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Avoidance of accidents during demonstration flights

This paper deals with problems of combating electronic failures in demonstration flights. For the first time they arose in the industrial production in the early 70s of the 20th century for the first time in the Soviet Union in connection with the transition from relay-contact systems for industrial control machines to electronic - so-called NCU - non-contact control units. Such control systems on non-contact electronics were equipped with thousands of presses, scissors, flexible automated lines (FAL), and automated complexes. In other countries - America, Japan, Europe, this transition to non-contact electronics is not it was. For example, the American press "Near" and the Japanese "Kamatsu" had relay-contact management systems, and our presses of all efforts had a contactless electronic management system.

Introduction.

Since industrial machines were maintained according to the state brigades (instrumentation and automation), electricians, mechanics, 80-90% of all failures had the character of failures, especially in the electronics of the NCU. Diagnostics of such failures - by accident arising and accidentally disappearing stops. Machines in the process work was very difficult. The usual classical measuring equipment - a tester, an oscilloscope, frequency meters, etc., to find a failure, to study its nature was impossible. Equipment was idle, sometimes for months [1].

The first scientific definitions of the category "failure" appeared in the early 70s 20 century, when creating the basis for the operation of radio electronic equipment. It was then that scientists proposed new classifications of the flow of failures on different grounds (temporary and permanent, dependent and independent, full and partial, stable, crashing, moving, constructive, technological, operational, etc.) Under «failure» is meant a one-time self-eliminating refusal, the duration of which is small in comparison with the duration robots before accidental failure. At the same time, a series of failures that quickly follow each other the other called an intermittent failure. Given that the fundamentals of the theory of fault diagnosis, design theory, the exploitation of "anti-sabotage" electronics from the 1970s to the present time did not actually develop. These definitions of the category of "failures" have been preserved to the present time, and the classification of faults is not actually exist.

The first "computer" air accidents and incidents. Nature errors.

Before the transition to a complex avionics during the operation of on-board aircraft equipment, there were practically no failures. Table 1 shows the general characteristics of the failure flow of "precomputer" aircraft B-727 and Tu-154 of all modifications.

Table 1

Systems	Type of system failure	B-727	Ty-154
Landing gear	Undercarriage extension	43	15
	Inward retracting landing gear	10	4
	(landing gear folding)	3	0
	Pneumatic destruction	0	1
	Nose gear steering (front gear control)		
	In total on system	56	20
Power Unit	Non-localized engine failure	13	5
	Starter failure	0	1
	Engine shutdown	2	0
	Separation engine from aircraft	2	0
	In total on system	17	6
Fight control system	Deceleration flaps	0	2
	Deceleration slats	2	0
	In total on system	2	2
Other systems	In total on all systems of the aircraft	5	1
		80	28

Among the first "computer" air crashes is the third airplane crash "flying computer" Airbus A320 in January 1992 in the mountains of Western Europe - Vosges. And although, as it turned out later, the ultimate technological cause (cause finales) of this accident was a functional failure of the system prevent collisions with the ground GPWS because of the steep slopes of the mountains. Such accidents were earlier, but this crash caused a reaction in the world press as follows: electronics is called a new risk factor. And it was the series of these accidents that led to a comprehensive assessment avionics, its modifications, the emergence of new systems EGPWS, TAWS, etc., as well as a new function of avionics - early warning collision with the ground. The main reason for these air crashes is a false thesis – computer Avionics qualitatively simplifies the management of the aircraft - "A 320 can control the chimpanzee "(the opinion of the designers). To remove this false conceptual premise of the Western aviation specialists in the initial operation of the eastern production aircraft IL-96-300, TU-204 with electronic avionics, for the prevention "Computer" AP were carried out complex scientific - methodological programs. The results of the work under the programs were presented to the flight managers, designers, flight crews, engineering and technical staff, reported at the scientific-methodical conferences of the CA.

Voice announcer malfunctions during demonstration flight

The prevention of accidents is carried out by engineering and technical methods, which includes analysis and research of the processes of human-machine interaction (flight crew and aircraft) from the point of view of accounting problems of a large number of factors in different flight conditions. As an example, consider

the air crash on July 27, 2002 of SU-27UB aircraft (Sknilov). At the first stage, aviation experts concluded that the cause of air travel was the human factor. At the second stage, after connecting engineering psychologists to the analysis of air traffic causality, additional work by engineering-psychological methods with decoding flight data of airborne recorders, it was concluded that the ultimate cause of air traffic was the technological factor - complex failures of the voice informer, which led to the emergence of supercritical angles of attack and misinformation of the flight crew. In this aviation accident, the complexity of the failures was that the attack angle indicator (in the cockpit on the left) actually did not work in the conditions of loading the channel of the indication of the current angle of attack There were also failures in the operation of engines. The nature of the voice informant's malfunctions is shown in Fig. 1.

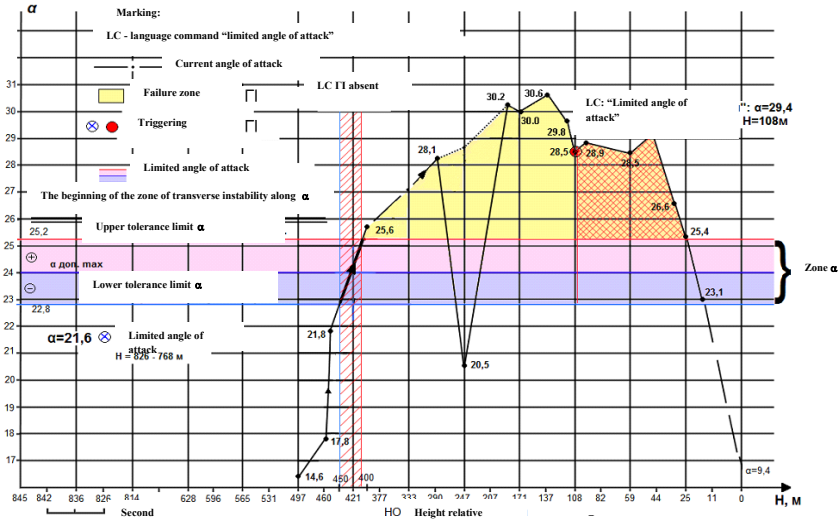

Fig. 1. Voice informant malfunctions

Estimation of the complexity of avionics by means of process analysis. The technology of process analysis of flights c methodology.

The first "computer" aircraft incidents and incidents in the early 90s. The 20th century arose because of incorrect premises that the transition from electric to electronic control of aircraft qualitatively simplifies (reduces) the flight control of the aircraft, and also because of technological and functional failures of avionics. On the implementation of comprehensive programs to ensure the operation of the aircraft with avionics of the first generations on the aircraft IL-96-300, AN-70, TU-204, A320 etc. The need to develop a special analytical methodology of TPAF (technology process analysis of flights), taking into account the technological complexity of standard flight

operations, planned by the designer in the REE (radio electronic equipment) of aircraft with electronic avionics of the first generation. At the same time, an analytical apparatus for constructing a cyclogram deployment of flight operations and the definition of statistical laws construction of flight technologies using special histograms deployment.

Conclusions

Diagnostics of flight failures is a very complex process, especially for aircraft, performing demonstration flights. These difficulties test pilots characterize as follows:

- imperfection of the systems warning the pilot to achieve by the airplane of the limiting parameters of flight (restrictions), in particular - angles of attack and overload. Currently, on all airplanes. Restrictive systems do not provide formation and indication necessary nomenclature of allowable angles of attack and overload. Of 5-10 required angles of attack and overload at best. Formed and tracked on the UAU for 2-3 values, the rest the pilot must keep in memory, in the process maneuvering repeatedly read, compare the current angle of attack, and overload with the current permissible. This reduces the reserve attention, complicates piloting and leads to errors;

- non-informed failures of pitch, bank, heading in which use the devices CAT, ICP-81, PNP. At the same time refusals such as "fading" or "slow drift" are recognized by the flight crew with a long delay (the recognition time is 10 s or more), that in difficult meteorological conditions and at night leads to occurrence of an emergency situation;

- there are no airplanes or absolutely insufficient capabilities of the pilot warning system of dangerous altitude and withdrawal from a dangerous height.

- do not correspond to the modern technical level of the device, warning pilot about the exit to the speed limit.

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