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Air Forces Armaments Chief on Problems, Prospects

92UM0897A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) pp 2-3

[Interview with Air Forces Deputy Commander-in-Chief for Armaments and Armaments [Directorate] Chief of the Air Forces, Doctor of Technical Sciences and Professor Lieutenant-General of Aviation Abrek Idrisovich Ayupov under the rubric "Our Commanders": "Looking to Tomorrow..."]

[Text] *Our editorial mail has letters that talk about shortages of aviation hardware (AT), operational documentation for it and technical maintenance equipment. The economic crisis is evidently making those issues even more acute.*

What will it be like, future Soviet aviation hardware? What path will it have to traverse, skirting the "reefs" of conversion, under the conditions of cutbacks in all types of resources for its creation?

That is discussed in this interview. Our interviewee is the Deputy Commander-in-Chief of the Air Forces for Armaments and Armaments Chief of the Air Forces, Doctor of Technical Sciences and Professor Lieutenant-General Aviation Abrek Idrisovich Ayupov.

[Question] Comrade Lieutenant-General, what is the activity of the service that you head?

[A.I. Ayupov] The armaments service of the Air Forces orders the industrial development and production of new combat aviation hardware and spare parts for it. The activity of the service is aimed at the technical realization of military doctrine in the realm of the development and application of combat aviation. I would ask you in advance to pardon me if I am not always concrete in my answers, since most of the decisions in this realm are strictly confidential.

The armaments service of the Air Forces, in an organizational regard, coordinates the activity of the institutes and flight-test centers of the Air Forces and directly supervises the work of the military representatives at the corresponding enterprises of industry.

[Question] Abrek Idrisovich, an article by Colonel A. Stefashin, published in Issue No. 12 of AVIATSIYA I KOSMONAVTIKA for 1990, gave his view of the principal shortcomings of the system for creating new aviation hardware. Do you agree entirely with his opinion? What is being done on the plane of improving this system, and what is projected to be done?

[A.I. Ayupov] I agree entirely with the shortcomings that exist in the process of creating aviation hardware, and I can supplement them where necessary. But the explanation of the causes, in my opinion, was too one-sided. The author of the article, for example, saw a way out in the transfer of appropriations for the development and production of aviation equipment from the manufacturing ministries to the customer—that is, to the USSR Ministry of Defense. That procedure has been adopted starting this year. The efficiency of capital investment has increased by 30-60 percent, but the shortcomings that were noted continue to "flicker," since they have multiple causes.

On the one hand, the existing system of creating aviation equipment has some noteworthy achievements that cede nothing to foreign ones. They include the MiG-29 and Su-27 fighters, the land-based cruise missiles being destroyed under the INF Treaty, the An-124 Ruslan aircraft, the Buran space plane and the An-225 Mriya booster etc.

There are also, on the other hand, instances of the irresponsible breach of deadlines for the creation of aviation equipment prototypes, instances of poor design study, monopolist dictate, official "arm twisting" and the like that have occasionally made themselves felt. The system for creating aviation equipment is only a fragment of the overall social-production picture of society in that regard.

What is important to us is not a search for integral shortcomings in the form of "blame" for the system, but rather a scrupulous, detailed and open analysis of the specific errors of specific officials.

The system of creating aviation equipment is in need of further development and improvement. It should enter into market relations, adapt to the limits of conversion, survive under conditions of cutbacks in state budgetary appropriations and structure relations with the customer and the manufacturer on a contract basis. The material vested interest of the participants in the end results must be increased, competitiveness introduced in development and the role of the ultimate consumer—the line units—strengthened at all stages of the process of creating aviation equipment, among others.

An interagency group of specialists has been created and is operating for this purpose, creating a draft of the "Statute on the Procedure for the Creation of Aviation Hardware for Combat Purposes."

[Question] The history of domestic aviation knows a host of cases where aviation equipment was accepted for service that did not, to put it mildly, fully correspond to the preliminary tactical-technical specifications (TTZ) for its development. Industry is obligated gradually to bring that aviation equipment into condition right during the process of using it for its purpose. Industry has until recently refused to pursue measures to raise reliability to the level specified in the TTZ, requiring payment for that from the Air Forces. One can of course delve into the details of each instance, but overall, in your opinion, should such actions by industry be considered legitimate?

[A.I. Ayupov] When the aviation equipment created does not correspond to the TTZ—it has been officially reported at all levels of command, but it is nonetheless accepted for service—many participants in the process of creating it are at a loss, and those who start to operate it are dissatisfied. There is blame here for the supervisors, who do not pass along to the personnel all of the circumstances for the acceptance of the hardware in such a form. The principal reasons for these decisions are political (the country must have this type of weapon), technical (it has been proved by special commissions that the requirements of the TTZ are too high and are not fulfillable in practice), a shortage of time (so much time is needed to bring the model up that it will be functionally obsolete and not needed by anyone), economic (there are not enough funds to achieve the TTZ in the assigned time period, it can only be refined later), social-production (it is necessary to start series production sooner, since the manufacturing plants cannot be left idle) and the like.

The refinement of the aviation equipment in service is inevitable in all these cases. Since appropriations now exist only with the customer, we should pay. The amount and list of refinements will have to be cut back to a minimum under conditions of sharp reductions in the funds being released, leaving just those that are connected with reliability, service lives and, most importantly, with safety.

The instances noted above of the acceptance of unfinished and untested hardware into service should virtually disappear in the future, with a reduction in the dictate of authoritarian decisions. Matters are moving toward that.

[Question] Our aviation equipment has a high and well-deserved reputation around the world. But that pertains to its flight and combat characteristics. It is well known to specialists that it is inferior to analogous foreign hardware in technical-servicing properties. Is that due to our poverty or from a lack of understanding of the role of the human factor in the technical servicing of aviation equipment? It looks like the sense of the expression "success in the air is forged on the ground" in the unit, pertaining to the preparation of aviation equipment for flights, is fading from the consciousness of both the developers and the customers of the aviation equipment, since proper attention is not paid to it. To form such an opinion it is enough to compare, for example, the execution of the servicing documentation for aircraft in the 1950s and the aircraft in our most recent generation.

[A.I. Ayupov] The term "servicability" became a commonly recognized one in practice as an indicator of aviation equipment quality about eight years ago. A lack of understanding of the importance of servicing characteristics had thus existed before. Today that lack of understanding has been replaced by a lack of the essential appropriations both for the refinement of hardware already being operated, and for the construction of additional airfield facilities and outfitting them with maintenance hardware.

The more complex an aviation system, the greater the volume of maintenance documentation. This is a reflection of the overall "information boom" in world practice. The overall amount of maintenance documentation has increased by a hundred to a hundred and fifty times compared to the 1950s, for example, and a combat pilot should study and remember four hundred restrictions and specific features in controlling the aircraft in flight.

Research is now underway to optimize the presentation of information in the maintenance documentation on the basis of pictographic principles. The results are encouraging.

[Question] The most labor-intensive operation in the preparation of an aircraft is fitting it with aerial weaponry (ASP). Air Forces specialists have been coming forth with very sensible suggestions, in my opinion, in the pages of the journal. Please tell us, for example, when the adoption of a built-in on-board system for the loading of ASP is planned? Specialists from the IAS [aviation engineering service] and the rear services are clearly interested in receiving an answer from you to the question of whether cardinal improvements in all means of technical servicing are being planned.

[A.I. Ayupov] If labor-intensiveness is taken to mean the physical burden of the servicing crews, the issue is the adoption of mechanization equipment. The replacement of the loading winches with more modern ones is envisaged in the future. The fitting of the new generation of aircraft with built-in weapons-loading units is planned. The development of universal modular self-propelled systems for bringing up and loading ASP, as well as robotized ones, is underway.

On-board automated monitoring systems, as well as integrated systems for the gathering and processing of flight information, are also being created to improve the monitoring of aircraft readiness for flight.

[Question] One painful question for the Air Forces is spare parts. Your service has the leading role in the system for providing them—you are both the customers for the spare parts and also, most importantly, you are the customers for the aviation equipment itself, whose reliability determines the requirements for them. The chief of Air Forces rear services reported to the readers in issue No. 9 of our journal on work to improve the supply of spare parts, but what is planned to be done on the part of the customers?

[A.I. Ayupov] The less the reliability of the constituent parts and elements of an aircraft, the less the service life and the greater the quantity of them that you must have in reserve.

The task of the armaments service of the Air Forces is to order the necessary quantity of spare parts for the formation as accomplished according to the yearly requisitions of the Air Forces rear services. They are virtually entirely fulfilled.

The whole issue is reduced to the satisfaction of real-time requisitions for spare parts that arise unexpectedly. Industry is not prepared for tasks above and beyond the plan, since it is not supplied with a quantity of constituent elements and raw materials above and beyond the plan. Analysis shows, on the other hand, that the yearly requisitions are composed with considerable padding, largely surplus, and the spare parts that are manufactured cram the warehouses. The real way out consists of raising responsibility for the quality of the annual requisitions, and forming a "real-time reaction" fund from the funds that would be freed up.

Raising the quality, reliability and service life of the hardware to the point where it is accepted for the supply of the line units should be considered the main thing for the armaments service of the Air Forces.

[Question] Have you encountered in the press the opinion that our misfortunes with the quality of armaments and combat hardware (VVT) are connected with a mercenary-minded "merging" of the customers with industry? How would you answer such an accusation directed at your service?

[A.I. Ayupov] That opinion has been encountered not only in the press, but also in anonymous statements, as well as the letters of military specialists to various state bodies, including law-enforcement ones. Various commissions have been working continuously by turns over the last five years. The last was assigned last year by order of the President of the USSR and involved prominent scientists and representatives of Soviet, monitoring and law-enforcement supervisory bodies. No foul play was found connected with any mercenary "merging" of the customers and industry.

[Question] Representatives of the customer in times past were made, either inadvertently or intentionally, dependent on the administration of the enterprises (housing, bonuses, travel passes and the like). How real is their independence today?

[A.I. Ayupov] The military representatives at the industrial enterprises are in an especially difficult situation today. First of all, they are officers and the members of their families residing in the regions where national conflicts are occurring. Second, military representatives without housing have been put onto the general housing list by decision of some of the labor-collective councils, and that pertains to experienced and knowledgeable officers from units that used to have and provide their own apartments.

The military representative depends on the management of the industrial enterprise not only for housing, but for the placement of the wife in a job and the children in kindergartens, for medical care and, finally, for food and consumer-goods support.

On the other hand, we are now requiring of our military representatives not only the correct organization of acceptance, but also that they monitor the pricing of the military products, the foreign-economic activity of the firms and the like.

The problem of creating independent military acceptance can be solved only in such a way that the expenditures for the upkeep of acceptance are part of the price of the military product and are paid by the customer. That is entirely natural, since expenditures for the social program, including for housing construction for the workers of the enterprise, exist in the price of an item.

[Question] Why, in your opinion, is industry oriented in conversion—along with the production and sale abroad of our aircraft and aircraft engines that enjoy demand there—with the production of products far from its potential, and unprofitable for it? Who are they, these people who are distorting the idea of conversion and whose actions are leading to the degradation of the aviation industry with all of the attendant consequences?

[A.I. Ayupov] Conversion at defense enterprises is being accomplished by directive methods and is monitored by a specially created state structure. Another "manager," and moreover a most unceremonious one, has appeared at the enterprises aside from the ministry, customer and local authorities. The production chaos that arose at first, fortunately, is gradually being eliminated by the personal initiative and common sense of the supervisors of design bureaus, aviation plants and participating enterprises.

The equipment of aviation plants is really not adapted to the mass production of consumer goods. The most advantageous thing for them is to make aviation products for export, and buy what the public needs with the monetary receipts. It is still quite far to that level of decisions, however, since a radical reform of the extant relations in the state structure of the country is required.

[Question] The cutbacks in defense appropriations clearly could not help but affect the plans for the development and testing of the latest prototypes of aviation equipment. Doesn't it follow from that that the level of essential sufficiency will soon become unattainable?

[A.I. Ayupov] The level of essential sufficiency will become unattainable in five to seven years at the prevailing level of appropriations. The way out is in the fastest possible entry of the armed forces into market relations and the extraction of profits from the sale of armaments and combat hardware that exist and that are being specially developed. This would make it possible to offset the shortage of state budgetary appropriations.

[Question] And the traditional question: please tell us about the principal stages in your own service and about yourself.

[A.I. Ayupov] My biography is a short one. I was born in Kazan in 1936, I studied at secondary school and then at the special school of the Air Forces, and in 1953 I entered the VVIA [Air Forces Engineering Academy] imeni Professor N.Ye. Zhukovskiy; I was engaged in test work at the Air Forces GosNII [State Scientific-Research Institute] for 28 years starting in 1959. I was transferred to the Air Forces high command in 1987.

I am married, with two children and three grandchildren. As a scholar I am proud of my fourteen pupils. In my free time I enjoy painting.

Long-Term Problems of Training, Aviation Service Analyzed

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[Article by Military Pilot 1st Class Lieutenant-Colonel V. Vysotskiy under the rubric "Combat Training: Viewpoint, Suggestions": "A Stumbling Block, *or The Problems of Combat Training*"]

[Text] *Mankind has developed throughout all of its history thanks to the existence of two Great Personalities—the Master and the Teacher. But it was namely their annihilation that was the glaring "achievement" of the cult of collectivism and like-thinking that held sway in our country for more than seven decades. The results of this anti-human policy are obvious: the complete collapse of the economy, the decline of culture and morality, the lack of faith in the future...*

The loss of the Master and the Teacher in any sphere of human activity is always fraught with the gravest of consequences. This is especially being felt, however, in military aviation—by virtue of the specific nature of flight work.

In attempts to create a solid building of flight safety we have currently arrived at the strict system of views set forth in the "Concepts to Avert Flight Accidents." We seemingly have everything to bring them to life, right up to a far-flung system for monitoring the preparation and quality of performance of flights at all levels of the aviation system. But there are no positive results in the fight against accidents, and in my opinion there cannot be. Why?

When undertaking any construction it is possible, of course, to invite the most talented architects, designate the executive supervisors, appoint agitators for them, proving convincingly that one must work "conscientiously," summoning them to lofty feelings. There will be no success, however, since one cannot build a building of bad bricks and mortar that is unfit for anything, in which there is not even a third of the technologically required cement.

Who and what have been considered the "bricks" since the moment of its birth? I think the answer is simple—the flight and technical-engineering personnel, the GRP [flight operations team] people, the commanders at all levels organizing the flights and, finally the aviation hardware. But today, unfortunately, there can be no discussion of the reliable functioning of the whole aviation system—each of the "bricks" in the building could crack at any moment. Which, strictly speaking, is noted: three quarters of flight accidents occur through the fault of the personnel, with the majority committed by 1st-class pilots—those who should be the backbone of military aviation and flight safety. This fact could be considered entirely natural and logical—all of the links in the chain for training a high-class pilot have rusted through.

The overall worsening of the economic situation in the country, decline in the prestige of the military profession, especially flight, and poor pay for fliers, against a background of an overall decline in the standard of living and a total scarcity, have led to the fact that there is virtually no competition among those desiring to enter the flight schools. At the beginning of the 1970s, after all, there were 6-8 people for each place!

There is nothing to hide here, it is not the first year we have been forced to accept adolescents into the schools who have demonstrated only fair knowledge on the entrance examinations. The criterion for their enrollment is just solid health, and even that with certain allowances. There is essentially no weeding out according to the results of testing in the psychological selection. There is no one to choose from! And after all it is right here, at the very beginning of the flight career, that the durability of the first "brick" is formed.

Pilots are the elite of society in the developed countries. And not because their training costs the state so much more than specialists in any other military profession. Aviation has the most able and physically robust fellows who have passed through tough selection, including psychological. They know what they are working hard for. They are paid accordingly for it. But we, touching on the topic of material incentives for flight labor, take as our point of reference the pay for a bus driver. They've sunk to that, as they say. But that is in no way accidental. Say two pilots of equal rank and position are serving in a regiment. The first leads a healthy way of life—he does not smoke, does not abuse alcohol, prepares carefully for flights and performs them with high quality, competently leads the collective entrusted to him and teaches his subordinates. But now the other is completely the opposite of his fellow serviceman. They both receive the same monetary compensation, however, regardless of the ultimate results of their activity. So is it worth it to work hard? I am sure that we will never be able to resurrect the Masters with such egalitarianism.

I have been convinced more than once that even the strictest punishments to which the "immediate perpetrators" of this or that flight accident are subjected will never have any positive results, since they absolutely do not touch on the very foundations of a System that is structured on universal—"from private to marshal"—lack of material responsibility, the cause of which is the poverty of the overwhelming number of the members of society. It is not the Masters, not professionals, who are at the foundation, the walls and the roof of our system, but rather mediocre amateurs.

How can one objectively assess the level of training of a pilot if his average annual flying time is 50-70 hours, instead of the 200-250 as determined "according to science?" Can such a "brick" be reliable?

Have you not been asking yourself the question of why many pilots of 35-40 years of age, in full flower, go into retirement? And it is moreover not just pilots who go, but the bearers of traditions and methodologists—in short, Teachers.

The lack of prospects for service growth, dissatisfaction with army service itself, housing and social problems—here is an incomplete list of the basic reasons, in my opinion, for this negative phenomenon. Serving and flying are becoming dis-ad-van-tageous! I will say bluntly that many pilots today feel no pride in their profession, it has been made so degraded and commonplace.

I cannot help but dwell on the problem of the length of flight careers. It must be owned that most of the pilots smoke, poisoning themselves and those around them. The use of alcohol on Saturdays, and then flights on Monday, have now become customary. Many evidently do not know that alcohol remains in the blood for up to 18 days, over the course of which it has a negative effect on the actions of both the pilot and the hardware regardless of his mental and physical powers. How are we fighting this evil? Not at all. The whole country drinks, after all, and do they ever! Why is aviation any better?

Only a handful of Air Forces officers are regularly engaged in physical training, and the rest suffer stress once every six months at the performance evaluations (especially in passing the cross-country running, and that only if the commission decides to hold it), earning their diagnoses. What use are these evaluations, run through with formalism, to anyone? They bring nothing but harm to the "amateurs." There cannot be a healthy spirit in an unhealthy body. And only with a considerable expansion of economic incentives, against a background of the overall rise in costs, will we thus be able to achieve any real successes in solving the problem of the length of flight careers based on a healthy way of life.

I would like to emphasize, concerning the reasons for the low level of theoretical training for the overwhelming majority of Air Forces pilots, that the "amateur" never has and never will have any inner need to know more than the commander or inspecting officer requires of him. And they don't demand very much—the conscientious copying over of answers from special literature that exists in abundance. The passing of any tests or exams—held, by the way, only from time to time—has been turned by the System into an out-and-out formality.

Whence the corresponding level of knowledge—that very same baggage that the pilot uses in the air. Sometimes, when fate gives the pilot only seconds to make a decision and take action in an emergency situation, the result is lamentable. The "amateur" has virtually no chance of success, and often proves to be in the role of the doomed, in an extreme situation in the face of an acute shortage of time. A paralysis of will occurs not only from poor psychological training, but also from ignorance. And the pilots continue to get into a spin, turn off engines in good working order in the air and do a great deal more that is not subject to logic. The same could pertain to a greater or lesser extent to the individuals of the GRP, the engineering and technical personnel and the specialists in support units as well.

It is commonly felt that the higher the skills qualifications of the pilots, the higher their level of readiness for combat operations and flight safety. Is that in fact the case?

An analysis of the accident rate in fighter aviation over 1984-90 is interesting food for thought. Fourteen of the 18 flight mishaps were committed by 1st-class pilots, and three by 2nd-class pilots. Eloquent statistics, are they not? You could object to me that we have a majority of highly rated pilots, and that is where the ratio comes from. But after all, excuse me, several years ago an order came from the Commander-in-Chief of the Air Forces that allowed commanders to deviate from the old production-line system of preparing pilots for a proficiency class that ruled out a regard for the individual abilities of the pilots. But despite that, to this day some commanders from time to time "haul" everyone to 1st class one after the other, sometimes flying half of the program of night training under good weather conditions instead of bad. That is not a mistake, no. That is a crime, because someday (God forbid, of course) nine pilots will be coming in for a landing at minimum ceilings, and the tenth will not be able to handle it. No one will help him in the air then.

An attempt was made in 1991 to put an end to the ruinous practice of approving 1st class at any price at the end of the year. The compensation for the class was increased and distributed by months. But the reasons pushing pilots and commanders to recklessness have not been eliminated. So it turns out that there will be "Decembrists," tears and grief once again?

The discussion concerning the commander who organizes the flights is a special one. Who is he—an "amateur" or a master of his business? Why was namely that officer assigned to command the regiment, and not someone else, often more capable and talented? It is very simple—all of the fates of the commanders are weighed in the bowels of the personnel bodies, and it is no secret that family ties or the patronage of influential people, sometimes with no relation whatsoever to aviation, can have decisive significance there. Secrecy in the assignment of the post of regimental commander is one of the most important reasons for the advancement of mediocrity up the service career ladder. No one has counted up the losses to the state treasury from such practices, but it would seem they are enormous. And not only in military aviation.

The incompetence of a commander of any rank costs society much more, the higher he rises along the hierarchy of that ladder on which his key posts lie. In military aviation they are, for example, the commander of the regiment, on whose personality success, the quality of performance of the tasks facing the unit and flight safety all depend to a considerable extent. But here is what gives pause—the regimental commander is "showered" every year by the higher levels with a stream of documents (more than a thousand) containing "valuable instructions" for all instances in life. The commander must study, interpret, organize execution of the requirements and implement monitoring for each of the documents. The concrete and vital work with subordinates is pushed to the back burner.

The reasons for this abundance of paper, it seems to me, are as follows: first of all, the conviction of the leaders that the "lower-downs" cannot manage the fulfillment of their tasks without pointers from the "higher-ups" and a mistrust of their competence (or confidence in their lack of it?); second, the "higher-ups" are removing from themselves the responsibility for shortcomings, shifting it with these regular documents to the "lower floors." The one and the other are the outgrowth of the administrative-command system that swallowed up our whole society. Namely there lies the cause of the low level of professionalism and competence of those who are organizing combat training, as well as the individuals in the "upper echelons" who are performing the oversight of that process.

Our current system is such that with the rare appearance of the Master and Teacher who desires to pass his talent along to the people, it dooms them to a constant battle with their own multitude of braking mechanisms, an empty waste of energy, time and health. And that is instead of, relying on the assistance of the state, creating their own schools, educating pupils and restoring the dynasty. There are more than enough bitter examples.

Listen attentively to the arguments of the opponents of a professional army. The principal one among them is the expensiveness of maintaining professionals. A false expensiveness, by the way. If all the human and material losses that have occurred as the result of the activity of the "amateur" fliers were counted up and made public, this would have the impact of an exploding bomb. The count runs to divisions! It is terrible to realize this, you will agree.

The opponents of the professional army fear the appearance of the Master the way the devil fears incense. You can't tell him, after all, "Do what I said!" The Master is first and foremost a person with his own opinion and reasoning on any issue, a proud and decent person with a keen sense of personal worth. Authority for him is only a professional who knows everything and accordingly has the right to order, "Do as I do!"

Professionals talk among themselves in a different language, in which there is no place for "safety measures." Each makes his own decisions and bears personal responsibility for them. The "safety measures" are for the "amateurs," so as later to share responsibility equally if anything happens.

The appearance of the Master in the army is the beginning of the requiem for the comfortable life of an enormous number of officials in shoulder boards who have no relation whatsoever to combat training in peacetime or the waging of combat operations in wartime.

When a professional sits in the cockpit of the aircraft, another prepares him for the sortie, a third is controlling the flights and a fourth organizes them, any need for a multitude of structures working for flight safety falls away. Life leaves in their stead a small analytical group that should be engaged in the gathering, processing and analysis of information on flight accidents and the precursors to them.

It is not difficult to imagine what resistance to possible changes on the path of professionalization of the Air Forces the structures of flight-safety bodies will offer. An inexhaustible trough will be disappearing, after all! Look at what is written, for example, in the same "Manual for Averting Flight Accidents in the USSR Armed Forces Aviation": "Expenses for BzP [flight safety] are always justified. Work on averting flight mishaps should be stimulated. Anyone who feels that BzP costs too much does not know what a flight mishap is, and what moral and material damage it causes."

So what is the increase in spending envisaged for? For the training of Masters at all levels of the aviation system, which is in and of itself a guarantee of flight safety? Certainly not. An increase is being demanded in appropriations to maintain the bureaucratic apparatus of staffers that would "send down" thousands of directives, not one of which will be completely fulfilled.

At the end of the 1970s, when the Central Inspectorate of Flight Safety of the USSR Ministry of Defense was being created, its financing was justified thus: it would pay for itself if it prevented just one flight accident. Since that time we have lost about a thousand aircraft and hundreds of people. So then, perhaps create another inspectorate, under the president of the country, for example? The question suggests itself—it is not the sign that must be changed, as was done with the political officers, but the system! This will occur all the faster—and all the more cheaply—the faster and more radically the conversion to the market is accomplished, including a market for skilled military specialists, when each serviceman will receive an amount of monetary compensation depending on the level of professional training and the practical results of his activity.

I am proposing the immediate implementation of a program of anti-crisis measures in military aviation in this regard.

First. At the beginning of 1992, reduce the numbers of flying personnel in frontal and army aviation on a competitive basis, bringing the coefficient of their upkeep to 1.3-1.5, with a regard for the disbanding of some aviation regiments being withdrawn from the countries of Eastern Europe.

The competition could be conducted by testing 100 percent of the flying personnel regardless of the positions they occupy, in three basic areas—physical, theoretical and flight (professional) training. Half a year is assigned to preparations for the competition, and the techniques for conducting it and the standards for evaluating it should be passed along no later than 3-4 months before it starts.

It must be noted that testing techniques were developed long ago in the armies of the developed countries and are being employed successfully in practice. It would thus not be worth it for us to "re-invent the wheel" here.

All fliers who successfully complete the tests and check-outs of flight training would occupy regular positions in accordance with the final results of the points they had gotten, regardless of the positions occupied before, military rank or length of service. The testing would be conducted once a quarter in the future. The decision to name an officer to a higher position is made according to the results of testing in the 4th quarter. It should be conducted by the regimental commander in the squadrons, by the commanding general of military aviation in the administrations of regiments and divisions and by the commander-in-chief of the Air Forces in the directorates of military aviation.

The checking of flight training is conducted using a combat trainer with the performance of comprehensive flight assignments, including the most complicated elements of piloting technique, aircraft navigation, weapons delivery, piloting and landing approach using back-up instruments. From three to five levels of difficulty for this assignment are established in each branch of aviation that essentially correspond to the class ratings of the pilot and the degree of his training. The pilot himself moreover selects the level of difficulty. The check flights should not be conducted under weather conditions more difficult than those which the pilot has mastered under the Combat Training Course. The instructor, who is part of the commission, bears responsibility for the safety of this flight.

It would be expedient to establish differentiated pay for the results of the performance of an assignment according to the level of difficulty of it. Such a procedure would make it possible for the pilot to assess his own capabilities in self-critical fashion at each stage of training, and not to "go against the grain."

Second. The commander who conducted the check flights, according to the results of the testing, establishes the individual remuneration for the current quarter for all servicemen. If the check-ups and tests are not passed in excellent fashion, the officer is paid 25 percent of the overall amount of the compensation (according to the given test) each for the level of physical and theoretical training, and 50 percent for flight (professional) training. With the receipt of an evaluation of "good" he receives only 50 percent of this sum, and for "fair" he should not be paid at all. If the pilot receives an evaluation of "unsatisfactory" on any of the tests, he is dropped from flights for a time period of two weeks until a repeat test. During that time the pilot receives pay only for his military rank.

The level of tactical air training (from pairs to regiment) should be evaluated according to the results of tactical air exercises and paid separately, in the same way as the ability of the corresponding commanders to command subordinates on the ground and in the air.

There should be one principle in paying for the labor of servicemen in all fields—a high standard of living with the highest personal and professional training.

The maximum amount of monetary compensation for the pilot, depending on his time served, position and military rank (with excellent grades on the tests and flight-training check flights) today should thus be within the range of 1,500-3,000 rubles, with the minimum at 150-200 (with the lowest results of the testing).

It would seem that this would create good preconditions for the appearance of a Master, who would himself determine the times for flight interruptions and the degree of difficulty of the flight assignments.

Third. All flying personnel should begin to study the fundamentals of hand-to-hand combat and driving motor vehicles starting in 1992. The check-up of those skills, along with the ability to shoot using personal firearms, could be conducted every year at special flight-personnel survival centers, where they should be paid monetary compensation within the range of 500-1,000 rubles according to the results of passing performance standards.

An entirely logical and natural question is where to find the funds for raising the pay of Air Forces servicemen. I feel that this problem could be solved as the result of cutting the number of flying personnel and youth accepted into the flight schools in half, and rejecting the procedure of paying the monetary compensation for skills grades that exists today (these steps should be accomplished in conformity with the projected increase in the flight service of pilots and changes in the personnel structure of the Air Forces); commercial activity by the Air Forces Military Transport Aviation; and, the disbanding of military-political structures (it is necessary to leave only small sociological bodies at the level of the Air Forces and the air armies).

The many dozens of flight mishaps that are averted will be the most important source of financing for professionals in aviation. Its combat readiness and fighting ability will rise inevitably therein without any substantial rise in spending for the Air Forces overall.

Analogous measures should be also be developed and incorporated in relation to individuals on flight-operations teams, engineering and technical personnel and staff officers.

The significant rise in the monetary compensation for the professional will make it possible to solve another problem as well—exacting sums of monetary damages caused by the culprit in a flight mishap. It could be withheld in installments over a long period of time and compensate entirely for the losses. An awareness of irreversible material responsibility for incompetence would force a sharp turnaround in the psychology of dependence and all-forgivingness that is so widespread in the army and society overall.

Fourth. I would propose the following as concerns the procedure for the naming of commanders of a regiment, division or commanding general of an air army. I feel that it should be done exclusively on a competitive basis with the involvement of no fewer than 5-6 candidates for a position from among all of those desiring it, and not only those recommended. Such a procedure, in my opinion, would ensure glasnost and rule out secrecy and protectionism in assignments.

The candidates should be subjected to testing by the appropriate commissions for physical, theoretical and professional preparation, as well as to prove their advantage over the others in their ability to command subordinates at command-staff exercises with the practicing of scenarios with enhanced complexity apropos of combat operations and everyday activity. It would be expedient to organize the exercises at the VVA [Air Forces Academy] imeni Yu.A. Gagarin for this purpose, as it has a modern technical base for it. I am convinced that each supervising officer will occupy that place on the service ladder that really corresponds to his true knowledge and abilities under this approach.

Today we have to speak with bitterness of the drop in prestige of army service, and the profession of the combat pilot in particular. The solution of this problem, in my opinion, could be facilitated to a considerable extent by the resurrection of the flight dynasties in our country—the preservers of the gene pool and priceless traditions of aviation. The sons, as a rule, take in life the cherished path of their fathers. Today's senior generation of fliers unfortunately has no serious arguments able to convince their sons to make the choice in favor of the profession of military pilot. Many are moreover even talking them out of such a step. A terrible symptom! The young men, meanwhile, who have hung around with their parents among garrisons enough, changing schools more than once, are coming to their own conclusions regarding the lack of amenities in the life of the military person.

It seems to me that upon the completion of the withdrawal of our troops from the countries of Eastern Europe, the objective preconditions will arise for an increase in the term of service for a flier at a single garrison. The "settlement factor," in other words, will appear. It cannot be ruled out, after all, that many officers will want to set up their own homes and households. With a high standard of living, this is the first way of resurrecting the flight dynasties.

I will allow myself a few thoughts on the score of changes in the personnel structure of the aviation regiment and the organization of internal service as well.

I feel it essential that all regular staff positions for conscript servicemen from the aviation regiments and army aviation be transferred to support units, and the wives of servicemen and warrant officers be invited to take the freed-up positions. This would allow the commander and staff of the regiment to concentrate on the main thing, organizing the process of combat training, rather than being engaged in the endless instilling of regulation order in the soldiers' barracks.

"And so who will be serving to protect the Combat Banner of the unit at Post No. 1?" you will ask. There is a way out of the situation—I propose that the Combat Banners of all the air regiments be concentrated at the headquarters of the large formations under a single guard during peacetime, freeing up hundreds of servicemen for supporting the aviation hardware for flights.

In conclusion I would like to call on all fliers to conduct a businesslike and principled discussion on the pages of the journal on the problems of the conversion of military aviation onto a professional track. I feel that there is simply no other path for radical reforms.

Today we are already not the same as we were before 18 Aug 91. The Air Forces should become different as well. Otherwise the soldiers of the practice-range team, painting the targets with white paint each time before the next exercises, will always be asking themselves one and the same question—are we ready to defend the Fatherland?

From the editors: *We recognize that one cannot agree unreservedly with all of the statements and suggestions of the author. They sometimes even sound a little too sharp and seem unfounded. We nonetheless have the right to listen to everyone who looks at the tomorrow of our Air Forces without a shadow of indifference. We unite in bringing Lieutenant-Colonel V. Vysotskiy to the readers and hope for a further continuation of the debate within the framework of the problem raised.*

Letters to the Editor

92UM0897C Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) pp 8-9

[Reader letters to AVIATSIYA I KOSMONAVTIKA]

[Text]

Start of the Path to Great Science?

The All-Union Student Gagarin Readings that are held annually at the Moscow Aviation Technological Institute imeni K.E. Tsiolkovskiy are today by rights considered the most imposing scientific forum for students in our country—emissaries come to them from the higher educational institutions of Moscow, Saint Petersburg, Kharkov, Komsomolsk-na-Amure... The spectrum of papers offered for discussion is also quite broad—from the mechanics of flight to questions pertaining to the problems of physical fitness and sports.

Cadets from the Daugavpils VVAIU [Higher Military Aviation Engineering School] have also taken part in the readings for several years. The works they offer have been noted more than once with certificates and awards by the organizational committee of the competition, and we consider that a great success in the activity of our military-science society.

I would like to note that many cadets, from the first days of training, are actively involved in military science work, and are soon ready to set to work on their candidates' dissertations. But... such an approach to the training of scientific personnel is categorically unacceptable to our army procedures, and service in officer positions in line units for no less than two years is stipulated as mandatory before their entry into graduate study. But isn't that really absurd?

Psychologists have established that the flourishing of the creative activity of the person comes at the ages of 25-30 years. But does the far from creative atmosphere of army service facilitate the intellectual development of the personality? The most talented students in civilian life, having already been studying at a higher educational institution, have the opportunity to start work on their candidates' dissertations, which reduces the time for training scientific and pedagogical personnel.

What is keeping us, the military, from solving this problem today? I think the time has really come to move from empty talk to practical steps in the development of military science.

[signed] Lieutenant-Colonel N. Avdonin (Daugavpils VVAIU)

From the editors. *The letters coming from our readers testify to the acuity of the problem of military education in the armed forces of the USSR, including the Air Forces. We hope for a continuation of the constructive discussion by the interested parties on the pages of our journal.*

I Believe in the Wisdom of the People...

First to introduce myself—Ragim Rafik-ogly Ragimov. I have worked the land for my whole life, as did all of my ancestors, Azeribaijanis, and in recent years I was the chief agronomist of a million-kolkhoz.

Why am I writing to a military publication? The men of our land have for centuries had the sacred obligation not only to grow grains but also to protect their fields, their people against misfortune. My grandfather fought in the Great Patriotic War and, like another twelve of my fellow villagers, did not return from the front. My sons served their terms with honor, one of them in Afghanistan. My nephews (I have two) became officers. I myself keep with pride, next to my Order of the Red Banner of Labor, my certificate for excellence in military service (an aviation weapons mechanic).

There is another reason that has prompted me to appeal to military readers through your journal. It is only thanks to the army that our family of many children, along with the inhabitants of the town of Shidlu, in the Ararat Rayon of Armenia, was able to avoid violence and was evacuated in time to Azerbaijan at the very height of the well-known events. So thank you, a deep bow to you, the people in shoulder boards! At first we helped the soldiers protect our families, but after the well-known Decree by the President of the USSR we, as opposed to the offenders, turned over all of our weapons.

So then, some will say that there will be complaints again. And they will err. I firmly feel that it is not right to pour oil on the fires, when yesterday's neighbors have become enemies to please someone's ill will.

I hold no grudge against the Armenian people. Yes, they plowed under the cemeteries of our ancestors knee-deep, several dozen people including the local mullah were killed or are missing, we have lost our shelter and livestock and the land soaked with the sweat of my people has been orphaned. Only I do not believe that it is reason that has created the misfortune in our republics. I see the path to concord in the resurrection of the traditions of good-neighbor relations that had been taking shape over centuries. Is this opinion of the ordinary citizen, the simple folk, who have experienced the tragedy not through words but from within, taken into account?

Much has truly been irretrievably lost in the relations between the Azerbaijani and the Armenian peoples. And neither side—no one will argue with the obvious—has gained from it. But judge for yourself, what was there for me to share with my work comrades Samvel Yegayan and Arut Antonyan, if we had been living with the same cares since childhood? Each of the 225,000 of my countrymen who were forced to leave Armenia will say the same thing. But the hostility has unfortunately broken more than the ties of friendship: how many mixed marriages have been faced with an inconceivable choice?! Not one of us has been officially deemed a refugee, by the way, and we have received no compensation whatsoever.

We older people cannot understand what has happened. Our children are confused. And what about the soldiers of the Soviet Army, who have involuntarily become a buffer in this outburst of passions?

It turned out that through someone's "light" hand our sons were called up into the military construction units, as a rule, in recent years. They worked conscientiously, not distinguishing in what republics the defense and civilian facilities were being built. So now here is our kolkhoz, on its feet, we built a school and a kindergarten, a Culture Hall, a poultry farm, stores, without thinking about the territorial divisions of our common home, the USSR. And let them serve new residents, we do not complain—the main thing is that what we created with our hands serves man.

I believe in the wisdom of the Armenian people. And I think that this admission elevates, rather than diminishes, my own fellow countrymen, who must also undoubtedly reconsider somewhat their own view of things, and select a constructive approach to dialogue. It is nobility, not rage, that gives true strength, after all. One cannot erect boundary stakes in the hearts of people linked by centuries of common joys and sorrows, common bread and children. It is time to stop the senseless bloodshed. Otherwise our descendants will not forgive us.

[signed] R. Ragimov (Baku)

Who's the First?

A letter from the Leningrad historian V. Korol was published under that title (AVIATSIYA I KOSMONAVTIKA, 1991, No. 3) in which he expressed his point of view on the problem of who should be considered the first military pilot of Russia. Colonel (Reserve) A. Belyakov, a Candidate of Technical Sciences and member of the Soviet National Committee of Historians of Natural Sciences and Engineering of the USSR Academy of Sciences, replied to that feature. Insofar as Arkadiy Ivanovich adheres to a different opinion—and the truth arises out of dispute, as is well known—the reader may not be without interest in the opinions of the letter's author.

I will not conceal the fact that I was upset, having read the article "Who's the First?" I am, after all, the author of the article on Lieutenant G. Gorshkov in the newspaper VOZDUSHNYY TRANSPORT to which V. Korol refers, in giving the first-place laurels to naval Lieutenant S. Dorozhinskiy. As proof he cites the dates and ordinal numbers of the diplomas for the completion of pilots' schools by the first Russian military fliers. I feel that this approach to historical research is not correct. History as a science is strong in the profound analysis of events and facts, the objective assessment of the role of individual historical personalities, with chronology serving as subsidiary, albeit, important material therein...

So then who is first? It is well known (this is affirmed by V. Korol) that Gorshkov had independently gone up on the day that Dobrozhinskiy completed training in France. Lieutenants I. Kogutov and Ye. Rudnev moreover completed the flight-training course at Gatchina at the same time as Gorshkov, and these four officers could thus formally be considered the first certified Russian military fliers. But what about informally?

Judge for yourself. S. Dobrozhinskiy, having returned to Russia, took the fleet command "for a ride" over the Bay of Sevastopol, and his flight career essentially ended with that. I. Kogutov got into an accident soon after receiving his diploma and did not fly any more on his own, if you do not count his few flights on the "Ilya Muromets" as the co-pilot. Ye. Rudnev flew for almost five years, and went into the history of domestic aviation thanks to several brilliant flights and records. Not only thanks to them, by the way. Not having been able to assess the merits of such a landmark aircraft as the "Ilya Muromets" for our own and world aviation, Rudnev nearly wrecked it—it was namely after the pilot's report that the Military Department of Russia pulled the order for the production of the aircraft from the Shidlovskiy Aviation Plant.

Gorshkov, figuratively speaking, never crawled out of the cockpit of combat aircraft from 1910 to 1919. He did a great deal to save the Muromets and to bring glory to that noteworthy aircraft. He himself advanced from crew commander to command of a squadron of airships in the skies of World War I. He was by rights the first bomber pilot in the world, the forefather of the tactics of bomber aviation. Some historians, however, give preference to the pilot N. Kostin, who was the first to drop a bomb from an aircraft on a Turkish fortress in November of 1912.

Such contentious situations are not rare in the history of aviation, by the way. However, it is of course simply not serious to judge who came first or the contribution of these or those people to the development of aviation according to the numbers of diplomas. By way of example, the Wright brothers, after all, received pilot diplomas numbered 14 and 15, with diploma No. 1 belonging to Bleriot and No. 2 to Curtiss...

A System of Orders for Curricula

The reform of higher and secondary education in the country is not bypassing the training and indoctrination process (UVP) at the VVAULs [higher military aviation schools for pilots] either. The instructors are employing new teaching techniques, introducing progressive forms of classes and making ever more extensive use of computer technology. The return from the improvements in the UVP on the end result—the professional training of the cadets—is not significant. And here is why.

The complication of flight training with temporary personnel for the purpose of improving tactical proficiency has required a fundamental review of the curricula and programs for the theoretical support of flights. The mandatory requirements of the USSR State Committee for Education, the Chief Directorate for Higher Educational Institutions of the Ministry of Defense and other agencies, however, dominate the list of theoretical disciplines, their amounts and the sequence for completing them. The content of the curricula, for instance, as well as the disciplines themselves (mechanical engineering, engineering drawing and a foreign language, among others), even though they take up the lion's share of the teaching time, are not employed in practice in the process of professional training of the soldier of the air.

A list of disciplines that are thoughtlessly brought in from the general technical higher educational institutions has held sway in the name of adding "engineer" to the field of "pilot" for more than 30 years now at the flight schools. The theoretical training of the graduate is thus determined not by the requirements of line-unit practices, but rather by set requirements. Everything is turned upside down. Even the most refined methods of teaching cannot correct the situation here.

A comprehensive systems approach to improving the UVP based on a correspondence of the content, volume and sequence of the completion of the curriculum to the skills requirements, in my opinion, could provide a way out of the current situation. A requisitions (orders) method is the most effective here. Its essence is as follows. Proceeding from the skills description of the graduate—a state order for a specialist—and in accordance with the tasks of his training, the departments of tactical and special tactical disciplines (Air Forces tactics and the branches of aviation, aviation armaments and their use in combat, aerial navigation) submit requisitions that take into account the time, substance and degree of study of the special military and other topics.

The teaching subdivisions where the requested disciplines are taught perform the planning and figuring of the order for all parameters, as well as determine their own requisition for the general engineering, technical and general educational departments, and they then plan their own work. The curriculum and the programs are then formulated in final form within the framework of time allocations.

The degree of importance of the content of each discipline requested is determined by the quantity and well-foundedness of the requisitions submitted. This indicator is considered to be a criterion of the importance of the topic or teaching discipline defining the significance of the teaching material in the formulation of the professional skills of the cadets.

The requisitions method makes it possible to establish the operative structural-logic configurational ties among the disciplines and types of training, determine the amount and sequence of completion of the teaching subjects, establish their importance for the training of the specialists and ensure the practical thrust of the general scientific and general engineering disciplines, as well as to devise recommendations to improve the standard organizational structures of the departments at the higher educational institutions.

The necessity has currently arisen for the creation of a competent inter-institutional scientific-research group for higher education for the practical realization of restructuring in UVP. This would make it possible to take a considered approach toward the given problem and raise the level of training of the aviation specialists.

Colonel I. Kaplya, Candidate of Military Sciences and Docent (Chernigov VVAUL)

Ways for Pilots to Detect, Counter Hypoxia in Flight

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[Article by Doctor of Medical Sciences and Professor Colonel of the Medical Service (Retired) I. Chernyakov, Candidate of Technical Sciences Colonel of the Medical Service V. Prodin and Candidate of Medical Sciences Lieutenant Colonel of the Medical Service A. Shishov under the rubric "Flight Safety: Experience, Analysis, Problems": "Diagnosing Hypoxia in Flight"]

[Text] Flight mishaps occur occasionally in the performance of high-altitude flights connected with disruptions of the working ability of the pilots as a consequence of the development of acute oxygen deficiency—high-altitude hypoxia—in them. Their immediate causes are most often violations of the rules for operating the oxygen equipment by the flight personnel and high-altitude stress or their faulty operation.

Factors that aggravate the outcome of such mishaps include the failure of the pilots to recognize their own oxygen-deficient state and (or) their failure to take the appropriate steps to get out of the emergency situation, as well as their erroneous actions under those conditions.

Also very noteworthy is the fact that erroneous actions by the pilots of aircraft under acute oxygen deficiency have analogues in more than a hundred years of history of high-altitude flights. French aeronauts flying the Zenit balloon in 1875 at an altitude of 7,500 meters, in a state of acute hypoxia, instead of letting gas out of the aerostat and decreasing altitude or going over to oxygen breathing, dropped ballast and went higher, to 8,600 meters, which led to their deaths.

A similar flight mishap, but with a less tragic outcome, occurred with the crew of an An-12 aircraft in our time. The members of the crew, detecting while gaining altitude that the flight deck was not pressurized, tried to eliminate the defect and did so in the absence of protective gear. Soon they were all unconscious, and the aircraft continued to fly for another hour on autopilot at an altitude of 7,000 meters. They were saved by the fact that the copilot regained consciousness.

Similar actions by aircraft crew members in hypoxic accident situations are noted in analyzing other, analogous flight accidents as well. Natural questions arise. Can the pilot identify (diagnose) the development of hypoxia in flight—according to changes in his condition and how he feels—in himself and the other crew members? Is he able, with acute oxygen deficiency, to make the correct decision to get out of the hypoxic situation and take the necessary actions?

The answers to these questions in the scientific literature are equivocal. Special research has shown that a person can select, proceeding from changes in his own condition, an environment with a normal oxygen content from environments that are varied in gas content and are unknown to him. The Air Forces of a number of foreign countries have developed and are employing "hypoxic simulators" for flight personnel, for the purpose of teaching the skills of rapidly restoring oxygen support in the emergency situations that could arise in high-altitude flight. The expediency of conducting analogous training for cosmonauts is also recognized. The focus therein is placed on the necessity of acquiring personal experience in recognizing hypoxia according to feelings (in connection with its pronounced specific individual nature).

A number of scientific works, at the same time, deny the possibility of diagnosing the hypoxic state according to feelings and the independent making of the correct decision to eliminate it in flight. This position is argued with experimental data and examples from the practice of flight accidents in high-altitude flights, which illustrate the specific effects of hypoxia on the central nervous system, ruling out the significance of feelings as a criterion of the hypoxic state of the person.

The lack of pronounced painful sensations—or even the presence of the distinctive euphoria in the deep stages of altitude sickness—and possible cases of the loss of consciousness, against a background of satisfactory feelings or the preservation of consciousness with the loss of attention and the ability to perform a critical analysis and take energetic actions, all impede the flier's correct evaluation of his condition in oxygen deficit and makes his performance of the necessary actions more difficult.

Cases are known where the pilots of opposing sides have greeted each other instead of attacking in a state of hypoxic euphoria in flight, and aeronauts have continued to gain altitude in a balloon instead of the descent that would save them. A well-known physiologist in a pressure-chamber experiment demanded that the altitude be increased and refused oxygen while at the verge of losing consciousness.

The equivocal nature of opinions on the possibility of the correct subjective evaluation of a hypoxic state in high-altitude flight was also reflected in the article "Hypoxia—An Insidious Enemy" (AVIATSIYA I KOSMONAVTIKA, 1989, No. 6). The authors first assert "that a pilot who is in a state of oxygen deficiency has a reduced, or is even lacking, critical perception of his condition... This could lead to actions that aggravate the emergency situation..." They close the material with a position of an opposite nature: "It is important, to avert oxygen deficiency, that the flight personnel... be able to determine in themselves or crew members the initial signs of the development of hypoxia and take competent actions to get out of that state."

Taking into account the contradictory nature of the evidence set forth in popular publications, we made an experimental attempt to resolve the issue of the possibility of a person's recognizing the development of hypoxia according to his own sensations and performing energetic actions to eliminate it, making use of standard-issue high-altitude means of life-support.

The modeling of high-altitude hypoxia was accomplished in a pressure chamber with ascent to eight kilometers with the inhaling of air or an oxygen-nitrogen mixture, as well as on a simulator using the feed of a hypoxic gas mix for breathing equivalent in the partial pressure of the oxygen to air at an altitude of six kilometers. The research was conducted on 46 effectively healthy males from 19 to 48 years in age, nine of them having solid skills in piloting the simulator.

Some 243 experiments (223 in the pressure chamber and 20 in the simulator) were conducted in the course of research. Four variations of the conditions under which the pilots encounter hypoxia most often were modeled in the pressure chamber. The altitude and rate of ascent, duration of the exposure and degree of "anonymity" were all varied. These variations were hypothetically designated as staged, stationary, increasing and combined hypoxia.

The possibility of diagnosing a hypoxic state was studied both under the conditions of rest and in the performance of a test "written count," as well as in the simulator. The evaluation criteria were the prompt and correct recognition of the change in one's sensations and the overall state by the subject when reporting on the appearance of standard or unusual "hypoxic" sensations, combined with objective signs of oxygen deficiency (increased pulse rate, rise in blood pressure, increased and deeper breathing, a drop in mental function and the quality of piloting). The subject, in order to rule out aggravation (simulation), was told only of the likelihood of the development of oxygen deficiency without offering any concrete information on the conditions of the experiment.

The ability of a person independently to take active steps to eliminate a hypoxic condition was ascertained according to the precision of the performance of actions by the subjects as stipulated in advance for an altitude of 5-6 kilometers—opening the oxygen vent, and turning on the oxygen feed valve and the "Emergency" valve.

The subjects noted their sensations in the record, evaluated the way they felt and orally solved multiplication problems and performed a "test count" during the process of ascent. The appearance of incorrect answers in the oral counting was considered a sign of acute oxygen deficiency, and served as a signal to feed in oxygen for breathing.

In the staged hypoxia, ten percent of the subjects noted hypoxic sensations at five kilometers in altitude, 83 percent at six and 7 percent at seven. The most typical sensations at those altitudes were shortness of breath, worsening vision, heaviness in the head, sleepiness and difficulty in performing the "written count" test.

It is important to note that the sensations associated with hypoxia appeared, by and large, in the third and fourth minute of exposure at an altitude of six kilometers—that is, long before the expiration of the "reserve time" defined by the period of the retention of consciousness and functionality at various altitudes, in the course of which the person was still able to establish violations of the oxygen support, critically evaluate the situation that had been created and independently take suitable measures to rescue himself.

In stationary hypoxia, 18 of the 19 people at six kilometers in altitude and all 19 at seven kilometers reported distinctive sensations of a hypoxic state in an average of five to seven minutes.

All of the subjects, under conditions of increasing hypoxia with a slow (20 meters/second) ascent, reported the appearance of typical sensations at altitudes of five to seven kilometers; in a rapid ascent (50 meters/second) the hypoxia was recognized by only three of 13 subjects.

Results were obtained, when modeling combined hypoxia providing the greatest "anonymity" of the oxygen regimen, that were close to the data from staged-increasing hypoxia.

A series of experiments to study the ability of a person in a hypoxic state to perform independently the necessary actions to eliminate high-altitude hypoxia revealed the following. In the first ascents only two of the 15 did not perform the diagnosis of hypoxia and did not perform the actions to eliminate it, and in repeated ascents even they were able to manage that task.

A person consequently possesses the capabilities of recognizing a hypoxic condition through sensations and correctly performing the actions to normalize the oxygen support under various conditions for modeling oxygen deficiency (aside from the variation with fast-moving development of acute hypoxia).

Analogous data were obtained in research on the simulator as well. Eight of the ten operators recognized the development of oxygen deficiency in the second or third minute from their sensations under the conditions of breathing a hypoxic gas mixture in the process of performing ascending and descending spirals. The sensations of "difficulties in piloting" were moreover the most pronounced as a consequence of the increased difficulty of adhering to the assigned "flight" parameters and decreasing reserves of attention. The subjects, after diagnosis of the hypoxia, named it correctly and promptly performed actions to restore oxygen support.

The results obtained make it possible to conclude that a person is able to recognize a hypoxic state according to sensations, both at a state of rest and in active operator activity, under the most varied versions of disruptions in the oxygen support. The qualitative level of the activity of the operator that was preserved under the hypoxic conditions being studied does not rule out the possibility of assessing his condition correctly and performing purposeful actions to escape the hypoxic situation for him.

The results of laboratory research were tested in two aviation hospitals, an aviation school and in three line aviation units with the participation of flight personnel and specialists from the medical service. The possibility of the pilots' recognizing hypoxia according to their sensations was confirmed as a result, and the safety to their health of modeling hypoxia was also shown.

The flight personnel and specialists in the medical service expressed a positive opinion on the expediency of performing familiarization pressure-chamber ascents for the formation in the pilots of the skills of diagnosing hypoxia and rehearsing their actions to eliminate it in possible emergency situations in high-altitude flight.

The experimentally substantiated concept of the possibility of diagnosing hypoxia according to sensations has applied significance, aside from its theoretical interest. This concept has been realized in practice in a new technique that has been developed for familiarization-simulator pressure-chamber ascents by flight personnel that are aimed at improving the psychological readiness of the pilots for high-altitude flights. The principal tasks of the technique are familiarizing the pilots with the signs of hypoxia, forming in them the skills of recognizing oxygen deficiency in flight according to their sensations and teaching them the actions to get out of a hypoxic situation.

Computer Support System for Flight Operations Officers

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[Article by Candidate of Technical Sciences Lieutenant Colonel P. Polynin and Lieutenant Colonel V. Salamakha under the rubric "Flight Safety and the Human Factor": "The SIS—To Assist the Flight Operations Officer"]

[Text] The problem of supporting flight safety in the area of the airfield, where more than half of all flight accidents in military aviation occur, is closely linked with the human factor. The strain of the work of the flight personnel, air-traffic control [ATC] dispatchers and flight operations officers [RP] has today almost reached the limit of human capabilities. This leads to errors in decision-making and, as a consequence, to flight accidents.

The rapidity of the development of situations in special cases in flight requires of the RP the necessity of digesting considerable amounts of information received from the aircraft in operative fashion, and making the correct decision and reporting it to the crew. The lists of special cases that are set forth in the instructions for the pilot sometimes reach several hundred points pertaining to essential actions by the crew. If one takes into account that flights are being made by more than 50 types of aircraft in the vicinity of some airfields, the necessity of the automation of the workstations of the flight operations group becomes obvious, allowing an improvement in the conditions for their information support. Some 45 million personal computers had been installed in the United States by 1988, according to the magazine COMPUTER PRESS, wherein more than half of them were being used by government employees in information-support systems.

Computers are penetrating into our life as well. A reference-information system for flight operations officers (SIS RP) based on a personal computer has been developed at the VVIA [Air Forces Engineering Academy] imeni Professor N.Ye. Zhukovskiy, and is undergoing experimental operation in one of the line units of the Air Forces. The foundation of the system is an extensive information base stored on magnetic disk. Its possible maximum volume is determined by the type of computer used and is, for example, 1.2 MB for one floppy disk and 40 MB for one hard disk for an IBM PC/AT (which correspond to 600 and 20,000 pages of standard typewritten text).

The rapid development of information storage units is revealing even greater prospects. Hard disks with a capacity of 120 MB are already common. Reports are appearing in the English press on CD-ROM compact optical disks with a capacity of 600 MB. Such volumes of external memory for a PC make it possible to accommodate not only a database with a developed control system in a single storage device, but also programs for data processing, the psychological unburdening of the operators and tests, among others.

Based on an expert survey of the shift flight operations officers, the information in the SIS RP database includes information on the actions of the crew and the RP in special cases in flight for 50 types of aircraft, back-up airfields, weather conditions in the airfield vicinity and along a routing, the characteristics of aircraft, the capabilities for performing a forced landing by the crew and the flying time to overflight points, among others.

The retrieval of the necessary information is accomplished by the RP according to the "question—answer" interactive principle. The system may be in two modes—ready, operating autonomously and continuously after the entry of the flight operations schedule, and reference—called up when needed by the RP.

A fragment of the flight operations schedule is displayed on the computer screen with a time warning in the **ready** mode. The flight operations officer is presented with the numbers of the aircraft, which according to the operations schedule should be starting their engines, taxiing and taking off or entering a circle, a landing heading or landing and taxiing in the course of five minutes. The RP duplicates the commands he transmits by radio to the crew with the aid of the computer, entering at the keyboard symbols adopted in the operations schedule for the corresponding aircraft number. The computer makes it possible to monitor the correctness of the sequence of crew actions.

The RP may call directly up onto the dthe isplay instructions for actions in special cases in flight for the corresponding type of aircraft, find out changes in the minimum ceilings in the vicinity of the airfield and the composition of crews in the air, among other things, when necessary without leaving the ready mode.

The RP may exit the ready mode and go into the **reference** to obtain more detailed information. A list of the operating modes of the reference system appears on the display in that case with an indication of the operations that must be performed in order to receive the required information.

The whole information-retrieval system is structured according to a hierarchical principle of a branching tree, and is designed for a user who is not familiar with the structure of the computer and has no programming experience. Only the four keys to control the movements of the cursor with arrows on them (up, down, right, left) and the RETURN key are used out of the whole computer keyboard. The current position of the cursor is shown on the screen in color; erroneous user actions are ruled out by a program blocking the other keys. The automation of the actions of an operator who had never before worked on a computer in the use of this system is achieved through a one-time simulation for one and a half to two hours.

We will dwell on a brief description of the information that is programmed in the reference mode:

—**on the actions of the crew in special situations in flight.** The display screen shows a list of the types of aircraft on which information exists in the database. This base is universal for all airfields, and is corrected only in the event that changes are made in the instructions for the pilot with the aid of standard servicing programs (text editors).

Having selected the required type of aircraft, the RP receives a list of the possible special cases and recommendations to the pilot for actions in each of them. The information on crew actions is presented on the display screen in text form analogous to the instructions. It should be noted that this form is distinguished by poor operativeness of perception. The replacement of the text form with pictographic fragments is being proposed for the future. The sequence of necessary crew actions will be presented therein in the form of a chain of symbolic figures that are perceived rapidly and unambiguously by the RP. After the receipt of the information, the system may be returned to the initial state;

—**on the crew.** Information is called up on 100 pilots in a given regiment. The database on the pilots should thus be prepared and corrected under the conditions of its specific utilization. A preliminary database preparation (data-entry) mode is provided for in the reference system for this purpose that makes it possible to enter 80 characteristics for each pilot, with 40 of them numerical (age, seniority, number of types of aircraft mastered and the like) and 40 character (name, condition, relation to the crew and the like).

After the receipt of the information, the system can be re-addressed to another pilot or returned to the initial state;

—**on the aircraft.** Information may be entered into the database on 100 aircraft. Information that contains 80 characteristics for any of them is called up according to the aircraft side number.

The information on the crew and aircraft is required principally for preparing the flight operations schedule both in "manual" and in automatic mode, which is planned to be included in the system. The necessity for this information right during the performance of flights could arise when correcting the schedule and making decisions on the performance of complex stages of a flight;

—**on the performance characteristics of the aircraft.** The characteristics of an aircraft needed by the RP are called up according to their type from a universal database for all airfields (including weight, geometric and refueling characteristics, the minimum ceilings for the aircraft etc.), as well as information on the required ground-support equipment;

—**on back-up airfields.** The information contains a list of the back-up airfields designated for the shift, data on which is prepared for the specific regiment. The RP, having selected the needed airfield from the list, receives on the display screen, in multicolored graphical form, a diagram of the landing approach, call signs and other attributes necessary to make decisions to redirect the landing of an aircraft;

—**on weather conditions.** The information offered to the RP almost duplicates the information in the standard panel of weather conditions. The distinctions consist of the more convenient and visible form of its presentation on the display screen and the possibility of a forecast evaluation of changes in the weather.

The presence of a weather database in the computer that is entered from the keyboard on the basis of information from the duty forecaster, as well as the database on the crews and aircraft, makes it possible to make a decision on performing a landing.

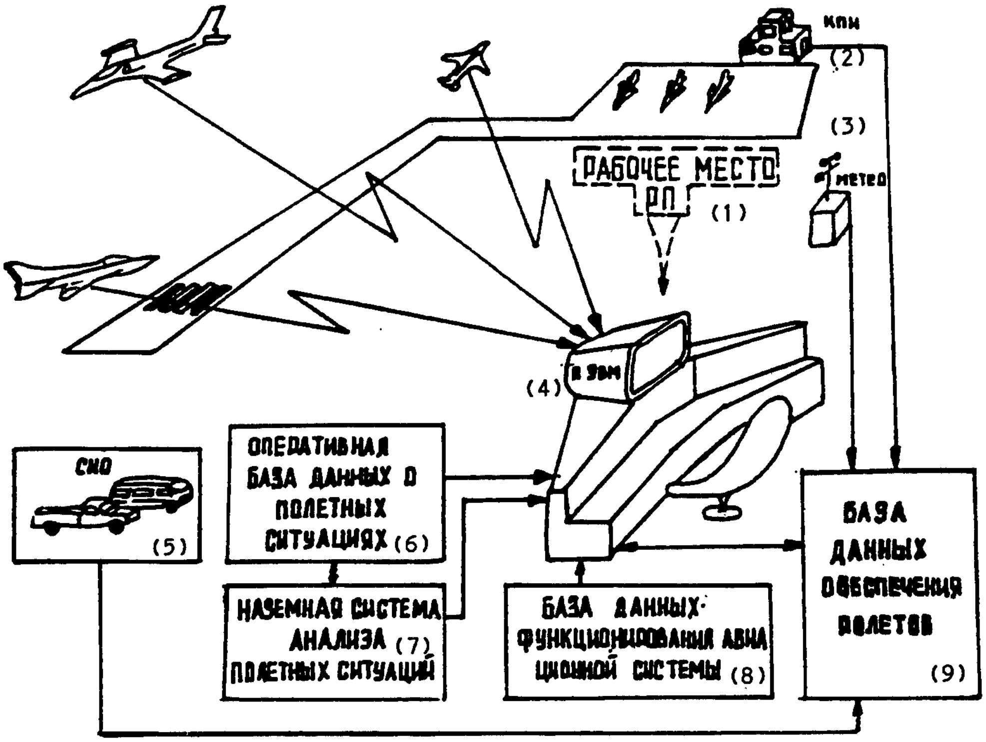
When making a decision to permit a landing the RP, having called up onto the display screen the given section, enters the call number of the pilot (crew commander). The artificial intelligence system, structured on the basis of intelligent query, next begins to operate. The system, analyzing the current weather conditions, the qualifications of the crew and the state of the runway and aircraft, issues a quantitative assessment of the level of danger and difficulty for the performance of the landing both at the base airfield and at the back-ups. A sound signal—a "siren"—is actuated if a stipulated level is exceeded. Information that clarifies which of the current factors is making the largest "contribution" to the danger of making the landing is simultaneously displayed on the screen for the RP, and recommendations are issued concerning to which of the back-up airfields the given craft should advisedly be redirected.

The information in all modes of the SIS RP is called up to the screen of a color display in multicolored form with sound signals that attract attention. The screens of the existing radar tracking systems are monochromatic, and they do not permit the delineation of the most important information by colors; it has been established by ATC specialists that the flight operations officer, in shifting his gaze from the screen of the color monitor to the monochromatic radar screen, gets into a situation similar to the blinding of a driver from the headlights of an oncoming car. Time is needed to accommodate the eyes to perceive the "black-and-white" image and identify details of it.

A simple conclusion suggest itself—the information on the aerial situation should be depicted on the color monitor of the computer. The technical capabilities for this currently exist. The capability of transmitting flight information on the side number of the aircraft, the fuel reserve, the altitude etc. to the command-dispatch point (KDP) is also contained in the Start ATC system and its Spektr development. The SO-77 aircraft transponder, for example, is able to transmit any of 4,096 answering codes and an identification signal in the secondary radar signal to a query code.

The utilization of these capabilities is a promising direction in the development of the SIS RP. The combination of a series of personal computers into a local GRP [flight-operations team] computer network for the automated processing of flight information transmitted along telemetric channels, information on the aerial situation and information databases on the crews, aircraft and guiding documents will make possible qualitative changes in the look of the airfield KDP. Standardized, multi-functional computer displays will replace the various existing types of information-depiction devices that require a constant shifting of attention and the "retuning" of perception.

The ground processing of flight information by a powerful and fast-acting computer included as part of the local computer network will make it possible to conduct full monitoring of the correctness of crew actions and the technical state of the aircraft and its systems. Forecast models of the development of various situations realized in such a computer would ensure the timely warning of the crew and the GRP of the possibility of the appearance of hazardous situations, while the automated database management system will "suggest" the necessary actions to eliminate them.



System for Operational Suggestion

Key:
1. flight operations officer workstation
2. KPI
3. weather
4. PC
5. SNO
6. operations database on flight situations
7. ground system for analysis of flight situations
8. database of functioning of aviation system
9. flight support database

The technical retrofitting of the KDP, of course, should be accompanied by organizational measures, improvements in the system for training and simulation for GRP personnel and the creation of a legal foundation for the employment of automated equipment based on computers.

Improper Flight Organization Also Cause of Accidents

92UM0897F Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) p 14

[Article by USSR Ministry of Defense Aviation Flight-Safety Service First Deputy Chief Major-General Aviation A. Osipenko under the rubric "A Special Case in Flight": "And Once Again... The Human Factor"]

[Text] This grave flight accident occurred in an air unit when performing a training flight for precision flying in diamond formation. The lead collided with one of the wingmen in a vertical maneuver, both pilots 1st-class.

What was the cause of this flight accident?

The flight assignment was undoubtedly complex—it was flight in diamond formation and the performance of a vertical maneuver in that formation. Gross violations in the organization of group flights, however, as a consequence of which unprepared pilots were permitted to perform this assignment, led to the flight accident first and foremost. The aviation hardware and equipment had no effect on the appearance or outcome of the situation in this case. The causes of the flight accident were thus in the human factor.

Who among aviation commanders does not know that flight safety depends to the greatest extent on that factor? The causes of most of the flights accidents are engendered by the activity of people, both as the creators of the aviation hardware and as the operators of it. But the person also can and should prevent them, first and foremost thanks to the clear-cut organization of flights.

We will consider how the flights of the flight shift were organized.

In view of the fact that sporting functions were to be held at the base of this unit, the regimental commander—in violation of a ban by the commanding general of the larger formation—decided to perform demonstration flights in diamond formation before the competitions. Pilots without formation training were assembled into the group, however. A methodological council to prepare to perform the demonstration flights was not held, and a preparation plan for them was not composed. The program of preparation and the configuration and technique for the performance of the flight assignment were not developed. Classes to study the specific features of piloting in the diamond formation or simulations in the cockpit, as well as a "flight walk-through" to practice the sequence for the accomplishment of the assignments and actions to avert collisions at various stages of the maneuver, were not held.

The unit commander actually did not fulfill the concrete requirements posed by the standard documents. The result was that a pilot was killed, and two aircraft were lost. There were fortunately no victims or damage on the ground...

But if the command personnel had every opportunity to avoid the flight accident, it must be noted that the pilot also had the same opportunities at the stage of organizing the flights. It would have been sufficient for him to fulfill the requirements of Article 179 of the Fundamental Rules of Flight in the Airspace of the USSR (OPP-85), according to which "it is prohibited to send a crew on a flight, and for the crew to make a flight, if the conditions of the impending flight do not correspond to the level of training of the crew or if the aircraft commander feels that the flight assignment is beyond their capabilities." But perhaps that word "feels" erodes the substance and thrust of this requirement, and takes the legal responsibility away from the supervisors? The phrasing "if the commander receives a flight assignment beyond their capabilities" would clearly have been more precise. The standard documents define precisely in what cases a flight assignment is beyond their capabilities.

Is this incident a "new" one in the practice of flight operations? Undoubtedly not. Practical recommendations to avert such incidents have been developed in existing standard documents.

According to data of the ICAO, human error is the most widespread cause of flight accidents in the complex "aircraft—crew—environment" system. It has been established that 65 percent of the flight mishaps in jet-powered air transport around the world occur due to errors by the flight crew. Another no less significant portion of them is connected with human errors that are committed in preparations for the flight, technical servicing and, what is especially important, in air-traffic control.

Domestic statistics have no significant differences.

The effects of the human factor at all levels in military aviation are more significant, since the tasks facing the personnel here are more diverse and complex, while the piloting of more maneuverable and high-speed aircraft compared to transport and passenger craft approaches the maximum limits in view of this, *i.e.* the direct threat of the appearance of an accident increases due to a poor professional level.

The "Concepts for Averting Flight Accidents" have thus been put into effect by order of the Air Forces commander-in-chief on 9 Jun 89. It recommends ascertaining the hazardous factors, developing and promptly realizing measures to eliminate them and providing information to all levels of the aviation system on those issues. The ascertaining of hazardous factors is accomplished on the basis of evaluations of the correspondence of the operational parameters of the aviation system to the requirements of standard documents.

It is unfortunately more legitimate to speak in this case, when talking about preventive measures performed by the supervisory personnel of the unit to avert accidents, about the creation of hazardous factors at the stage of flight planning and about their getting stronger in the process of preliminary and pre-flight preparations.

The conclusion suggests itself. Flight safety is a complicated process, and it can be assured not by good intentions alone, but rather first and foremost by the high professionalism of people and reliability at all levels of the aviation system.

Concepts, Economic Aspects of Long-Term Aircraft Storage

92UM0897G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) pp 16-17

[Article by Colonel P. Kazazayev, Colonel V. Ivantsov and Candidate of Technical Sciences Colonel A. Kutsyn under the rubric "Military Reform—Making a Suggestion": "A Modern Conceptual Framework is Needed"]

[Text] The defensive thrust of military doctrine, the redeployment of our troops from the countries of Eastern Europe, the cutbacks in defense appropriations—these and other reasons have made it necessary to withdraw a quantity of our aviation equipment into reserve for long-term storage. The expensive aircraft must be preserved at minimal expense. The required expenditures for the storage of aviation equipment using existing methods are virtually non-commensurate with the capabilities of the troops. This is explained first and foremost by the fact that a conceptual framework and system for the long-term storage of aviation equipment, as well as the operational documentation for it, have been effectively lacking in the Air Forces. Specialists in the long-term storage of aviation equipment are not trained at the higher educational institutions of the Air Forces. The corresponding military-science accompaniment has also been and is virtually lacking. The very question of the expediency of long-term storage of aviation equipment has remained virtually unstudied for a long time. Aircraft that are not designed for long-term storage are being put into reserve today as a result.

The existing system for the maintenance and repair of aviation equipment envisages the clear-cut realization of two basic stages in its life cycle—"active" maintenance

(maintenance with flights) and plant repairs (Fig. 1). The stage of realization of "passive" maintenance (long-term storage) is in practice lacking in this system. Such practices of the maintenance and repair of aviation equipment are typified, aside from an acceptable duration for the bringing of the whole aviation equipment inventory to combat-ready condition, by higher expenses in relation to the average flying time being supported (technical servicing and repair) for the aviation equipment and large losses of material assets connected with the write-off of a large quantity of airframes with considerable remaining service lives when re-arming.

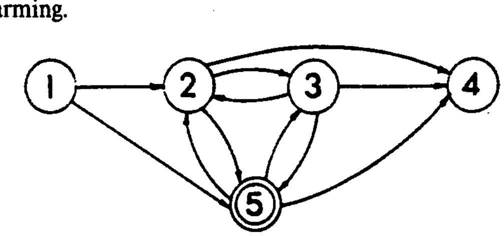


Fig. 1. Diagram of the life cycle of an airframe

1. development and series production
2. "active" maintenance
3. plant repairs
4. write-off and cut-up for scrap
5. long-term storage

Experience has been accumulated in the storage of armaments and military hardware in the USSR. The time periods for the storage of individual models of hardware without additional corrosion protection reach 10 years. The expenditures for servicing are several times lower than "active" maintenance therein.

Experience in the long-term storage of armaments and military hardware, including aviation, has also been accumulated abroad. A considerable quantity of aviation equipment is stored in the desert in the United States, under favorable climatic conditions for that purpose. Storage areas of various designs and covers, made of rubberized fabric with a monitorable and controllable environment, are used. The level of relative humidity of the air in them is kept within the range of 40-50 percent. The labor-intensiveness of the storage is insignificant. An average of one person is used to service three to five aircraft in storage. The role of reserve armaments and military hardware is increasing substantially abroad. The experience in conducting combat operations in the Persian Gulf region testifies to this as well.

Both domestic and foreign practice shows that the expenditures for the maintenance of the aviation equipment inventory can be reduced substantially through the efficient organization of long-term storage of a portion of the aviation equipment in the field. The expected economic impact from the long-term storage of aviation equipment can be approximately calculated according to the following formula (1):

$$\Delta C_{st} = (C_m - C_{st})N_{st},$$

where C_m and C_{st} are the average monetary expenditures for the upkeep of a single airframe in "active" maintenance and long-term storage respectively, and N_{st} is the number of aircraft in long-term storage.

C_m is always higher that C_{st} in practice, *i.e.* the removal of an airframe into the reserve is economically expedient.

The size of the aviation equipment reserve, however, is determined by more than economic considerations alone. The organization of the long-term storage of aviation equipment makes it possible to control the average service life of the aviation equipment in "active" maintenance. The withdrawal of a portion of the aviation equipment inventory to reserve will thus require an increase in the average flying time per aircraft in "active" maintenance. It may be determined in approximate fashion in the following matter (2):

$$T'_m = (T_m + (T_m - T_{st})/(N - N_{st} - N_r)N_{st},$$

where T_m is the average annual flying time per aircraft in the absence of a reserve, T_{st} is the average annual flying time per aircraft in the reserve with check flights, N is the overall number of aircraft of the same type, and N_r is the quantity of aircraft in repair.

The dependence of T'_m on the quantity of aircraft put into the reserve is presented in Fig. 2.

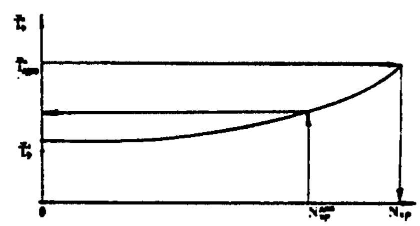


Fig. 2. Dependence of the average flying time per aircraft in "active" maintenance T'_m on the quantity of aircraft withdrawn into the reserve N_{st}; $T'_{m/all}$ is the maximum possible average flying time for one aircraft; $_{st}N^{all}$ is the maximum allowable number of aircraft withdrawn into the reserve for long-term storage.

The expected economic impact from a decrease in the residual service life when writing off an aircraft in the process of re-arming for new aviation equipment can be determined in approximate fashion in the following manner (3):

$$\Delta C_{sl} = (T'_m - T_m)N_{wo}C_{sl},$$

where N_{wo} is the average number of aircraft subject to being written off in re-armament, and C_{sl} is the cost of one hour of the aircraft service life used.

The economic impact from the correct organization of long-term storage for aviation equipment can reach tens or even hundreds of millions of rubles. Fig. 3 shows the dependence of the expenditures on the maintenance of aviation equipment when organizing its long-term storage.

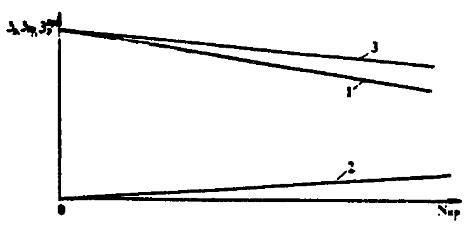


Fig. 3. The dependence of the expenditures Z_m and Z_{st} in "active" (1) and "passive" (2) maintenance respectively and the total expenditures $Z_{m/st}$ for the maintenance of aviation equipment on the quantity of aircraft allocated to the reserve, N_{st}

We will cite an example. For the existing system of maintenance and repair let N = 1,100, N_m = 1,000, N_r = 100, T_m = 100 hours and C_m = 50,000 rubles/year (**version 1**). With a regard for the organization of long-term storage of aircraft, let N_{st} = 200, T_{st} = 2 hours and C_{st} = 10,000 rubles/year (**version 2**). For both versions let N_{wo} = 100, in the time interval of one year, C_{sl} = 1,500 rubles/hour. It is necessary to determine ΔC_{st}, T'_m and ΔC_{sl}. In accordance with (1), (2) and (3), we have ΔC_{st} = approximately 8.0 million rubles/year, T_m = approximately 124.5 hours and ΔC_{sl} = approximately 3.675 million rubles/year.

It should be noted that the organization of long-term storage of aircraft itself also requires certain expenditures. This makes necessary an efficient redistribution of resources among "active" and "passive" maintenance, long-term storage and repair of aviation equipment, *i.e.* the availability of a definite conceptual framework.

The contemporary concept for the long-term storage of an aviation equipment reserve should, in our opinion, envisage, first of all, a determination of the look of the aviation equipment reserve (its quantity and quality) and, second, a description of the system of long-term storage and its bringing to readiness for utilization according to purpose.

The look of the aviation equipment reserve is determined from the condition of maintaining the combat readiness of the Air Forces at the required level. The foundation of the system of long-term aviation equipment storage should be a method of storage that combines "natural" and "artificial" methods of protection. It is realized via the concentration of the aviation equipment at bases in regions with favorable climatic conditions, as well as the use of methods of corrosion protection and the performance of technical servicing and check flights.

Promising versions for the long-term storage of aviation equipment are:

a) for light aircraft with engines and equipment on board, in unheated facilities in a corrosion-protected and sealed state with dynamic or static drying of the air or in an inert environment. The performance of technical servicing every 1.5-2 years and check flights every 3-3.5 years is envisaged;

b) for heavy aircraft with the engines and equipment on board, on open sites with dynamic or static drying of the air or in an inert environment. The performance of technical servicing every 1.5-2 years and check flights every 3 years is envisaged.

The maintenance of the program of technical servicing of the aviation equipment in long-term storage depends markedly on the method of protecting it and the climatic conditions. It is currently expedient, when putting aviation equipment into long-term storage, to envisage the partial sealing of the airframe (from above) or the placement of the aviation equipment in storage areas to avoid the direct entry of precipitation, as well as to utilize local corrosion protection of individual units, assemblies and engine systems, the airframe and the equipment. Removable equipment, batteries and measuring instruments require the creation of special conditions for their storage.

Two types of technical servicing are recommended to be performed in the storage of aviation equipment: at the storage locations without check flights of the aviation equipment, and under special production conditions (routine inspection and servicing in the maintenance unit) with check flights. Additional inspections and ventilation of the compartments of aircraft must also be performed in the fall-winter and spring-summer periods, as well as after the fall of intensive precipitation during the summer months. It should be noted that the periodic ventilation of compartments of the aircraft in dry weather through open hatches and access holes leads to the circulation of air and elimination of stagnant zones and moisture, and impedes the development of corrosion and biological damage.

The incorporation of these technologies into practice would make it possible to reduce by several times the labor, material and monetary expenditures for the servicing of aviation equipment in its long-term storage compared to servicing it in storage according to the standard servicing procedures. The development and application of methods of storage with monitorable and controllable environments (dynamic drying of the air, inert environment) moreover creates conditions for the more complete adoption of a strategy of technical servicing of aircraft according to their technical condition and with a regard for the results of monitoring the parameters of the environment. This would in turn reduce substantially all types of expenditures for the long-term storage of aviation equipment.

The effectiveness of the long-term storage of aviation equipment is determined to a considerable extent by the level of perfection of the organizational structure of the subunits that are supporting the aviation equipment reserve and the systems for managing them. It would seem expedient, in addition to the permanent-readiness forces (SPG) of the Air Forces, also to create reserve forces (SR) whose system of administration would be part of the overall system of administration of the Air Forces, *i.e.* to divide the functions of the SPG and the SR. This version is aimed at economizing material, labor and financial resources to a greater extent than the version for the development of reserve forces that are "included" with the permanent-readiness forces. But it would require certain changes in the organizational structure of the Air Forces, and first of all the creation of regular administrative structures for combat (operational), technical and rear support for the activity of the Air Forces SR in peacetime and during special periods, as well as for their interaction with the Air Forces SPG, at the level of the Air Forces General Staff and the individual formations. The entrusting of the resolution of these issues to the commanding bodies of the permanent-readiness forces would lead to a "criss-crossing of zones of responsibility." The priority in practice would always go to resolving the issues of the SPG, and the SR would not be properly developed. The orientation of the development of the Air Forces in the direction of creating reserve forces, along with the permanent-readiness forces, creates an opportunity to improve the aviation equipment to increase its physical preservation, along with the training of specialists at Air Forces higher-educational institutions and the military-science accompaniment of the aviation equipment reserve.

It also seems important to consider a variation for the development of the Air Forces SR as a unified constituent element of the reserve of armaments and military hardware of the USSR Armed Forces. Strategic, operational and tactical aviation equipment reserves should be allocated therein.

It would also be expedient in the future to "level off" the generations ("age") of the aviation equipment in the permanent-readiness and reserve forces. The latter is justified from many points of view—repairs, supply of spare parts, training of personnel etc.

It would seem that the creation of effective reserve forces is one of the most promising contemporary ways of developing the Air Forces. This, however, brings about the necessity of the further development of the whole existing system of maintenance and repair of aviation equipment.

It would be expedient in this regard to create a unified system of "active" maintenance, long-term storage, plant repairs and the recovery of aviation equipment with a regard for the prospects for the development of the Air Forces and their activity both in peacetime and in wartime. One of its functions will be the efficient distribution of aircraft between the SPG and the SR, which would make it possible to prepare the support, repair and other subunits of the Air Forces in a timely manner for the resolution of organizational and technological issues connected with supporting a high permanent level of combat readiness of Air Forces units, flight safety and a rise in the effectiveness of the combat application of aviation.

MNF Direct Air Support in Desert Sword Operation Reviewed

92UM0897H Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) pp 26-27

[Article by Candidate of Military Sciences V. Dubrov under the rubric "Aviation in Local Conflicts": "In Search of New Tactics"; continued—for beginning see Nos. 9, 10]

[Text] *(From materials in the foreign press)*

Operation "Desert Sword"

In accordance with the intent of this operation, which lasted from February 24 to 28 and concluded with the 42-day war in the Persian Gulf, the principal task of the MNF [multinational forces] aviation was considered to be direct air support (DAS) for the attacking troops. The decisive role in its accomplishment belonged to the subunits of A-10 ground-attack aircraft, AH-64A fire-support helicopters and carrier-based A-6E and AV-8B Harrier attack aircraft, whose firepower was augmented with Air Force F-16C tactical fighters and Navy F/A-18 aircraft.

The successful execution of the concluding 100-hour stage of the war (more than a thousand Iraqi tanks alone were destroyed), as noted by foreign military specialists who covered the course of the war, was conditioned by a series of substantial factors. The results of the air support that were achieved, in the opinion of observers, were largely preordained, first of all, by the results of the performance of the battlefield interdiction mission (from January 20 through February 24). MNF aviation, flying up to 1,500 sorties a day at that time (not counting the use of allocations for other missions), had destroyed 90 percent of the most important lines of communication linking Kuwait with Iraq. The forward-based units of Iraqi troops, thereby cut off from their principal bases of supply, had lost their ability to fight to a considerable extent and did not offer energetic resistance to the coalition troops.

Second, the air-support forces encountered virtually no resistance on the part of Iraqi air-defense assets, which had suffered considerable losses in the course of the round-the-clock raids on their positions, not only by fighter-bombers but also by B-52 aircraft. Employing the "scorched-earth" policy familiar from Vietnam, each of the twenty strategic bombers that took part in the combat operations dropped up to 20 tons of lethal cargo on the positions of Iraqi troops in a single bomb run.

And finally, third, both the ground-attack aircraft and the combat helicopters of the MNF that were supporting the troops did not experience any serious threat whatsoever on the part of Iraqi fighter aviation, whose actions were completely neutralized in the first three days from the start of the offensive operation (the strikes of MNF aviation against Iraqi airfields played a considerable role in this). All of the MiG-29 aircraft in the Iraqi Air Forces had moreover flown to the territory of neighboring Iran before the start of the Desert Sword operation.

It is difficult not to agree with this assessment by the experts. It must be noted nonetheless that notwithstanding the clearly practice-range conditions under which the air support was implemented, the substance and procedure for executing the principal stages of it underwent substantial changes in the course of the operation, caused by a qualitative leap in the development of the hardware and weaponry.

As recently as the period of the war in Vietnam, American military specialists had concluded that no single type of aircraft that was in service in U.S. aviation at that time corresponded in capabilities to the nature of the combat missions being performed in the course of DAS; the expenditures of time to call up aircraft to strike the forward edge of enemy defenses were too large; the mechanism for the interaction of aviation and ground forces had not been completely streamlined; the organization of the DAS itself was unsatisfactory; and, the combat losses in the course of accomplishing the DAS were considerable compared to the results of the performance of other missions by aviation.

The MNF aviation command, taking into account the lessons of the past, nonetheless considered it expedient to redeploy subunits of A-10 attack aircraft to forward-based dirt airfields (wagering on the large—more than 1,000 km—operating radius of the aircraft with an ordnance load). The crews of those aircraft, after takeoff from their principal bases during the course of the Desert Sword operation, patrolled in the air for a long time (sometimes up to an hour and a half) in the immediate proximity of the forward edge own troops, and after receiving a specific assignment made raids deep into enemy territory at distances of up to 300 km. High indicators for the criterion of "duration—range" were also demonstrated by the carrier-based A-6E aircraft.

The problem of organizing the interaction of the two branches of the armed forces was not completely solved, in the opinion of experts. The fact that the combat might of aviation fell not only upon the enemy, but also the close allies of the United States in this war, testifies to this. Nine British soldiers, according to a report from the Reuters agency, were killed and another six were seriously wounded after attacks by several A-10 crews on the combat vehicles of British motorized infantry. A case was also noted where the crew of an AH-64A Apache helicopter employed antitank missiles against its own troops. The result was two killed and four wounded. The pilots later reported that "getting acclimated" to the battlefield situation was made significantly more difficult by the flanking maneuvers of their own tank subunits into the enemy's rear and their wedging into the combat formations of the Iraqi troops.

The territory of Kuwait occupied by Iraqi troops was typically divided into sectors during the development of the operation, each of which was later subjected to intensive group strikes by the aviation subunits "assigned" to them. The crews of the aircraft and helicopters, after reaching the assigned region according to a standard routing laid out by echelons for "there and back," thus quickly ascertained any changes in the ground situation, and the leaders of the groups established contact with "their own" forward spotters, after which the crews over the battlefield used standard target-designation signals or ways of designating the strike targets. All of this raised the reliability of orientation and saved time for the performance of the attacks. This standardization, however, had a negative effect on the observance of one of the basic principles of the combat operations of aviation in DAS—flexibility and rapid re-orientation to the performance of new missions in another sector. It is noteworthy that such an organizational (rather than tactical) solution was a copy of the Vietnam model, which foreign commentators have for some reason forgotten.

Two E-8 JSTARS reconnaissance and target-designation aircraft were to have been included in the MNF command plans for the organizational set-up. Both craft were immediately removed from field testing and redeployed to the Persian Gulf. These aircraft alternately patrolled the airspace over Kuwaiti territory for 8-11 hours during the offensive operations. The composition of each crew included the operators of on-board electronics systems for guidance and identification, representatives of the ground forces and weapons-control officers (the crews of the aircraft and helicopters).

The radar installed on the aircraft, whose operating range in lower-hemisphere scan mode reaches 225 km, made it possible to detect and track both airborne and small ground targets. Its high resolution capacity made it possible to accomplish the reliable selection of the targets detected (the combat crew of the E-8 could distinguish a helicopter from a truck without difficulty). The reconnaissance information obtained was automatically transmitted along radio channels to ground command posts that were 160 km away from the patrol areas. Each E-8 usually monitored a territory of about 90,000 square kilometers during its patrol time.

It should be noted, when describing the combat operations of ground-attack aircraft in the course of providing support for the troops, that they were striking, by and large, against armored vehicles using guided aerial bombs with laser or television homing systems outside the range of fire of the target's air-defense assets. Groups of A-10 and A-6E crews, for example, destroyed 24 T-55 tanks and 13 armored personnel carriers without losing a single aircraft when repelling a counterattack undertaken by the Iraqis in the vicinity of the city of Ras-Khafji (Saudi Arabia).

American aviation in the war against Iraq, despite the quite high operational effectiveness of the ground-attack aircraft, nonetheless lost four A-10s, five A-6Es and one AV-8B Harrier-2. Two A-10s were shot down by fire from shoulder-fired anti-aircraft missiles at the time they were departing the target (the relatively low speed of the aircraft—no more than 700 km/hr—had an effect here).

MNF ground-attack aviation struck against Iraqi troops at night as well. Several instances were recorded, however, where groups of F-16C aircraft returned to their bases without having carried out the assigned missions, due to the impossibility of employing guided weaponry with laser and television homing systems in the thick smoke covering the targets.

The participation of the F-16C tactical fighter in air support may seem somewhat strange. The fact is that this aircraft, according to the plans of the American command, should be replacing the A-10 assault aircraft at the end of the 1990s. A real opportunity to test this aircraft when performing DAS missions under combat conditions and to obtain concrete results from its application presented itself with the start of the war in the Persian Gulf.

The F-16C attack aircraft had completed two months of testing using a test range specially equipped for it in the United States before its arrival at airbases in Saudi Arabia. Work was performed in advance to raise the survivability of those aircraft—the vitally important assemblies in the aircraft structure and the cockpit body were strengthened with armor protection against firearms. The ordnance load was supplemented with Maverick guided air-to-ground missiles.

An improved navigation and aiming system compared to the A-10 along with apparatus to warn the pilot of illumination of the aircraft by enemy radar, high maneuvering speeds (about Mach 0.8) and an experimental prototype of an electro-optic and infrared system for scanning the forward hemisphere made it possible for the American pilots to establish and maintain reliable contact with the forward air spotters in the course of night raids over Kuwaiti territory, make rapid shifts in aim to back-up (newly revealed) targets and strike them (after designation by other crew or from the ground) in the first attack.

It was nonetheless noted, despite the positive results from the combat testing of the F-16C ground-attack aircraft, that this craft was not sufficiently evaluated in development from the standpoint of the criterion of "cost-effectiveness." The price of each sortie increased sharply in conjunction with the expanded capabilities of aviation to support the troops and increase the effectiveness of its operations connected with the participation of F-16C aircraft in DAS. It is moreover well known that the loss of one such aircraft entails a cost of millions.

The results and analysis of the Desert Sword operation by the troops of the anti-Iraqi coalition unequivocally confirmed the necessity of the presence of ground-attack aircraft in the force composition of the Air Force; insofar as the mission of direct air support for the troops remains, the acute need for an aircraft that is specially intended to perform it remains as well. But what will it look like in the future? The question remains an open one.

(Conclusion to follow)

Psychological Techniques to Resolve Conflicts Among Subordinates

92UM0897I Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) pp 28-29

[Article by Candidate of Psychological Sciences Lieutenant-Colonel N. Azarnov under the rubric "The Soldier's Education": "How to Eliminate Conflict?"]

[Text] Private First Class V. Shupenya asked Private K. Kerimov, in the cockpit of the aircraft, to help him check the readings of the on-board instruments against the control readings during preliminary preparations. Kerimov refused. Shupenya then tried to drive him out of the cockpit, using coarse language offending the national sensibilities and dignity of his fellow serviceman. It is not known how this conflict may have ended if the technicians and mechanics on the hardstand had not intervened in time. The chief of the group, Captain N. Belousov, having found out about what happened, punished both of them strictly.

Officers and warrant officers frequently encounter such incidents among subordinates. And far from all supervisors and teachers find the correct way out of these acute situations. That same Captain Belousov also did not act in the best manner from the standpoint of psychology and pedagogy. After all, he essentially did not resolve the conflict, but only "silenced" it.

That is, unfortunately, a widespread error. Attempts to eliminate frictions in the interactions among soldiers using harsh methods, as a rule, accomplish nothing. Repressive measures, in the opinion of the NCOs and soldiers, on the contrary alienate them from the officers and force them to seek out protectors "on the side," carefully selecting a convenient moment to even up scores with the offenders. The friends and countrymen of soldiers who do not get along are often dragged into the conflict, and in the worst case matters come to blows or even the use of weapons.

Conflict, as is well known, is a contradiction between people and their confrontation. Conflicts can be long or short, between individuals or groups, in the sphere of training or the service or in everyday life, as well as during rest. They arise, as a rule, when the status, honor, dignity or reputation of a person is affected, and his interests and needs are infringed upon. Various violations of the norms and rules of interchange, the requirements of military regulations and the poor organization of the teaching and service of the personnel also facilitate quarrels.

The timely recognition of deviations that have been noted in the mutual relations among soldiers and the operative taking of psychologically substantiated steps to normalize them are very important. Methods of ascertaining growing conflicts are most often observation, discussion and sociometry—the aggregate of means and techniques utilized to study the processes of intragroup dynamics.

Observation—the purposeful perception and interpretation by an officer of the specific features of the interchange and behavior of soldiers. It should be conducted in systematic fashion, with the mandatory recording of the data obtained. The alienation of fliers, mutual complaints, insulting attacks on each other, the confrontation of ethnic or countrymen groups, dissatisfaction with the behavior and actions of individual NCOs and officers etc. can testify to the presence of acute situations in the subunit. The commander, by observing subordinates in various settings, can obtain a primary impression of the nature of conflicts that exist or are rising.

This information can be markedly supplemented and clarified with the aid of **discussion.** The scale and causes of differences and the aims, motives and specific individual features of people involved in conflicts can be ascertained in the course of vital, immediate discussion. The information accumulated in this manner can be verified and duplicated using **sociometry.** It is necessary first and foremost to select the criteria or questions in order to ascertain conflicts using this method. The questions could be formulated, for example, in roughly the same way as is done on the sociometric card that is issued to each flier in the course of the survey along with a list of the personnel for the incident described (mutual relations among the aviation mechanics).

Sociometric card

No.

1. With whom of the soldiers and NCOs of the squadron are you friends, socialize with more often and quarrel with less?

2. With whom are you not friends, and are often in conflict?

Thank you for participating in this work.

A small amount of instruction is performed on the procedure of the work and the rules for filling in the cards.

The material obtained as a result of the survey is analyzed and summarized. The results of that analysis and summarization can be structured as a sociomatrix (see table).

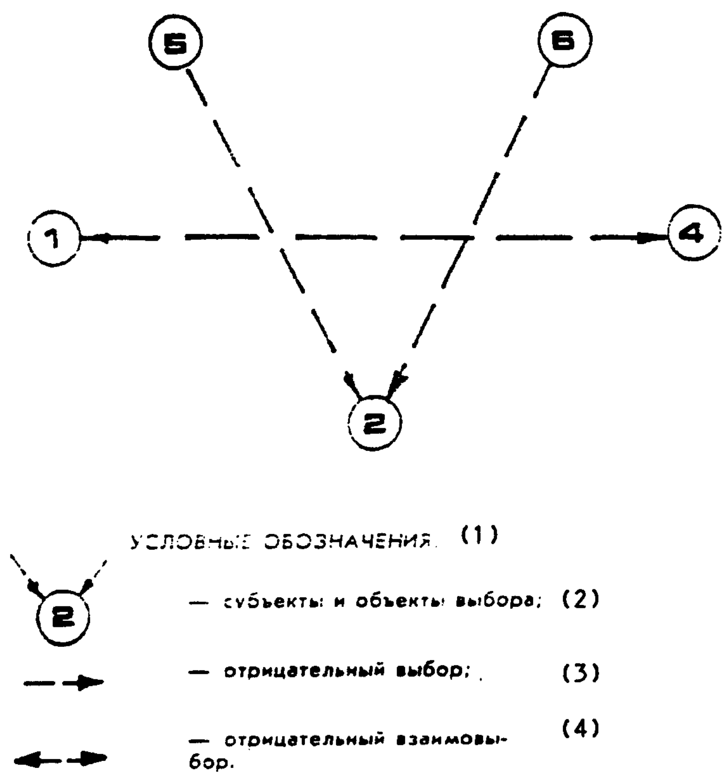
Sociomatrix of Friendship Ties and Conflicts

Number	Military rank	Who is choosing (FIO)	Who is being chosen						Sum of choices	
			1	2	3	4	5	6	ΣR+	ΣR-
1	Private first class	Shupenya V.I.		+		-			1	1
2	Private	Petrov S.P.	+				-		1	1
3	"	Kuzmin N.I.	+						1	0
4	"	Kerimov K.K.	-		+				1	1
5	"	Sergeyan K.K.		-	+				1	1
6	"	Belyanko V.G.	+	-					1	1

Sum of the choices (ΣR): ΣR+ 3 1 2 0 0 0—ΣR- 1 2 0 1 1 0

A sociogram of likely conflicts and conflict situations is sketched on the basis of data on the negative choices (-) taken from the sociomatrix (see figure).

Analyzing the sociogram for our incident, it may be concluded that Private First Class Shupenya and Private Kerimov, as well as privates Sergeyan and Petrov, are in a state



Sociogram of likely conflicts

Key:
1. Symbols
2. subjects and objects of choice
3. negative choice
4. negative mutual choice

of conflict and are in need of psychological assistance. It is important now for the commander to ascertain quickly the essence of the differences and the reasons and sources for their appearance, conduct individual discussions, analyze the actual mutual relations among the soldiers, make a forecast of their development and devise and realize a program for the settlement of the conflict.

Varying methods of psychological influence—direct and indirect—are used in the military collectives. We will first consider the **direct** ones.

The method of the "competent judge" consists of the following. The officer invites the participants in the conflict for a discussion one at a time, in the course of which each openly relates the circumstances and reasons for the conflict at his request. He asks therein that unfounded slandering of the "offenders" or the offending parties be avoided, and that they rely only on the facts. If the picture becomes clear as a result of the conversation, the educator makes the appropriate decision, calls in his subordinates and passes along his opinion. It can be in favor of one or not in favor of either. But they should in any case leave with the conviction that the decision of the commander is the sole correct one. That conviction services as a kind of signal for them—the incident has been exhausted, and it is not worth returning to it.

The method of "public statement of complaints" is based on the power of collective opinion. The officer proposes that the parties in conflict openly relate their mutual offenses and express critical observations in the presence of their fellow servicemen, for example at a general meeting of the conscript personnel of the squadron. The final decision is made on the basis of group evaluations and judgments. It is announced to the participants in the conflict in the name of the collective as a common and objective opinion, and is not subject to further discussion.

The "sanctions" method is used in a case where neither the commander nor the collective has been able to extinguish the conflict. The senior officer is then forced to employ administrative-legal sanctions against the "warring parties"—from repeat notations and putting them on report to a procurator's warning, depending on the concrete circumstances.

But if good will, as they say, is still unable to smooth over the conflict, the commander is forced to resort to the method of "organizational measures"—the unaccommodating soldiers are transferred to other subunits at his intercession.

One can find a lot of examples in aviation units where hostile situations were not only eased under the influence of an experienced and prestigious officer and a sound collective, but the parties even ultimately became friends. There are also no few instances, however, that testify to the opposite. Attempts at direct pressure on those in conflict on the part of the superior officers or the collective, as has already been stated, do not produce positive results. The "sickness" is not eliminated, but rather takes on a chronic form. The **indirect** methods of resolving conflicts are thus more effective.

We will begin familiarization with them with the method of "release of feelings." It is well known that as a person freely expresses his negative emotions, they are gradually changed into positive ones "in and of themselves." But the realization of this method requires no little restraint and patience from the commander. There would seem to be nothing difficult in the fact that the educator hearing out the mutual complaints of Privates Petrov and Sergeyan simply remain silent and nod his head from time to time, "supporting" the conversation through gestures—I understand, he is saying, I am listening attentively.

But officers most often, as they say, cut off their subordinates, appealing to logic, conscience, duty etc. This is worth saying, of course, but at its due time. Then that same Petrov, having calmed down, will more easily receive the reasonable arguments of the educator.

The method of "emotional compensation" is no less effective. Imagine that a soldier in a discussion with you speaks negatively of his fellow serviceman and reproaches him for uncomradely deeds. It would seem that there is no doubt who is the offender and who is the aggrieved. But the more deeply you look into the essence of the conflict, the more understandable it will be to you—they are both to blame, and your interlocutor to a greater extent. He has convinced himself, however, that it was not his fault that the dispute arose, and the more insistently you try to convince him of the opposite, the more energetically he will screen himself with his own conscience and those around him, creating an aura of the "martyr" and "victim" around himself.

Try to share the feelings of the subordinate, even if they seem unjustified to you. Having shown that you as the commander are not indifferent to the anxieties of the soldier, you will thereby emotionally compensate for his dispirited emotional state. Words of sympathy, and even praise, directed toward him are very appropriate in such a discussion.

Such a statement will not really contradict your principles and reality as, "You, Shupenya, are a good person by nature. You are ready to share your last with your comrade. How can you offend Kerimov in such a nasty and unjust way?" Or, "You know, it is most often the more intelligent one who gives way in a dispute. And everyone, by the way, considers you to be an intelligent person."

The method of the "authoritative third party." It is well known that the state of conflict skews the mutual perceptions of the soldiers and makes their role expectations extremely biased. Private Kerimov, in a protracted dispute with Private First Class Shupenya, thus cannot now accept any praise, assistance or petty favor from him, since he will be suspecting concealed mockery or irony in it. The conciliatory, good opinion of one soldier about another could be transmitted through a third party who is respected by both. Such a person may be found, "incited" and "sent" to one of the conflicting parties. It is most important that it remain a secret that this help was organized; otherwise, it will do greater harm than good. But if the experiment succeeds, the impact will be the highest! A positive opinion of the offended soldier on the part of the offender is an impetus for his own thought in the necessity of seeking a compromise.

The educator using the method of "revealing aggression" intentionally provides an opportunity for the conflicting parties to express their hostility to each other. With people this should be done exclusively in "camouflaged" form. The quarreling sides could "clash" in a sporting contest, in a debate, in the performance of housekeeping chores etc. The direct form of "revealing aggression" is realized as follows: the officers pushes the subordinates to argue in his presence, and does not cut off the give and take for quite a long time. Having let them get it out, he does not dismiss the soldiers, but rather continues to work with them on the basis of one of the principles set forth above.

The set of psychological methods for ascertaining and resolving conflicts in military collectives is naturally not limited to the methods and principles cited. I hope that we will have the opportunity to continue the discussion on this topic. The rejection of the dictate characteristic of the administrative-command system in the training and indoctrination of the soldiers of aviation, after all, presupposes the primacy of methods of persuasion. And moreover a method of persuasion founded not on the principle of "Do as I said!" but rather on the formation among the soldiers of an inner need for conscientious study and service and the observance of moral norms via skillful influence on their consciousness. A knowledge of the psychology of the personality and the military collective and the help of psychologists are therefore particularly necessary to each officer today.

Development of Energiya Series of Launch Vehicles

92UM0897J Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) pp 33-36

[Article by Energiya URKTS Deputy Chief Designer V. Filin under the rubric "Space Flight Support": "Universal and Basic"]

[Text] The expansion of the scope of human activity in outer space—the creation of large orbital complexes, flights to planets in the solar system—should soon lead to an appreciable increase in cargo traffic between the Earth and orbits, including an increase in the lift capacity of launch vehicles [LV]. Questions of their ecological cleanliness are no less acute.

The realization of future tasks in the peaceful assimilation of space have thus posed in all clarity the question of creating a modern inventory of LVs using non-toxic and non-corrosive fuel components. That is why, as the result of the consideration of a host of concepts, the basic image of the Energiya universal missile space transport system (URKTS) in that inventory of missiles was defined. One of the principal requirements therein was ensuring the launch of both the Buran reusable orbital craft and other large payloads of large mass. The possibility of creating a series of advanced launch vehicles with a payload capacity of 10 to 200 tonnes on the basis of a minimal quantity of newly developed cruising engines and missile units and based on the Energiya URKTS has been advanced as another. This in turn predetermined the modular-unit principle in building the Energiya LV.

This solution also ensures more economical land-based experimental training and the possibility of flight testing of individual units as part of smaller LVs.

The new launch vehicle is represented, as the result of design studies, in the form of a set of four identical missile units in the first stage surrounding the central missile unit of the second stage, with the lateral positioning of the payload on the central unit (Figs. 1, 2).

The height of the LV is about 60 meters, and its maximum cross-section is 17.7 meters.

The missile unit of the first stage, 39.5 meters in length and 3.9 meters in diameter, is equipped with an RD-170 four-chamber liquid-fueled missile engine operating on liquid oxygen and hydrocarbon fuel. Its thrust at the Earth's surface is 740 tonnes. Its unit thrust in a vacuum is 308 kgf-sec/kg, and the thrust is 806 tonnes. The pressure in the combustion chamber is 250 kgf/cm^2. The power of the turbopump assembly is more than 250,000 horsepower.

The second-stage missile unit has a length of 58.8 meters and a diameter of 7.75 meters. Its engine installation operates on oxygen-hydrogen fuel and has four single-chamber liquid-fueled engines. The thrust of each of them at the Earth's surface is 148 tonnes, with a unit thrust of 353 kgf-sec/kg (200 tonnes and 455 kgf-sec/kg in a vacuum respectively).

During design engineering the developers considered all possible ways of raising the reliability, lifespan and safety of the Energiya LV. Reserves of thrust and the possibility of controlled flight with one engine shut off were envisaged according to the results of the studies. The existing system of emergency protection monitors and performs diagnosis of the state of the cruising engines of both stages and, in the event of deviation of the parameters beyond the allowable limits, shuts off the faulty engine.

The missile in that case will continue flight, but the autonomous control complex will automatically, depending on the time of appearance of the failure, either put the Energiya craft into a lower orbit or onto a single-orbit trajectory with subsequent landing at an airfield, or will perform a maneuver to return to the start region at an altitude of about 60 kilometers and about 200-300 km away from the landing strip. The conditions for the separation of the ship from the launch vehicle are formed at the end of this maneuver, ensuring getting the ship to the landing strip.

In the event of engine failure with the separation of the Energiya LV from a payload in a container different than the Buran, its direction to special landing areas is provided for in order to rule out damage to national-economic facilities.

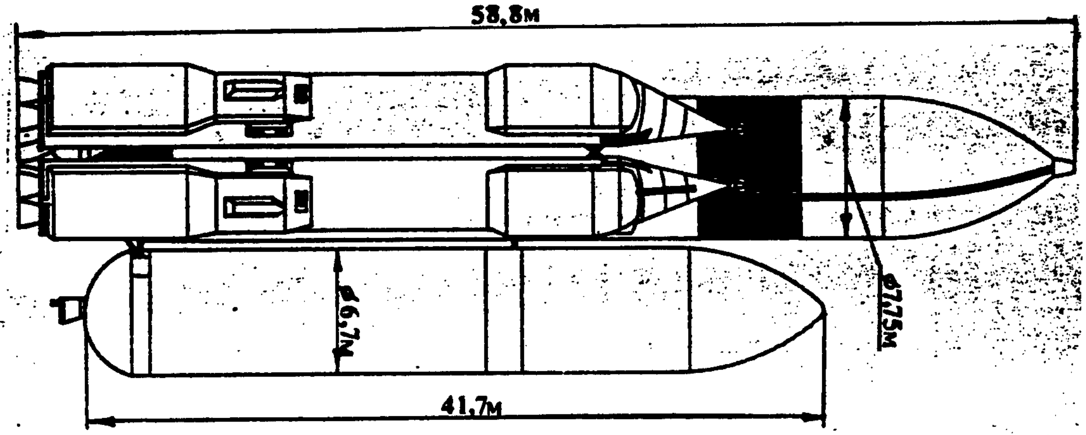


Рис. 1

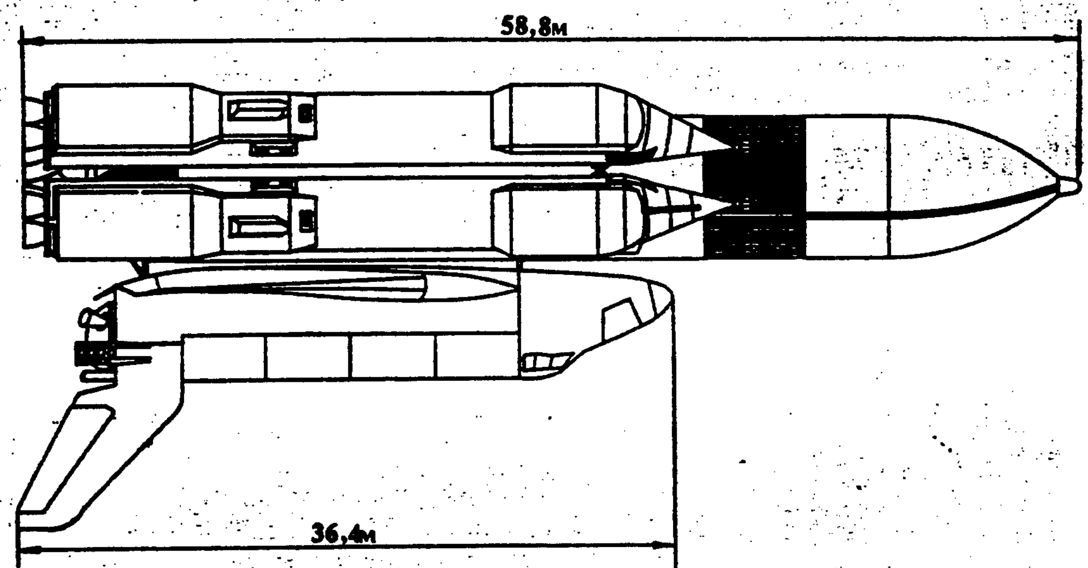


Рис. 2

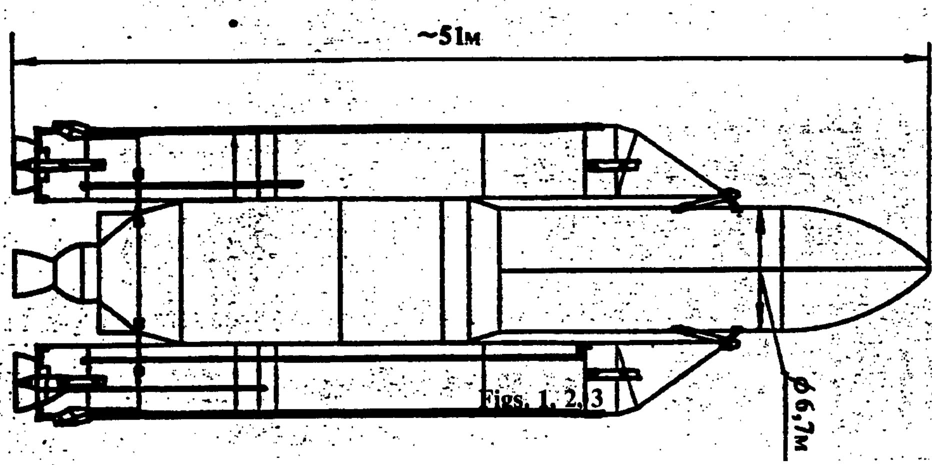


Рис. 3

Figs. 1, 2, 3

The Energiya also has a system of fire and explosion prevention. It is intended to detect and avert hazardous situations on board due to any failure of the seal of fuel systems, and consists of both active and passive means of preventing the formation of hazardous concentrations. The active means accomplish the blowout of the fire or explosion-hazardous compartment with an inert gas.

The first-stage missile units are joined to the second-stage units with two mechanical binding rods. The payload of the Energiya LV is also fastened to the second-stage unit in the same way.

The assembly of the launch vehicle is accomplished in horizontal position on an installation and joining car in the installation and test wing of the cosmodrome engineering complex. All of the missile units undergo check-out testing before assembly, and a comprehensive check of the missile overall is performed after assembly.

The Energiya is delivered to the launch complex by a transport and placement assembly that is moved along a special railroad track by two pairs of diesel locomotives.

The refueling of the tanks of the launch vehicle, as well as monitoring of the preparation for launch, is done automatically. When the "Launch" button is pushed—and that occurs ten minutes before launch—the preparations for launch and the launch itself are accomplished by an onboard automatic-control system. It monitors more than 7,000 system parameters of the launch vehicle, and provides for the automatic curtailment of launch preparations and the putting of the LV into a safe state in the event of a non-standard situation.

The ignition of the first and second stages occurs virtually simultaneously, with the engines of the central unit slightly ahead. This cyclogram rules out the launch of the launch vehicle with engines not started.

Some 140 seconds after the launch, at a flight speed of about 1.8 km/sec and an altitude of almost 50 km, the first stage ceases operation, while the engines of the second stage are turned off after gaining suborbital speed after approximately 460 second of flight at an altitude of about 120 km. The detached second stage is landed in the ocean. This reduces the pollution of space with spent stages. The "boost" of the spacecraft into working orbit is accomplished by its engine installation (or a booster unit).

Here are the technical capabilities of the Energiya URKTS:

Mass of payload placed in near-Earth orbit (altitude of 200 km, inclination of 51°), tonnes:	
—in cargo transport container	up to 90
—on external rack	up to 102
Mass of payload put into geosynchronous orbit using booster unit, tonnes	up to 19
Mass of payload using booster unit placed onto flight trajectory, tonnes:	
—to the moon	up to 32
—to Mars and Venus	up to 28
Mass of payload put into near-Earth orbit by Buran craft, tonnes	up to 30
Mass of payload returnable by Buran craft from near-earth orbit, tonnes	up to 20
Range of launch altitudes, km	
—using booster unit or Buran orbital craft	200-1,000
—using booster unit	1,000-36,000 and interplanetary trajectory
Range or orbital inclinations, degrees	51-110

How do matters stand with the development of a series of launch vehicles based on the Energiya URKTS?

One lateral missile unit being employed on the Energiya launch vehicle serves as the first stage of the Zenit LV, which was created at the Southern NPO [Scientific-Production Association]. The Zenit, depending on the missions being performed, is used in a two- (Zenit-2) or three-stage (Zenit-3) version. The Zenit-2 supports the placement of a payload up to 13.8 tonnes in mass into near-Earth orbit at an altitude of 200 km, while the Zenit-3 delivers a spacecraft with a mass of about one tonne from the territory of the Soviet Union into geostationary orbit. The height of the Zenit-2 launch vehicle is about 57 meters, while the Zenit-3 is 59 meters, with a diameter of 3.9 meters.

The Energiya-M launch vehicle (Fig. 3), which is able to place a payload with a mass of up to 35 tonnes into an orbit of 200 km in altitude or a mass of 4.5-6 tonnes into geostationary orbit, is being developed using two of the side missile units of the first stage and a reduced unit of the second stage of the Energiya LV. The launch and joining unit, fittings, engine from the oxygen-hydrogen engine installation and elements of the design of the central unit of the Energiya LV are being borrowed for the Energiya-M. This makes it possible to make full use of the launch and engineering complexes and the production, test and experimental bases that were created earlier for the Energiya LV in the creation and operation of the Energiya-M.

A launch vehicle with a lift capacity twice as large as that of the existing Energiya should have, as part of it, eight modified modular units from its first stage and a modified second-stage unit with increased fuel reserves.

The successful start of flight testing for the Zenit and Energiya launch vehicles and ground tests of a technological mock-up prototype of the Energiya-M launch vehicle testify to the correctness of the concept chosen for the development of launch systems and their design-engineering solutions.

The operational start-up of the Zenit, Energiya and Energiya-M launch vehicles is revealing broad opportunities for the development of international collaboration in the realm of space science at a qualitatively new level.

Development History, Prospects of Buran Spacecraft Related

92UM0897K Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) p 37

[Interview with LII imeni M.M. Gromov deputy division chief Yuriy Vasilyevich Sharanov by V. Ageyev under the rubric "Topical Interview": "Clouds Over the 'Buran'"]

[Text] *More than two years have passed since the first flight of the reusable Buran spacecraft. And the time has evidently come to talk about the role played in its creation by the Flight-Research Institute (LII) imeni M.M. Gromov, formerly little-known to the general reader. Our correspondent met with the deputy chief of one of the divisions of that institute, Yu. Sharanov, and asked him to answer a series of questions.*

[V. Ageyev] Yuriy Vasilyevich, please recall for us the history of the creation of the Buran.

[Yu. Sharanov] The idea of an air/space craft has long excited the minds of scientists and specialists in our country and abroad. We already had several plans for the development of such a craft in the 1970s. Experimental research was moreover conducted on flying models with their launch into space (the Bor, for example). A manned subsonic full-size analogue of an orbital aircraft (the Spiral system) was manufactured, and it made autonomous flights after being dropped from a Tu-95 aircraft. The concept of creating an air/space craft in the USSR was genuinely defined, however, only after the United States set about work on the Space Shuttle craft. And although both spacecraft are similar, they have marked differences as well. The Space Shuttle system, first and foremost, has oxygen-hydrogen cruising engines installed on the orbital craft, while in the Buran configuration all of the booster engines are on the launch vehicle. That is what makes it possible to use the Energiya launch vehicle to put other payloads into orbit as well. The control system is also original, and is a most complex system of electronic equipment without analogue in domestic air and space engineering.

[V. Ageyev] And what is the role of the Flight-Research Institute in preparing the orbital craft for flight?

[Yu. Sharanov] The very creation of the air/space craft that later received the name of Buran had already assumed the participation of the LII in its design engineering at the very early stages. This was conditioned first and foremost by the fundamentally new configuration of the craft, which required a combination of design-engineering methods from aviation and space technology. The craft should thus brake in the atmosphere when descending from orbit, reach the area of the airfield and land without utilizing engine thrust. The accomplishment of this task was to be carried out both in automatic and in manual mode. It was thus essential, first of all, to create a control system that met the requirements for autonomous descent and landing and, second, to train a crew able to take upon itself a portion of the most crucial and complex operations to control the craft.

The decision was made to create flying laboratories (LL) based on the Tu-154 in order to realize the flight of the craft according to the first configuration. The similarity of orbital flight to it was achieved through reversing the main engines and dropping the landing gear and lift spoilers. The ergonomics of the flight deck and the instrumentation also imitated the effects of such a flight.

At the heart of the standard control system for the craft as installed on the LL was a computer with algorithms for controlling movements and navigation. More than a hundred automatic landings were made using it. This also served as the foundation for giving the institute permission to make a flight.

This work was then used in horizontal flight research of an exact copy of the Buran. The distinction in aerodynamics was only that the analogue was fitted with air-breathing jet engines to support the modes of takeoff and gaining altitude. These results also went into the summary conclusion for allowing the orbital craft to fly.

[V. Ageyev] Yuriy Vasilyevich, how was the training of the crew accomplished?

[Yu. Sharanov] A program of special flight training was developed for that purpose at the LII. It envisaged the mastery of the modes of engineless maneuvering and landing using specially equipped LLs by the test pilots (using the MiG-25, Su-7 and Su-17), which were similar to the orbital craft in their dynamic characteristics. These laboratories, however, did not correspond fully to the analogue, and the flight crews thus gradually shifted to controlling craft based on the Tu-154 after a certain time. During the training process they mastered control techniques developed by the institute and became familiarized with the information support that was usually displayed to the pilot on the screens of the multifunctional display indicators in flight.

As for the contingent of pilot/cosmonauts itself, it was created long before the first flight of the Buran. It was headed by Hero of the Soviet Union and Honored Test Pilot of the USSR I. Volk. And despite the fact that further flights of the orbital craft have been postponed for a time, the training of the crews in the contingent continues.

[V. Ageyev] What opportunities are opened up to space science by the first flight of the Buran?

[Yu. Sharanov] If we are speaking of the future, the country will have a new air/space fleet with the completion of the testing of several orbital craft of the Buran type. And that means that great opportunities will appear to return large payloads to Earth. The landing of the craft with cargo can meanwhile be accomplished at a conventional airfield located, say, in the region of this or that production complex. That opens up new horizons for science and technology, although the creation of such craft is difficult given the current state of our economy, and there is thus not full confidence in the full-scale realization of the whole project.

From the editors. *The problem of creating such man-machine systems is undoubtedly not simple, but they open up new opportunities, as testified to by the operational experience of the American Space Shuttle space vehicles. The resolution of that task here is encountering not only objective difficulties, but subjective opposition as well. The structure itself is playing far from the last role here, as are the departmental interests of the Ministry of General Machine Building*

(MOM), a monopoly in the production of space hardware. Its interests do not intersect with the interests of the Ministry of the Aviation Industry—another monopoly, but now for aircraft in the Earth's atmosphere. The Buran is both an aircraft and a spacecraft. And a very great deal—obtaining funds, paramount financing, prestige—depends on whose share is greater.

The scales are currently tipping toward MOM by virtue of certain reasons, and this has immediately affected the working through of the regimens for descent and landing using back-up airfields. The financing for that work has declined sharply in the last two years. The extant ties and the cooperation of collectives have begun to be destroyed.

The issue could be resolved on the basis of a study of supply and demand. Such an approach would make it possible to economize substantially the funds invested in the design engineering, building and flying of the orbital craft.

Legal Foundations of Authority of U.S. Spacecraft Commanders

92UM0897L Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) p 41

[Article by G. Silvestrov under the rubric "Space and Law": "Authority Supported by Law"]

[Text] The question of adopting space legislation has become a full-fledged one under the conditions of the overall legal reform in the USSR. Space law will naturally proceed from a regard for our realities. It would be useful to take into account the positive experience of foreign countries at the same time.

A whole system of norms of space law is in force in the United States. The first law was adopted there in 1958—that is, the same year the first American Earth satellite was launched. The trend toward the rapid regulation of the relations that arise was later preserved as well. The norms of a law regulating many important aspects of the operation of the Space Shuttle reusable spacecraft were adopted at one time on the eve of the launch of that space system. Insofar as the leading figure in the spacecraft crew is the commander, a separate subsection of the Code of Federal Instructions establishes his authority. It was adopted in 1980. The operation of the Space Shuttle, meanwhile, only started in November of 1982.

The fact of the codification of the status of the commander of the spacecraft was itself noteworthy first and foremost. Complicated situations may arise in the course of fulfilling the flight program, in which the lives of the astronauts themselves could depend on the precision of the commander's actions. The legal certainty permits him to make the necessary decisions without fear of responsibility. The limits of his authority that he can under no circumstances overstep, on the other hand, are also clearly defined.

Legal relations are thus created between the commander and the crew, as well as the ground flight-control bodies, that make possible the optimal performance of the flight mission. That raises his authority and responsibility; he answers to an independent level of authority—an American court—for the observance of the norms of the law. The possibility of any willful decisions on the part of both the commander or senior officers is reduced thereby.

The power of the commander extends to more than the Space Shuttle itself, but also to other elements of the transport system not strictly connected to the orbital craft, as well as to the payload (that is, the cargo), which could belong to foreign clients. The principle of one-man command of the commander is observed during the flight.

In view of the fact that he is endowed with great rights, the time limits of his authority are precisely defined. It is stipulated that the commander enjoys the given rights during all phases of the flight, which include the launch of the craft, the orbital stage, the descent from orbit, the landing and a certain post-landing time.

The procedure is stipulated in the event of a forced landing. In that situation the commander continues to exercise his rights as long as the flight continues. His authority ceases only after U.S. authorities take responsibility for the craft and its crew.

The law specifically does not stipulate the skills requirements for the commander of the Space Shuttle. That is done in the corresponding instructions. As a crew member, however, he should adhere to all the standards of behavior that are stipulated for American astronauts. The commander can only be an American, but it is interesting that according to law it can also be a woman.

The commander is designated for a specific flight. If the flight proceeds normally, he is subordinate to the director of the Johnson Space Center. In emergency situations, however, as well as in other cases that are specially defined, he has the right to make final decisions independently.

A procedure for replacing the commander is envisaged. Insofar as the pilot is the second person of the craft by force of law, the authority passes to him (if the commander himself is not able to fulfill it). In the event that both the commander and the pilot prove to be unable to execute the functions of commander, the flight operations officer designates the order of replacement of that position before the start of the flight.

The essence of the authority of the commander is defined extremely broadly and fully. He has the right to exercise it exclusively for the purpose of ensuring order and discipline, safety, the health and well-being of the crew, and the protection of all the elements of the space transport system and the payload. He is endowed with "absolute authority" therein, and he is given the right to undertake any measures that he is convinced are necessary. No person in the world seems to have such broad authority founded on the law. The commander has in particular the right to employ any "reasonable and essential" measures during the course of the flight, including the application of physical force, to achieve the indicated aims.

Another element of the authority of the commander is also specifically mentioned. He has the right to subject any individual on board the craft, where necessary, to such restrictions in freedom of action and movements as are dictated by circumstances. These restrictions remain in effect until the offender is handed over to the authorities.

Finally, responsibility is established for violations of the law. An individual who intentionally violates, tries to violate or enters into a plot for the aim of violating any legal order of the commander or norm of the law can be fined a sum of up to 5,000 dollars or imprisoned for a term of up to one year. The punishments may be deferred. A commander who violates the provisions of the law himself bears the same responsibility.

It must be said in conclusion that the first Soviet law regulating space activity is currently being developed at the Institute of State and Law of the USSR Academy of Sciences. The first law of this type should naturally not dwell in great detail on the authorities of the commander of a spacecraft. It is important that the foundations of his legal status be laid down.

Soviet Airpower Role in Defense of Moscow in WWII

92UM0897M Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, Nov 91 (signed to press 9 Dec 91) pp 43-44

[Article by Hero of the Soviet Union and Candidate of Military Sciences Major-General Aviation (Retired) L. Shishov under the rubric "Toward the 50th Anniversary of the Most Important Events in the Great Patriotic War": "Soviet Aviation in the Battle of Moscow"]

[Text] The battle of Moscow had enormous military-political significance. The Hitlerite army suffered a major defeat there for the first time since the start of World War II. The Soviet armed forces shattered the myth of the invincibility of the Wehrmacht and temporarily seized the strategic initiative from the enemy.

Our aviation played an important role in this. It had won supremacy in the air by the end of the defensive period of the battle, and held it in the course of the counter-offensive, an intense battle with a powerful and experienced adversary. Favorable conditions were created thereby for the successful operations of the ground troops.

The start of one of the greatest battles in the history of the Great Patriotic War went extremely badly for our country and army. By the end of September 1941 the enemy had regrouped his troops, concentrating the principal forces in three strategic sectors—Tikhvin, Moscow and Rostov. The Hitlerite command considered the Moscow sector to be the most important of these, insofar as they linked the fall of the capital of the Soviet Union with the victorious conclusion of the march to the East.

The task of seizing Moscow was entrusted to Army Group Center, which had 77 divisions—of which 22 were armored or motorized—and no fewer than one million men and over 2,000 tanks. The aviation group, part of the 2nd Air Fleet of the Luftwaffe, numbered some 950 aircraft, including 495 bombers. Airfields seized from Soviet aviation were used to accommodate them, as were specially prepared field airfields close to the front lines.

Fascist aircraft ruled the air and struck against our troops on the battlefield and in the communications zone, destroying bridges and crossings, bombing railroad centers and airfields, making raids on Moscow and waging intensive reconnaissance.

The Hitlerite armada was opposed by the troops of the Western, Bryansk and Reserve fronts, which had about 800,000 men and up to 600 tanks. Our aviation, which had been operating in the Moscow sector, had just 401 aircraft and was numerically 2.3 times inferior to the enemy. The data are presented in more detail in Table 1.

Table 1—Composition of Aviation and Correlation of Forces of Opposing Sides by 30 Sep 41

Branch of aviation	Soviet Air Forces	Enemy aviation	Correlation of forces
Fighters	207	247	1:1.2
Bombers			
—day	43	200	1:4.6
—night	89	295	1:3.3
Ground-attack aircraft	44	—	—
Reconnaissance aircraft	18	208	1:11.5
Total	401	950	1:2.3

A large quantity of obsolete hardware and the repeated redeployment of units in the course of the retreat, along with other factors, also made the already strained situation even more difficult.

The troops of Army Group Center began an offensive with part of their forces in the Orel sector on 30 Sep 41. The principal enemy forces went over to the offensive on October 2. Ferocious fighting took place in the Kalinin, Yuzhno-Maloyaroslavets and Orel-Tula operational sectors.

The Soviet troops, while offering stubborn resistance to the enemy, were forced to cede ground nonetheless, suffering large losses therein. The Hitlerite advance suffered large losses as well, including from the strikes of Soviet aviation.

At the beginning of October the 6th Reserve Aviation Group, in conjunction with the Long-Range Bomber Aviation of the High Command (DBA GK) and the Air Forces of the Bryansk Front, operating continuously day and night against the enemy tank columns and inflicting substantial losses on them, facilitated a slowing of the advance by the German 2nd Tank Group toward Tula.

Over the course of two days, October 18-19, the aviation of the Kalinin and Western fronts and three divisions of the DBA GK supported the troops of the Kalinin Front in making a counterattack there against the enemy, who had broken through north and east of Kalinin. The 3rd Tank Group of the Wehrmacht suffered large losses and was forced to halt its offensive in the course of the operation.

Our aviation was also actively supporting the troops of the Western Front, who had held the enemy at a line east of Volokolamsk, at Naro-Fominsk, by the end of October.

Soviet troops inflicted significant losses on the strike groups of the fascist German troops in the course of heavy defensive battles, and at the end of October and beginning of November had halted their offensive along the line of Kalinin, Volokolamsk, Naro-Fominsk, Aleksin, Tula, Bogorodistk and Livny. The attempt by the Hitlerites to win Moscow in October of 1941 had been smashed, largely thanks to the energetic actions, courage and skill of the winged warriors.

The fliers carried out 19,202 aircraft sorties during the period of defensive battles on the distant approaches to the capital, of which 56 percent fell to the main task of strikes against enemy troops.

Cruel fighting for air supremacy was underway at the same time. Soviet pilots engaged in 554 aerial battles from September 30 through November 13, in which 307 enemy aircraft were shot down. The aviation carried out a series of bombing raids against Hitlerite airfields from October 11 through 18 by order of the Hq SHC. Frontal aviation destroyed 47 enemy aircraft in the first stage of the defense.

The German command was counting on destroying Moscow, disorganizing the command and control of the country and the army and the operation of enterprises in the defense industry, and demoralizing the population and the troops with mass air strikes. Fascist aviation made 31 raids on the capital in October. Only 72 of the 2,018 aircraft taking part in the raids penetrated to the city, however, thanks to the energetic actions of pilots in the units of the 6th Fighter Air Wing of PVO Moscow [Moscow Air Defense] and the anti-aircraft gunners. Our fighters destroyed 278 enemy aircraft.

The enemy used the first half of November in the Moscow sector to prepare a new offensive and to regroup and bring the troops up to strength. His principal forces—up to 55 divisions, of which 18 were armored or motorized—were concentrated against the troops of the Western Front, which had six combined-arms armies and five divisions from the Moscow garrison. The Hitlerites had achieved an insignificant superiority in manpower (1.1:1) and a more appreciable one in tanks (2.3:1), artillery and mortars (1.8:1).

The group of fascist German aviation had been weakened somewhat by the start of the second offensive on Moscow. The 2nd Air Fleet numbered some 670 aircraft in the middle of November.

Our aviation protecting the capital, on the contrary, had been strengthened chiefly through the redeployment of aviation units there from other parts of the Soviet-German front, and had 1,058 aircraft—1.6 times more than the Germans. It is important to note that the proportionate share of aircraft of new types in the aircraft inventory had grown, although a significant portion of it—450 aircraft—was aircraft of obsolete designs.

An enemy strike group undertook an offensive against the right flank of the Western Front on November 15-16. A considerable superiority in tanks and artillery allowed the Hitlerites to break through our defenses.

In the critical situation that had developed, Soviet fliers supporting the ground troops carried out strikes against the enemy tank and motorized groups that had broken through, forcing the fascists to avoid the highways and move along lesser side roads and to disperse, which slowed the pace of their offensive.

The pilots of the 6th Fighter Air Wing of the PVO operated particularly effectively during this period. They destroyed and damaged 77 tanks and 260 vehicles from November 25 through 30 in the area of Fedorovka and Krasnaya Polyana. These flying protectors of Moscow made more than 4,500 aircraft sorties to attack the enemy troops over just these six days.

The fighting also continued for air supremacy. On some days there were up to 40 aerial battles on the right flank of the Western Front alone. Pre-emptive and blocking strikes were made against German airfields at Klina and Alferov, among others.

Aviation groups under the command of generals I. Petrov and G. Kravchenko were created at the end of November in order to strengthen the air forces, by directive of the Hq SHC. The former had 163 aircraft, of which 56 were not in working order, and the latter had 40 aircraft. The Petrov group supported our troops north of Moscow and covered the concentration of the reserve 1st Shock and 20th armies. The Kravchenko air group, formed up in the area of Ryazhsk, operated against the enemy who had developed an offensive against Mikhaylov and Pavelets. An aviation group under Colonel Shcherbakov was also created to strengthen support for the troops of the 50th Army around Tula.

The Germans, counting on seizing Moscow with the aid of a mighty frontal assault, renewed the offensive on December 1 with major forces in the sectors north and south of Naro-Fominsk, as well as west of Zvenigorod. At first they were able to break through the defenses of the Soviet troops and advance to the Aprelevka Station. Units and formations of the 33rd and 5th armies, however, with the active support of aviation, made a counterattack on December 2-4, as the result of which the enemy suffered large losses and was pushed back to his initial positions.

The fliers carried out about a thousand sorties in the course of these battles from December 1 through 6. The principal efforts were aimed at fighting the enemy tanks and infantry that had driven a wedge into our defenses. Bombing strikes were made against airfields, as well as against the Moscow—Minsk trunk highway, with the aim of impeding the approach of his reserves.

The second attempt of the Hitlerites to win the capital of the Soviet Union thereby collapsed thanks to the energetic actions of the ground forces and aviation and the courage and heroism of the Soviet soldiers and laborers of the front rear services.

The Air Forces played a significant role in achieving the aims of the defense. Our aviation made 15,903 aircraft sorties and destroyed a large quantity of manpower and enemy hardware over the period from November 14 through December 5. The principal efforts of the Air Forces during this most difficult period for the fate of Moscow and the Motherland were strikes against enemy troops on the battlefield, the coverage of our own troops and the protection of the capital and the military industrial facilities and cities around Moscow from the raids of enemy aviation, as can be seen from Table 2.

Table 2—Number of Aircraft Sorties by Soviet Aviation in Accordance With Missions in the Defensive Battle of Moscow

	Number	Percent
Total aircraft sorties	35,105	100
Combat missions performed:		
—strikes against enemy troops and targets	18,685	53.2
—covering our own troops	7,190	20.5
—escorting bombers and ground-attack aircraft	1,458	4.1
—interception of enemy aerial reconnaissance	1,110	3.2
—operations against hostile airfields	593	1.7
—aerial reconnaissance	4,247	12.1
Operations against rail centers, crossings	1,822	5.2

The stubborn fight for air supremacy continued at the same time. Our aviation destroyed 312 enemy aircraft in the second stage of the defense of Moscow, 177 of them in aerial battles and 135 at airfields.

Fascist aviation undertook 41 raids on Moscow in November 1941. Of the 1,953 aircraft that took part in them, only 28 broke through to the city. Fighters and anti-aircraft artillery shot down 198 of the airborne pirates.

Our fliers made 35,105 sorties overall during the period of the defensive battles around Moscow, at an average rate of 524 sorties a day. The tasks given by the Hitlerite command to their aviation to support the capture of Moscow in the course of the October, and then the November, offensives and the destruction of the capital with mass air strikes were not fulfilled. What is more, 875 Luftwaffe aircraft were destroyed and damaged in aerial battles and by anti-aircraft artillery. Meanwhile, the decisive battles for Moscow, in the course of which the enemy would be smashed and thrown back from the suburbs of the capital, were still ahead.

(Conclusion to follow)

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