

The Design of Technological Instructions for an Assembling the Aircraft Engine

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Abstract – This article is about a design of new technological instructions for an aviation industry. The goal of the new technological instructions is to replace the old ones. The old instructions are less clear and less suitable for new workers. A change and an upgrade of the new instructions is shown on the technological instructions for disassembling of free turbine's blades during general overhaul. The free turbine is from the M601 engine. The new instructions should be more efficient and enhanced general overhaul.

Keywords – *technological instructions, assembling aircraft engine, design of technological instructions, instructions for aviation industry*

I. INTRODUCTION

The Department of Air Transport closely cooperates with an aviation industry in some areas. One of the areas is a preparation and a production of new documentation that is designed for an assembly line of the engine M601.

Contemporary assembly documentation seems to be very outdated in these days of the digitalization. Because of this a common intention arose for design of new technological instructions in an assembly of aircraft engines.

All assembly of the aircraft engine is a very complicated operation. Especially in a case of a turboprop engine that comes through general overhaul. There is an important combination of some factors that in finally sum have a very important influence not only on a quality of the assembly but also on a behaviour of the engine in the course of its life. One of this factors is a good technical documentation. This article deals with the assembly documentation.

II. DOCUMENTATION

The technical documentation is systematically divided complex of graphical, textured and if need another (special) obligatory materials that together permit to realize all phases of a production (for example production of a product, a technological device or a system). Integral part of the technical documentation is also operational, assembly, branch and revision regulations (standards). The regulations must be respected if you want to achieve and stabilize required properties of the product or the device for all time of their planned lifetime.

A scope and a complexity of the technical documentation depends on a construction, required properties and a complexity of the product. The current status of a technical and technological level greatly affects a construction, a method of the preparation and also an archiving of the technical documentation.

III. THE ASSEMBLY DOCUMENTATION

It is necessary to write down the assembly documentation (a special type of the technical documentation) in case that the complexity of the product or the device requires to abide the exact procedure during the assembly. Its drawing part contains connecting dimensions and a spatial positioning of the product or the device. The connected or otherwise functionally linked components are pictured simplified. The texture part defines conditions and a procedure of the assembly.

As an example, it can be mentioned the actual technological instruction (figure 1) that describes the free turbine's assembly (a numbering by el. pen on a discus of the free turbine and a blade's description) into the M601E engine for the general overhaul. The second example can be the new

technological instruction (figure 2 and 3) in which the photos from the assembly are inserted. These photos had to be edited or highlighted in relevant programs. The new technological instruction designed for the free turbine’s assembly is made according to general demands of this type of the documentation and according to the demands of the aviation industry.

IV. THE DESIGN OF THE TECHNOLOGICAL INSTRUCTION

The old technological instruction (figure 1) that is mentioned below corresponds to an actual valid version that is used by aircraft workers for the free turbine’s assembly.

The form of a processing and a way of technological instruction’s division must ensure maximal intelligibility. The text is written by simple form. It must not to be comprehensive because a big quantity of the text can lead to losing attention away from the assembly’s operation. This instruction is for workers who have been trained and their experience are sufficient enough to manage the assembly without any help.

There are many reasons for establishing the new type of the technological instructions. To the most important are the fact that a training time for the aircraft assembly workers needs reducing, a possibility to transfer the instruction onto a touchable monitor, a visualization of each steps and a minimization of human mistake during small technical changes of the construction.

V. THE COMPARISON OF BOTH TYPES OF THE TECHNICAL INSTRUCTION

A. Advantages of the actual instruction:

- Several operations on one page
- Simple form of the instruction

B. Disadvantages of the actual instruction:

- Only few information for the aircraft workers with minimal experience
- Unutilized space on the page
- Old form of the instruction
- Worse readability because of the repeated copying and stocking in a paper form

C. Advantages of the new instruction:

- Visualization
- Clarity
- Simplicity
- Independent changing
- Utilization of the free space
- Big facilitation for beginning workers
- Possibility of simple transfer onto the touchable monitor

D. Disadvantages of the new instruction:

- One operation = one page
- Hard preparation
- Time-consuming editing of the photos because of their quality (zooming, highlighting of contours and other important parts)

TABLE 1 THE TRANSLATION OF THE OLD TECHNICAL INSTRUCTIONS (FIGURE 1).

ENGINE M601E THE MANUAL FOR THE GENERAL OVERHAUL The assembly of the free turbine’s rotor		
<i>Section No</i>	<i>TECHNOLOGICAL PROCESS</i> <i>- work volume</i>	<i>Tools, devices, auxiliary material</i>
11.	You must number the blades 1-28 for a control of the vibration. You must write number 1 and an arrow (figure 310) under the first hinge. The mark must be done by electronic pen only in section between Ø111 and Ø90. You must marked the relative position of all assembled parts.	Control device 100-565-9029/01 Counterweight 400-475-4011 El. pen
12.	The transport must be done with the crate and bearings must be protected by PVC foil.	Crate 100-747-0031/01
13.	You must control prescribed dimensions R between blades before mounting the locks.	Folic Gauges 0.5-1.0x100 CSN 251670
14.	You must check the blade’s locks according to the M601-P13-09B. The excess of the blades h3 and dimension Ø267.6 -0.4 must be written down into assembly list (according to figure 310 and technical drawing). The dimension of the highest blade is written down.	Control device 200-565-9020/03
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<p style="text-align: center;">MOTOR M601E PŘÍRUČKA PRO GENERÁLNÍ OPRAVU Montáž rotoru volné turbíny</p>		
Číslo úseku	TECHNOLOGICKÝ POSTUP - obsah práce	Nářadí, zařízení pomocný materiál
11.	Pro kontrolu házení podle bodu č.40 očíslovat lopatky 1-28. Pod první závěs vyznačit číslo 1 a šípku podle obr.č. 310. Označení provést elektroperem pouze v oblasti vymezené $\varnothing 111$ a $\varnothing 90$. Označit vzájemnou polohu všech smontovaných dílů.	Kontr. přístroj 100-565-9029/01 Protizávaží 400-475-4011 El. pero
<div style="border: 1px solid red; padding: 2px; display: inline-block;">THIS SECTION IS REMADE INTO THE NEW</div>		
12.	Přeprava musí být prováděna v doprav. bedně a ložiska nutno chránit PVC folií.	Dopr. bedna 100-747-0031/01
13.	Kontrolovat předepsané vůle R mezi lopatkami před zamontováním pojistek.	List. měrky 0,5-1,0x100 ČSN 251670
14.	Překontrolovat správnost zajištění lopatek dle předpisu M601-P13-09B. Převýšení lopatek h3 a rozměr $\varnothing 267,6 -0,4$ zapsat do montážního listu (dle obr.č. 310 a tech. výkresu), zapisuje se rozměr přes nejvyšší lopatku.	Kontr. přípr. 200-565-9020/03

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Figure 1 The current technological instructions. The translation of this instructions is in the table 1.


		TECHNOLOGICKÁ NÁVODKA Technology Sheet		Listů/No of Sh.: 46
				List/Sheet No: 45
Pracoviště (číslo a název)/ WorkCenter (No & Description): 6031 Montáž VT		ČÍSLO A NÁZEV ÚSEKŮ/NUMBER AND NAME OF THE SECTION: 45) Číslování lopatek		
Popis pracovních úseků/ Description of Working Steps:				
<p>Očíslovat lopatky čísly 1 - 28. První závěs označit na disku + šipku dle obr. 310. Značení provést elektroperem pouze v oblasti vymezené Ø111 a Ø90mm. Dále vyplnit průvodní list – sada oběžných lopatek VT.</p> <p><i>El. pero.</i></p> <p>Označení otvoru č.1 + šipka (Zvýrazněno oranžovou barvou)</p> <p>Označení lopatek (Zvýrazněno oranžovou barvou)</p> 				
Tg. změna č.:	Platnost:	Rev.:	Vypracoval/Originator	Schválil/Approved
Proc. Chg. No:	Validity date:	Rev.:	Jméno/Name:	Jméno/Name:
			Podpis/Signature:	Podpis/Signature:
			Datum/Date:	Datum/Date:
			Revize/Revision:	Oper. č./Oper. No: 220

Figure 2 The designed technological instructions in original language.


		TECHNOLOGICKÁ NÁVODKA Technology Sheet		Listů/No of Sh.: 46
				List/Sheet No: 45
Pracoviště (číslo a název)/ WorkCenter (No & Description): 6031 Assembly of VT		ČÍSLO A NÁZEV ÚSEKŮ/NUMBER AND NAME OF THE SECTION: 45) Numbering of the blades		
Popis pracovních úseků/ Description of Working Steps:				
<p>You must number the blades 1-28. The first hinge must be marked 1 and by an arrow on the disc (figure 310). The mark must be done by electro pen only in an area between Ø111 and Ø90. The cover sheet must be fulfilled – a set of the circulating blades VT.</p> <p><i>El. pen.</i></p> <p>the marking of the hole 1 + an arrow (highlighted by orange colour)</p> <p>the marking of the blades (highlighted by orange colour)</p> 				
Tg. změna č.:	Platnost:	Rev.:	Vypracoval/Originator	Schválil/Approved
Proc. Chg. No:	Validity date:	Rev.:	Jméno/Name:	Jméno/Name:
			Podpis/Signature:	Podpis/Signature:
			Datum/Date:	Datum/Date:
			Revize/Revision:	Oper. č./Oper. No: 220

Figure 3 The designed technological instructions translated into English language

VI. CONCLUSION

To reach the most effective preparation of the assembly documentation, it is important to include a big number of factors that can quite quickly be changed in small details. We can mention some of them: worker's experience, the quality of the production and of the supplied parts.

To finish the whole project of the assembly documentation's creation, it will be necessary to listen to all people who take part in the process of production, assembly, disassembly, general overhaul and other processes that are connected with the M601 engine.

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