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ENGINEERING-PSYCHOLOGICAL ANALYSIS OF VISUAL INSPECTIONS QUALITY OF OLD AND NEW GENERATION AVIONICS

Represented results of work are connected with analysis of one of technological operations of aircraft maintenance, namely – visual inspection. The analysis of visual inspection technological operations for aircrafts of type AH-24 and AH-148 was performed on the basis of detailed studying and statistical processing of line and base maintenance task cards

Responsibilities connected with aircraft maintenance may be very complicated and may change in conditions, favorable for errors occurrence. Maintenance staff, at least in most developed aviation systems, often works at considerable time deficit. Operators have increased the intensity of aircraft operation in order to avoid economical difficulties of aviation field.

Also, technical specialists should often serve aging aircrafts. Nowadays there are often aircrafts of 20-25 years old in many air transport companies, including the largest ones. Moreover, many operators mean to go on operation of some of them in the near future. The installation of the noise absorbing devices complete sets on the engines of some old aircrafts makes them profitable for operation from economical point of view and from the point of view of environmental protection. However these aircrafts require intensive maintenance. Their airframe need diligent check of fatigue and corrosion prevent general wear. It makes additional load for maintenance staff and creates stress production situations, as additional maintenance is needed. If aging evidences, often intangible, stay undiagnosed, their consequences may be very serious [1].

While maintenance of aging aircrafts, many air transport world companies are filled with aircrafts, corresponding new level of technics development and this increases the volume of works, connected with aircraft maintenance. In the new aircrafts technical achievements are embodied, such as load-bearing element from composite materials, “glass cockpits”, automated systems, built-in-test equipment. The necessity to serve new and old aircrafts requires substantially new knowledge and skills from maintenance staff.

The understanding of the human factor importance during aircraft maintenance at this time increases. Safety and effectiveness of flights on air lines also become more connected with the quality of work of people, checking and serving airlines aircrafts. It makes pay attention to the aspects, connected with the human factor of great importance for aviation safety [2].

In this article there are results of work, connected with analysis of one of technological operations of aircraft maintenance, specifically with visual inspection (VI). This analysis is carried out on the basis of task cards studying as the main document of line maintenance and different checks of base maintenance planning and realization. Two types of aircrafts are considered: AH-24 (as the veteran of ukrainian aviation) and AH-148 – which recently started operation in airlines of Ukraine. The analysis was carried out for visual inspection operations (VIO) of different types of aircrafts.

Analysis of visual inspection technological operations for aircrafts of type AH-24 was realized on the basis of detailed studying and statistical processing of line and base maintenance task cards (issues 18 and 23; issues years – 1984-1986). Task cards were separately considered and correspondingly the data was grouped due to operations for specific type of equipment: navigation, electrical, instrument, fire and conditioning systems. For every technological operation there was counted up the number of visual inspection operation and total number of operations.

In a similar manner the task cards processing for the aircraft AH-148 was performed. As there was an access only for task cards for line maintenance, data is shown only for this type of maintenance.

Generalized data of statistical processing are shown in the tables 1 – 3. In these tables the data is shown in different sections.

So, in the table 1 there is data, characterizing the number of visual inspection operations for different kinds and forms of equipment maintenance of AH-24. In every cell of this table there is data, showing correlation of number of visual inspection technological operations and total number of operations in accordance with task cards for specific type of equipment and also percent correlation of previously shown values of numbers of operations.

Table 1

Number of visual inspection operations for different types and forms of equipment maintenance of AH-24

AH-24							
		Types of maintenance					
			Base (flightf hours)				
	Types of equipment	Line	300 ± 30	100 30	900 ± 30	1800 ± 30	Total
	Electrical, %	50/775	57/7378	/100	10/1191	30/6050	154/23167
	Navigation, %	22/2588	44/7063		10/1377	—	76/10870
	Instrument, %	43/7338	74/14651	/100	17/27	—	135/24755
	Fire, %	21/2488	26/3672		—	5/2520	52/8561
	Oxigen %	13/23575	54/5696		—	—	67/8975
Total		149/245555	255/381567	/113	37/51772	35/85371	484/760663

In the table 2 there is statistical processing data of task cards in a little bit another section. Here the dependence of equipment inspection operations of specific type for different maintenance types and checks is shown. It is possible to compare the data processing results for both types of aircrafts in this statistical data representation: AH-24 and AH-148.

On the basis of tables 1 and 2 selective data, allowing to compare number of visual inspection operations of different equipment types for aircrafts of type AH-24 and AH-148 was obtained. That data is shown in the table 3.

Statistical data in the table 3 may be represented graphically in the form of bar graph, shown in the figure 1. There are two bar graphs, placed one by one. In every graph on the X-axis there are types of aircraft equipment and on Y-axis – values from the table 3 in columns, characterizing the number of technological operations during maintenance of the given equipment. For every type of

equipment there are two columns: left proportional to the general number of operations during line maintenance of the given equipment; right proportional to number of visual inspection operations. Numerical values are marked above every column and it helps to perform qualitative comparison, as well as quantitative.

Statistical task cards processing data, shown in tables 1 – 3 and in the bar graph 1, allow making some previous conclusions about visual inspection operations. First of all it is necessary to mention, that they concern only number of technological operations, connected with maintenance. For more complete statistical picture it would be necessary to obtain expenses on inspection operations execution and general loss of employment in maintenance realization for every group of equipment [3].

General number of visual inspection operations for all types of aircraft equipment of aircraft of type AH-24 is 149, while for AH-148 – only 75, that is twice less, while correlation between visual inspection operations and general number of operations almost match (are correspondingly 149/245 = 55 % and 75/129 = 59 %).

Table 2

Number of visual inspection operations, carried out during line and base maintenance for different equipment types of aircrafts AH-24 and AH-148

AH–24							
Types of maintenance		Number of operations	Types of equipment				
			Electrical	Navigation	Instrument	ire	Oxygen
Line		Total	77	25	73	4	23
		Visual inspection	50	22	43	1	13
		%	65	88	59	8	57
Base	Check 130 0 ± 30	Total	73	70	146	6	56
		Visual inspection	57	44	74	6	54
		%	78	63	51	2	96
	Check 260 0 ± 30	Total	10	–	1	–	–
		Visual inspection	7	–	1	–	–
		%	70	–	100	–	–
	Check 390 0 ± 30	Total	11	13	27	–	–
		Visual inspection	10	10	17	–	–
		%	91	77	63	–	–
	Check 518 00 ± 30	Total	60	–	–	5	–
		Visual inspection	30	–	–	5	–
		%	50	–	–	0	–

AH–148						
Line	Total	40	47	31		9
	Visual inspection	21	24	25		4
	%	47	51	81	00	44

Note: according to check 4 (1200±30 flight hours) there are no visual inspection operations.

Table 3

Correlation of visual inspection operations for aircrafts of type AH-24 and AH-148

Aircraft type	Type of equipment									
	Electrical		Navigation		Instrument		Fire		Oxygen	
AH-24	7	0	5	2	3	3	4	1	3	3
AH-148	0	1	7	4	1	5				

Five groups were selected from types of aircraft equipment, represented in task cards, as it shown in the tables: 1) electrical; 2) navigation; 3) instrument; 4) fire protection and 5) oxygen equipment. Data comparison shows, that operation distribution by different types of equipment for both aircraft types differs. So, for the aircraft AH-24 electrical and instrument equipment viewing is correspondingly 33 and 29 %, navigation (including communication equipment) and fire protection equipment - approximately about 15 %, and on oxygen equipment – approximately 9 %. For AH-148 relative number of operation due to the equipment types is distributed in following way: instrument -33,5 %, navigation equipment – 32 %, electrical – 25 %, and on fire and oxygen equipment - 11 % from the general number of visual inspection operations. As we can see the main work load of maintenance staff of AH-148 have the instrument and navigation equipment, while for the aircraft of type AH-24 – have instrument and electrical equipment. Operational expenses on fire and air equipment maintenance essentially decreased for AH-148 and have only 11 %, comparing with 23 % for AH-24.

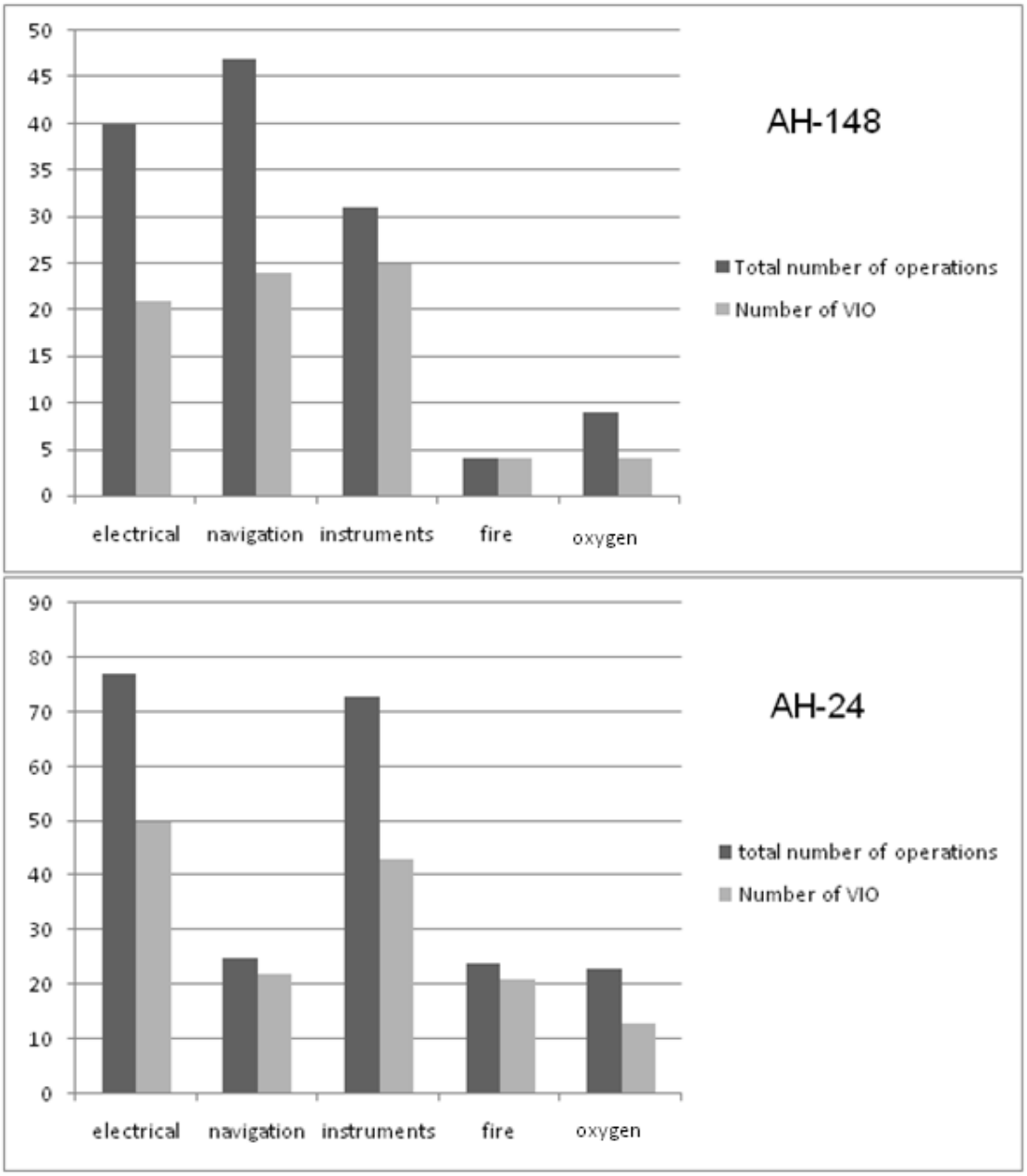

Fig.1. Bar graph of the results of task cards data processing results of the aircrafts AH-148 and AH-24 during line maintenance

Considering base maintenance we can compare data only of aircraft AH-24. As we can see from tables the prevailing number of visual inspection operations has the check 1 maintenance (works, carried out every (300±30) flight hours): 255 operations from 335 – total operations number for all forms of base maintenance.

Analysis shows that number of visual inspection operations is essentially decreased during the transition from lower to higher maintenance check and also depends on type of equipment. For the electrical equipment visual inspection operations are carried out on all checks of base maintenance in every 300, 600, 900 and 1800 flight hours, for navigation and instrument equipment – by checks 1 and 3, for fire – by checks 1 and 5, and for air – only by check 1.

On the bar graphs, showing relation between general number and number of visual inspection operations in test cards of AH-24 and AH-148 (fig.1) general number of operations predominate and it`s obvious, because task cards include not only operations connected with visual inspection, but also include assembly, blocks and systems disassembly, testing with the help of test equipment and some other operations.

Conclusions

1. Maintenance process of AH-24 (beginning from 1962) relatively to the new generation aircraft AH-148 is requiring the expenditure of much labour on general number of technological operations. Labour intensity decrease for AH-148 is reached with the help of new electronic equipment application, new technologies and principally different avionic structure relatively to AH-24.

2. Number of visual inspection operations and their comparison on aircrafts AH-24 and AH-148 shows that these operations take main part of maintenance technological operations of all types, as before. That`s why during the organization of maintenance it`s rather important to organize studying and training of maintenance staff, directed on visual inspection operations accomplishment optimization.

3. During maintenance of AH-148 it is necessary to intensify navigation systems (including communication) maintenance accomplishment control, especially concerning visual inspection checks.

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