective missile equipment assemblies. For example, electrified diagrams of the respective systems are drawn on a large scale, and for clarity certain additions are introduced (different colors for individual elements, relief, etc.). The installation of electrical illumination depends on the purpose and the availability of the various automatic elements of the diagram being prepared. Thus, the design collective of units must be able to carry out the development and preparation of similar diagrams without any additional documentation.

The activities of the design groups of rationalizing and inventing collectives in the regiments must at present be directed mainly toward the solution of the main task of supplying training materials bases with special training aids.

As has already been said above, the technological process of preparing a missile for launching consists of a large number of different operatives, for the correct and rapid fulfillment of which a good standard of training is needed in the personnel. For this, the best training aids will be actual examples of missile equipment, but in practice, the requirement for the high combat readiness of material and for the preservation of its resources excludes the possibility of frequent training with it. Additional training of personnel must be carried out on specialized training aids.

Specialized training aids cannot be examined in isolation from other types of training equipment. It is sufficient, for example, to put the elements for controlling the illumination of the electrified hydraulic and electrical diagrams of the fuel servicer on a separate panel, arranging them in the same order as in an actual assembly, and one has a training aid which will permit the members of the crew to perfect the work of fueling. The same applies to the working model of an erector. An electrified pneumo-hydraulic diagram of the missile will make an original training aid if the possibility of simulating prelaunch preparation is taken into consideration during its construction.


In order that a crew member, working with a training aid, can follow the results of his actions, it is advisable to develop training aids which are combined with electrified diagrams and working mock-ups. In training aids which are being set up it is essential to foresee the possibility of having the instructor artificially introduce various malfunctions, in order to train the personnel in their quick detection and correction.

Thus, for non-organic design organizations and for the rationalizing and inventing collectives of missile regiments the field of activity in the problems of development and preparation of training aids is very wide.

In setting up a training materials base, the problem of finding materials for the preparation of training equipment assumes a special place. Elements and assemblies of missiles which are of obsolete construction and aircraft equipment, delivered to units for mounting by classes, are a big help in the preparation of training aids.

For most samples of equipment only general commercial materials are needed, but for some samples elements in short supply are used--relays, timing mechanisms, small electrical motors and other elements of automation, which are general purpose products and are not produced at missile equipment enterprises. Attention should be drawn to the initiative of certain unit commanders, who managed to organize the receipt of sub-standard (nekonditsionnyy) production samples (relays, electric motors, etc.) from enterprises of the electrical industry, located close to their disposition areas.

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Part of the equipment of training classes (from the list given above), intended for manufacture by the forces of regiments, was entered in the Table of Norms for the Supply of Military Training Equipment to Units of the Missile Troops (Table norm snabzheniya voyenno-uchebnym imushchestvom chastey raketnykh voysk). Materials in short supply will be supplied by the Chief Engineering Directorate of the Missile Troops (Glavnoye inzhenernoye upravleniye raketnykh voysk--GIURV) on application by units.

The Table of Norms for the Supply of Military Training Equipment envisages the preparation of the following equipment at the repair factories of the Chief Directorate of Missile Troop Equipment (Glavnoye upravleniye raketnogo voyskovogo oborudovaniya--GURVO) and its supply to units:

- training aids for carrying out the pneumatic testing of a missile;
- training aids for carrying out independent and complex testing of the control system;
- training aid stands on the oxidizer servicer;
- training aid stands on the fuel servicer;
- training aid stands on the erection of a missile on a launch pad.

Some of the samples of this equipment are already prepared at troop units and handed over for adaptation and perfection to the repair factories of GURVO, and part is still being developed at institutions of higher learning and in troop units in accordance with subjects of scientific research which have been assigned. But these are only the first steps. It is possible to evolve and prepare all the samples of training equipment, including simple training aids for the perfection of individual operations in the technological process of preparing missiles for launching, with the forces of the design collectives of units.

In view of the need for the quickest possible equipment of missile troops with high quality training and practice equipment,



it is advisable to set up a special experimental-design organization, supplying it with an experimental and a production base. Great assistance must be rendered to the units in the evolution and preparation of training equipment by the workers of the directorates and services of the Commander-in-Chief of the Missile Troops.

In certain missile regiments, the construction of training buildings to house the special training classes is being carried out with initiative. This is a very good start. It is advisable to encourage this initiative in every way.

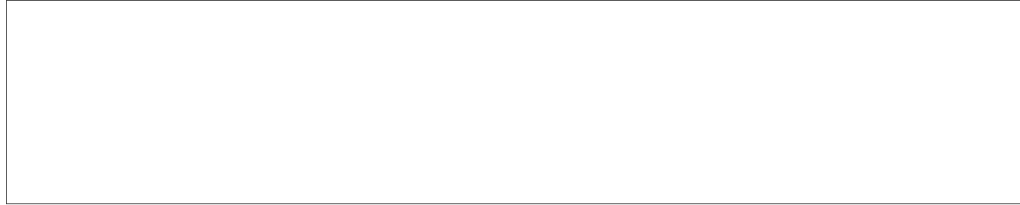
The constant exchange of experience of work and of periodic information about achievements in setting up a training materials base is also not unimportant.

The commanders and political workers of large units and units are responsible for setting up a model training materials base for special training. However, there have been some cases in which commanders of regiments who did not have a training materials base, on receiving instructions on the establishment of a non-organic design bureau, have limited themselves to writing into the instructions the names of several officers who have entered the composition of these bureaus.

In their content, composition, and work, non-organic design bureaus must conform with their designation. The preparation of training aids greatly facilitates the improvement of the special training of those who are to carry out the work directly. It is necessary to bring the most skilful craftsmen (master) and handy men (umelets) from among the enlisted men and noncommissioned officers into the design bureaus. The design bureaus must be supported with all means, material and tools, and special premises and a production base must also be allotted to them, even at the expense of existing repair shops. Specific tasks with time limits for their performance and for the preparation of this or that sample of training equipment, should be assigned to the design bureaus after the status of the training materials base has been clarified and after the availability of means and materials has been determined.

It is necessary to search more persistently and locally for all the ways and means to combat this task, directing Party and Komsomol organizations toward its accomplishment, and enlisting the whole group spirit of units.

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**The establishment of a model training materials base in each missile regiment within a short period of time is the duty of all commanders and chiefs at all levels.**

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