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Installation Time Reduction of Engine Air-Intake Particle Separator

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ABSTRACT

Particle Separator is an instrument used to filter out sand particles from the air through engine air-intake. Particle Separator is installed on the air intake cowling on the helicopter using L-angles, nuts, bolts and anchor nuts, whose position has to be standardized for making Engine Air-intake Particle Separator (EAPS) assembly interchangeable, a template should be used and our project is aiming to design, develop and proving of drill template for Engine Air-intake Particle Separator installation and to reduce cycle time for installation of Engine Air-intake Particle Separator(EAPS).Our project is to reduce cycle time for the installation of Particle Separator in Advanced Light Helicopter.

Keywords – Engine Air-intake particle separator, Interchangeability, Templates.

1. INTRODUCTION

Particle Separator is an instrument used to filter out sand particles and another solid particulate from the air through engine air-intake. Solid particulate contamination causes compressor erosion, Turbine blade glazing, Turbine blade vibration and fatigue problems and blockage of blade cooling passages. Particle Separator is also used to avoid brownout. Brownout is the term used to describe the result of helicopter rotor wash as it kicks up a cloud of dust while landing and take-off operations in desert terrain, dust storms or general vehicle movements [1].

Particle Separator is installed on the air intake cowling on the helicopter using L-angles, nuts, bolts and anchor nuts, whose position has to be standardized. For making Engine Air-intake Particle Separator (EAPS) assembly interchangeable, a template should be used and our project is aiming to design, develop and proving of drill template for Engine Air-intake Particle Separator installation and to avoid suite on assembly and reduce cycle time for installation and to avoid suite on assembly and reduce cycle time for installation of Engine Air-intake Particle Separator [2].

Our project is to reduce cycle time for the installation of Particle Separator in Advanced Light Helicopter.

2. METHODOLOGY OF PARTICLE SEPARATOR INSTALLATION

The Particle Separator is fixed to the engine air intake cowling using L-angles, nuts, and bolts. For fixing, 96 holes should be drilled both on cowling and L angles. Particle Separator Unit is connected to L angles using bolt and anchor nuts. The holes can be made during composite molding process and the other processes includes

1. Layout Method
2. Jig and Fixture Method

2.1 Layout Method

In layout method, the layout is made on the cowling and the angles as per the drawing and holes are drilled as per the layout. The drilling of holes is done using bench drilling machine and hand drilling gun.

2.2 Jig and Fixture Method

In jig and fixture method, cowling and angles are locked to drill jig and holes are made according to drill jig. In layout method, interchangeability cannot be achieved because layout will be different from part to part and person to person [3].

The cycle time will be more for layout method. This method will depend on the skill of labour. Hence, the chance of rejection is more. In Composite Molding Method holes, can be made only on the cowling. For

angles, layout method is followed. Shrinkage of the cowling during the process may affect the position of the holes. But in Jigs and Fixture Method, all the drawbacks above can be avoided. It does not depend on the skill of technician and cycle time for drilling is less. Hence, the best method is Jig and Fixture. In this method, Class A interchangeability can be achieved [4].

Fig. 1 Particle Separator

3. PROBLEM DEFINITION

a) Lack of Interchangeability: The errors caused by a worker while assembling a single part on the helicopter will cumulatively add errors at subsequent assembly processes and thus the components are not assembled as per the standard drawings.

b) The worker has to load the components on the cowling and make layout according to drawing. Then he has to remove the component and drill holes on the component and again install the component. This increases the cycle time of installation process [5].

c) Skilled Labour Required: The requirement of skilled labour is important, as skilled labour reduces cost and cycle time.

d) Availability of LRU: Line Replaceable Unit is required for reference, but this is not used in our current method, which reduces errors.

e) Mass Production: The production of components in large numbers is difficult. With this method, we can increase the production.

f) Fabrication at Outstation: Fabrication of components at outstation is difficult as it increases cost and cycle time [6, 7].

4. TOOL DESIGN

The tool is very much important for a finished product with dimensional accuracy.

If it is not giving proper results, it will add error to the assembly process. So, a tool must be used to eliminate the problem of not achieving interchangeability [8]. To achieve high target on mass production, productivity has to be increased, cycle time has to be reduced, the cost of production should be minimal and fatigue of employees has to be reduced. One of common practice to achieve the goals of mass production target is to use jigs and fixture [9]. Following points are taken into consideration for the design of tools:

- Ease of installation: - the tool must be designed such a way that the worker just has to load the tool on the cowling and drill required holes. The angle should perfectly fit on the tool
- Rigid tool: - The tool should be rigid enough to withstand the forces which act on it during the drilling operation.
- Mass production: - the tool should be designed for mass production.
- Surface to surface hole transfer: - It should be designed in such a way that it should help the worker to locate the hole which is to transferred from surface to surface.
- Skill and fatigue free: - operator fatigue should be minimal and minimum skill requirement should be achieved.
- Safe tool: - The worker should feel safe while using the tool [10].
- Modular tool: - The tool is designed in such a way that its shape is a shame as that of work piece. The tool is dividing into a finite number of elements and provision for tool extension is allowed.
- Minimalistic design: - To reduce cost and material for the tool, RH and LH tool can be made on the same component.

From the information gained from drawing tool was designed. By keeping the above points in mind the tool was designed in CATIA. The following modules were designed.

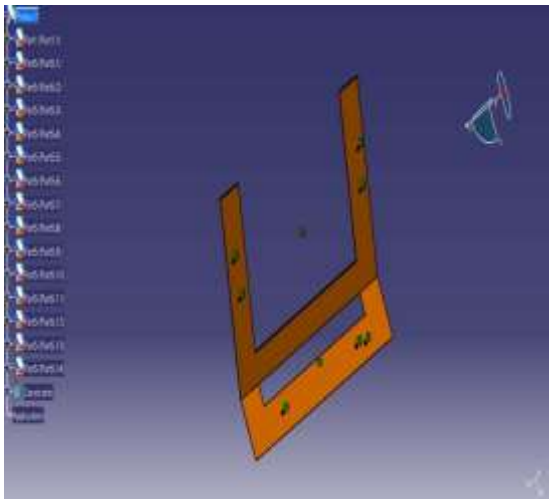

Fig. 2 125 Degree Angle Plate

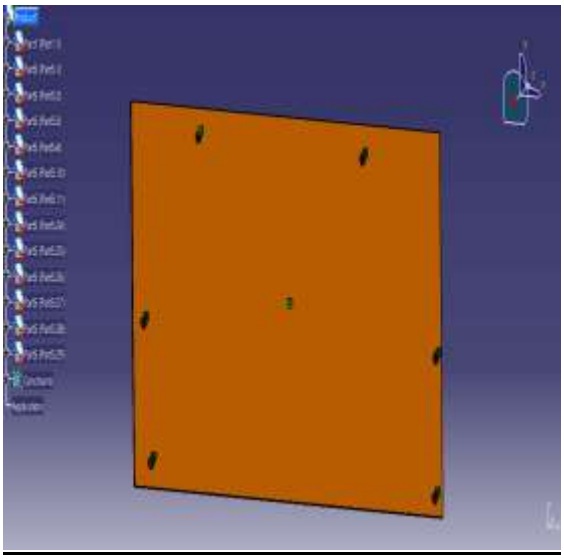

Fig. 3 Bottom Plate

Table 1 Part Dimension Details

Part Name	Dimension
RH/LH Side plate	**555x370x4**
Bottom plate	**344x198x4**
125^{o} plate	**355x350x4**
Stopper 1	**180x30x2.5**
Stopper 2	**250x30x2.5**
LH bottom angle	**330x30x2.5**
LH side angle	**580x40x2.5**
LH top angle	**330x35x2.5**
RH side angle	**580x40x2.5**
RH top angle	**325x35x2.5**
RH bottom angle	**325x30x2.5**
Radius angle	**325x35x2.5 at 65^{o}**

5. STUDY OF CYCLE TIME OF IMPROVED METHOD

Total time required for engine air – intake particle separator is divided into following phases.

Table 2 Work Phase

ACTIVITY	MAN-HOUR
Preparation and set-up time	4
Layout	96
Hole Opening (Drilling on cowling and angles)	126
Hole Drilling for anchor nuts	30
Anchor nut Riveting	30
Angle Installation on cowling	36
Total Man Hour	**322**

6. CALCULATION

Man Hour Rate (MHR) = Rs. 1800
Before Project time needed for EAPS Installation
= 322 hrs.
After Project time needed for EAPS Installation
= 124 hrs.
Saving in hours = 198 hrs.
Cost saved per hour = 198 x 1800
= Rs.3, 56,400
Annual Target = 30 Helicopters
Annual Saving =30 x 356400
= Rs.1, 06, 92,000
No. of helicopters in Project = 159 helicopters
Cost saved for entire Project = 159 x 356400
= Rs.5, 66, 67,600

Cost of Tool Development

Cost for Raw Material = Rs.2, 00, 000
Labour Cost = 100 MHR = 100 x 1800
= Rs.1, 80,000

7. ADVANTAGES OF MODIFIED METHOD

- Reduces cycle time for the installation of Particle Separator in ALH.
- Interchangeability is achieved
- The particle separator is equipped with less skilled labour
- Mass production is achieved

7. CONCLUSION

The modified method of installation of Engine Air-intake Particle Separator showed satisfactory results in reduction of cycle time, cost and improved interchangeability of the part and mass production is achieved.

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