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Production Process of D-Nose Panel Components for A-350 Airplane Wings, PT Dirgantara Indonesia

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ABSTRACT

Airplanes are one of the most frequently used forms of transportation globally. The aircraft's ability to mobilize between continents and its near-sound speed makes it an excellent cross-country travel choice. This paper discussed the production process of D-nose panel components for A-350 airplane wing in PT. Dirgantara Indonesia. PT. Dirgantara Indonesia (Persero) or commonly referred to as PTDI, is one of the aircraft companies in Asia with core competencies in aircraft design and development, aircraft structure manufacturing, aircraft production, and aircraft services for civil and military from light and medium aircraft. The main components of the aircraft consist of the engine, propeller (power plant), fuselage, wing, tail (empennage) and landing gear. The components that make up the wing of the aircraft consist of a fuel tank, wing flap, spar, aileron, skin, ribs, stringer, wingtip, as well as external parts such as the D-nose panel. The process from beginning to end of the D-nose panel component requires several stages. Finally, this process also checks data from existing component documents and ends with the final stamp as a sign that the entire process for making the D-nose panel component has been completed.

KEYWORDS: *Aircraft, Production process, Airplane wing, D-nose panel, PT. Dirgantara Indonesia*.

1.0 INTRODUCTION

The aircraft manufacturers are trying to produce aircraft to meet the costumers demands. However, there are limitations for a factory in increasing production capacity. To increase the speed of aircraft production, several aircraft companies outsource aircraft components. Outsourcing is an action taken by a company to share the necessary tasks with other companies. Outsourcing is done by forming a partnership with different companies with the competence to produce the desired components. With outsourcing, not all parts need to be made in one factory, leading to an increase in aircraft production capacity and costs.

Some of the study of airplanes wings has been done multiple times. Djunaidi and Ryantaffy [1] discusses the problem of the components of the rib component in the wing structure of the CN235 aircraft during the assembly process of the aircraft wing structure. The data indicate that the components that many fails are rib, with the severity generated into the fatal category. By using the failure mode effect analysis approach [2], the case of incompatible rib becomes the form of failure mode that becomes the priority of improvement with the highest RPN value compared to other failure modes [1]. Alternative solutions to overcome these problems is to conduct more rigorous inspections of specific components, as well as perform analysis for other factors.

Setiawan [3] Examines the evaluation of the process and production time of the wing parts of the Airbus A380 using a five-axis Cincinnati Milacron CNC milling machine. The focus of the research is on identifying the stages of working on the wings of the Airbus A380 using a 5-axis Cincinnati Milacron CNC milling machine, calculating the actual total production time in the field, and identifying the factors that cause differences in the whole production time based on the company's quality standards and the exact production time in the area. The research results found that the Cincinnati Milacron CNC milling machine operator carried out the production process to make the "Sub Spar" part of the Airbus A380 wing was by the quality standards set by the company as stated in the NCOD [3]. However, the operator's total time of the production process carried out is not by the NCOD calculation, namely the entire time required to be greater by about 43%. Several factors caused the difference in total production time, among others, related to the time needed to

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install raw materials, machine factors, and factors or HR competencies (operator skills) which were not considered in calculating the time based on NCOD [3].

Moral [4] display a clear tendency out of generative designed ribs: rupture load and displacement increase, and rigidity decreases as mass is reduced. In addition, the reference rib shows the lowest load resistance in comparison with the optimized designs and triangular filling pattern shows better performance than square pattern [4].

Dababneh and Kipouros [5] describe that the lack of reliable and accessible wing mass prediction methods that allow assessment of the relative benefits of novel technologies that can enhance the lift-to-drag ratio of the aircraft wing, while reducing the structural wing weight, is significant. It requires the development of new and generally applicable wing mass estimation methods [5].

Teo *et al.* [6] found that additive manufacturing provides cost-effective wing components for wind tunnel test components with fast turn-around time. They can be used with confidence if the wing deflections could be accounted for systematically and accurately, especially at the region of aerodynamic stall [6]. Jamshidi *et al.* [7] says that discrepancies of materials, tools, and factory environments, as well as human intervention, make variation an integral part of the manufacturing process of any component. In particular, the assembly of large volume, aerospace parts are an area where significant levels of form and dimensional variation are encountered [7].

While Tawfeeq *et al.* [8] focused on the evaluation of raw materials that used in the wings of modern airplane. These materials either would be fiberglass, carbon-fiber, or aramid-based composites like Kevlar. These common materials have been selected and evaluated depending on experimental data obtained from mechanical tests. These tests include hardness, tensile strength and bending stress. The tests based on ASTM standards for mechanical properties. The results show increasing in the hardness value of graphite-epoxy by 9% comparing with that of fiberglass and by 18% comparing with that of Kevlar-epoxy [8]. The results also show an increasing in the maximum tensile strength of graphite-epoxy by 2.9 times to that of fiberglass and by 5.5 times to that of Kevlar-epoxy [8]. Furthermore, the results of bending stress test show increasing of the maximum strength of Kevlar-epoxy by 30% comparing to that of glass fiber and by 75% comparing to that of graphite-epoxy [8].

The high demand for airlines to get the airbus outsource. One of the companies that become suppliers of Airbus outsourcing is PT Dirgantara Indonesia. PT Dirgantara Indonesia is an Indonesian state company engaged in aerospace. Through a contractual relationship with Spirit Aero Systems, PT. Dirgantara outsources the Airbus A320, A350 and A380 aircraft components. PT. Dirgantara Indonesia (DI) (In English: Indonesian Aerospace Inc) is the first and only aircraft industry in Indonesia and in the Southeast Asia region. The company is owned by the Government of Indonesia. PT. DI was established on August 23, 1976, under the name PT. Nurtanio Aircraft Industry and BJ Habibie as President Director. Nurtanio Aircraft Industry then changed its name to Nusantara Aircraft Industry (IPTN) on October 11, 1985. After being restructured, IPTN then changed its name to Dirgantara Indonesia on August 24, 2000. PT. Dirgantara Indonesia not only manufactures aircraft but also helicopters, weapons, provides training and maintenance services for aircraft engines. PT. Dirgantara Indonesia is also a sub-contractor for major aircraft industries in the world such as Boeing, Airbus, General Dynamic, Fokker and so on.

2.0 LITERATURE REVIEW

2.1 Airplane Components

The main components of an aircraft consist of the fuselage, wings, landing gear, engine and propeller, and tail. The airplane components in detail can be seen in Figure 1. The airframe (fuselage) on airbus a-350 and skeleton (truss) is illustrated in Figure 2. The power plant on airplane can be seen in Figure 3.

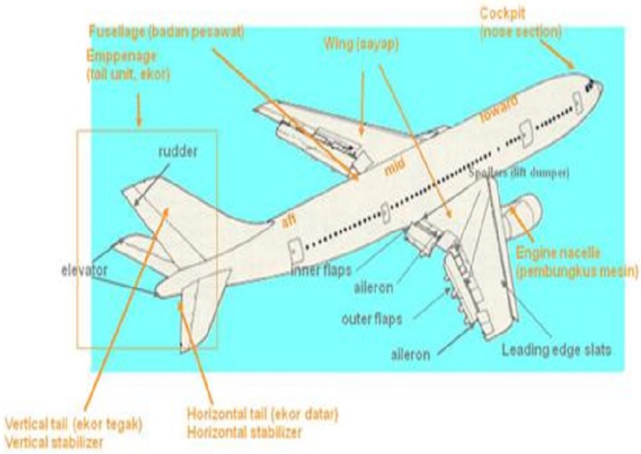

Figure 1: Airplane components

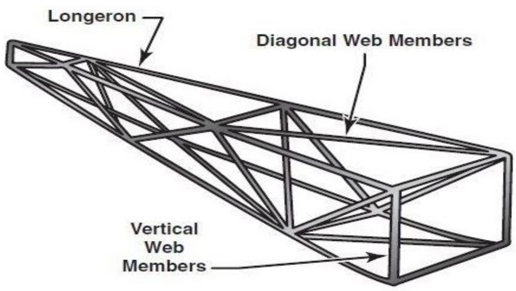

Figure 2: Airframe (fuselage) on airbus a-350 and skeleton (truss)

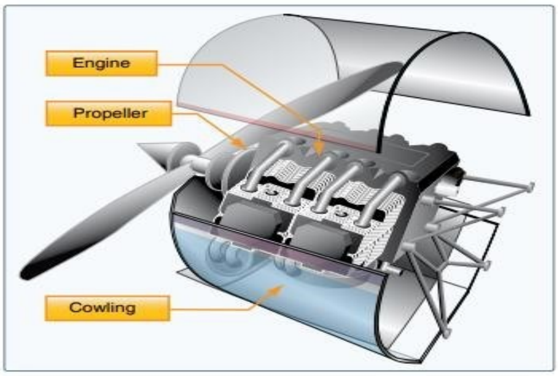

Figure 3: Power plant on airplane

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The fuselage is a cabin or cockpit that contains passenger seats and aircraft controllers and consists of cargo space and connecting points for other main aircraft components. Usually, several aircraft's fuselages use an open truss structure made of steel and aluminum. The strength and density of the open truss come from the welding of the tubes that form a triangular shape called the trusses.

Power plants usually consist of an engine and a propeller. The machine's primary function is to produce power to rotate the propellers, electric power, vacuum for some aircraft instruments, and heating for the pilot and passengers on a single-engine aircraft.

The wing is an airfoil attached to each side of the fuselage. The aircraft's wing is the most critical component of an aero plane because it acts as the main generator of lift on the plane [9-10]. In addition, the wing of the aircraft serves as a place for fuel tank and a place to depend on the engine. The components of airplane wing are depicted in Figure 4. The airplane wings are usually installed in the top, middle, or bottom positions of the fuselage or are referred to as high-wing, mid-wing, and low-wing. The number of wings fitted with one set of wings is called a monoplane, and two sets of wings are called a biplane.

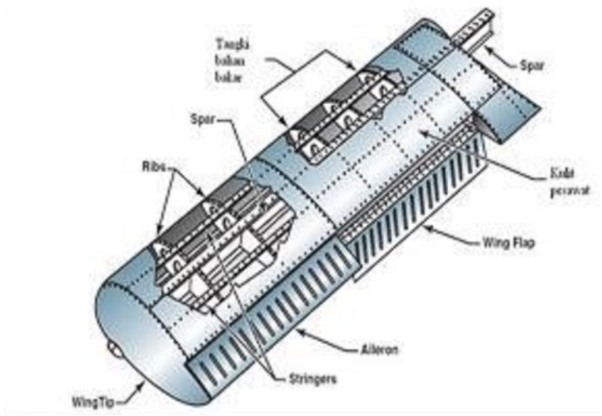

Figure 4: Airplane wing

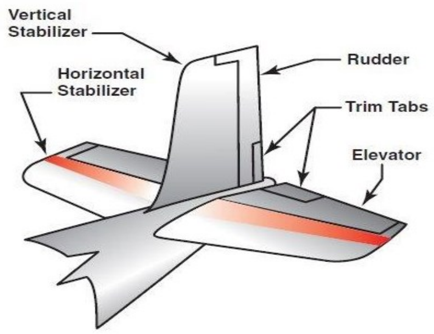

Figure 5: Airplane tail

Figure 6: Landing gear

2.2 Materials on Airplanes

The development of increasingly sophisticated aircraft design and technology, the need for materials is also increasing. Starting from creating airplanes with wood materials to aluminum, then using titanium and high-efficiency materials that require intensive development from experts. The following are the criteria for selecting materials for aircraft:

1. Efficient static strength
2. Fatigue properties
3. Toughness and crack propagation
4. Corrosion and embrittlement properties
5. Stability to the environment
6. Ease of obtaining and working on materials
7. Material price
8. Fabrication characteristics

The following are materials commonly used to build aircraft construction:

1. Composite is a material structure consisting of several or more combinations of materials formed on a macroscopic scale and physically united. Generally, the composite material used as a filler and binder of fibres is called a matrix. Composite materials that are often used in the aerospace industry are carbon fibre, fibreglass, boron, and kevlar. Composites are often used in the aerospace world because their strength and stiffness are higher than steel and aluminium, their fibre direction can be adjusted according to loading so that they are used efficiently, and they are more flexible in forming aerodynamic contours because they are developed using moulds.
2. In addition, there is also Steel alloy which is a material that is often used in aircraft structures because it has great strength, high tensile stress, and lower costs. The content in alloy steels such as small percentages of carbon, nickel, chromium, vanadium, and molybdenum under stress conditions of 50 to 150 tons per square inch can be made into tubes, rods, and cables. Another type of steel commonly used is stainless steel which is corrosion resistant and excellent for use in aqueous conditions.
3. Titanium is a lightweight, strong, and corrosion-resistant material. This material also has a higher strength-per-weight value than aluminium and steel. However, at the beginning of technological developments, the whereabouts of titanium was still unknown due to its extreme chemical reactivity and the difficulty of refining it from mines to moulds and forgings. In addition, the high cost of machining makes it rarely used in large quantities, so its use can only be found in specific components.
4. Aluminum Alloy. This material is almost 80% used in structural materials. Aluminium in aircraft structures has been combined with several mixed materials that can increase its stiffness, strength, and toughness. Aluminium alloys that are often used in aircraft include:
    1. Aluminum 2024-T3, T42, T351, T81
    2. Aluminum 2224-T3, 2324-T3
    3. Aluminum 7075-T6, T651, T7351
    4. Aluminum 7079- T6
    5. Aluminum 7150- T6
    6. Aluminum 7178- T6, T651
    7. Aluminum-lithium
    8. PM aluminium

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2.3 Production Process

According to Gaspersz [11], the production process is the sequential integration of labour, materials, information, work methods, and machinery or equipment [12] in a competitive environment in the market. Meanwhile, according to [13-15] is an activity that involves human labour, materials, and equipment to produce useful products. This can be interpreted that the production process being a step to make something and produce something that has added value [12], [15].

The Airbus A-350 is a family of wide-body jets under development by European aircraft manufacturer Airbus. The A-350 will be the first Airbus aircraft to have both wing structures made of carbon fiber reinforced polymer. Depending on the variant, the aircraft will carry 270-350 passengers in third class seats. Reporting from the PT. Dirgantara Indonesia page, it was stated that PT Dirgantara Indonesia (Persero) became an equivalent design partner for Airbus in the manufacture of the A-350 after only being a component maker (manufacturing).

1. Wing Configurations
   The wing (Figure 7) is an airfoil that moves quickly through the air and provides lift to the aircraft. Wings come in many shapes and sizes. Wings are designed in such a way for the needs of different aircraft. Therefore, the shapes and sizes also vary.
2. Wing Spars
   Wing spars are one of the types of parts in the wing configuration of an aircraft. The spars are located at the base of the aircraft wing, from the fuselage to the wingtip or at the outer end of the aircraft wing and are usually assembled in the aircraft fuse language. Spars are made of metal, wood or composite materials that meet aircraft-specific criteria. In general, there are four types of spar configurations on aircraft wings, namely solid, box-shaped, partially hollow and in the form of an I beam.
3. Wings RIBS
   Ribs are part of a wing configuration that combines with spars and stringers to form the framework of an aircraft wing. Usually found on the leading edge of the wing or on the trailing edge of the wing. Ribs transmit the force from the skin and stringer to the spars. Ribs are usually made of metal or wood, depending on the material used for the spars. If the spars use wood, the ribs will use wood materials, and vice versa. If the spars are metal, the ribs will use metal as well. Wing ribs that are in special locations or have special functions are named according to their respective characteristics. For example, ribs located in front of the spar that is used to give shape and strength to the wing leading edge are called nose ribs or false ribs.

The D-Nose Panel is an important part of the aircraft wing. This is because this section will support the bottom light of the aircraft which is commonly called the landing light. Landing lights are usually used as runway lighting when the plane is about to land in dark weather or at night.

One of the materials commonly used in the manufacture of aircraft parts is aluminum. Aluminum is a light metal that has good corrosion resistance and good electrical conductivity, and other good properties as a metal. In addition to that, its mechanical strength is greatly increased with the addition of Cu, Mg, Si, Mn, Zn, Ni, etc. Individually or together, they also provide other good properties such as corrosion resistance, wear resistance, low coefficient of expansion.

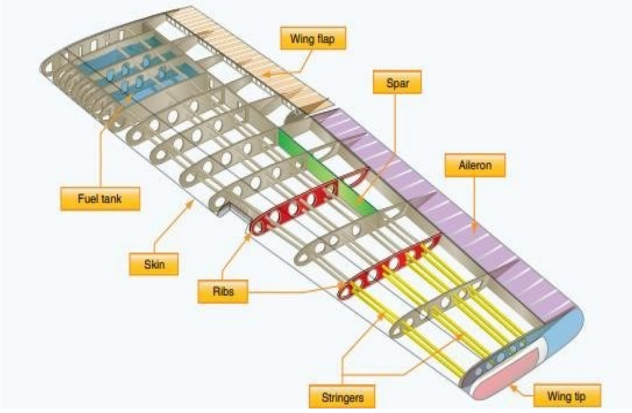

Figure 7: Airplane wing structure


Figure 8: D-Nose Panel Airbus A-350

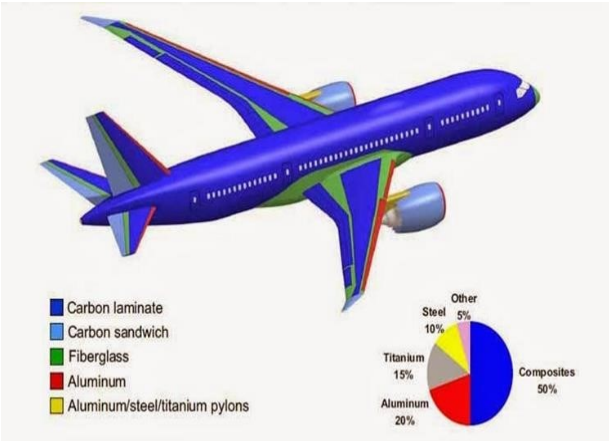

Figure 9: Percentage of material on aircraft [8]

Aluminum alloys have advantages and disadvantages, namely:
The advantages of aluminum alloys include:

1) Density is low.
2) Has high strength even though its density is low.
3) Has excellent corrosion resistance.
4) Good conductor of heat and electricity.
5) Has excellent reflectivity.
6) Have high tenacity.
7) Has a low modulus of elasticity.
8) Easy to join (as welded).
9) Easy to recycle.
10) Easy to form (such as extrusion).
11) Easy to pour.

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The lack or disadvantages of aluminum alloys include:
1) The melting point is low, so it cannot be used in high-temperature applications.
2) Some alloys are susceptible to stress corrosion.
3) There can be embrittlement of grain boundaries when exposed to mercury directly (so it cannot be used anymore).

The material commonly used to manufacture the D-Nose Panel is aluminum alloy 2024. Aluminum alloy is an aluminum alloy with copper as the primary alloying element. Although copper is the main alloy, magnesium and small amounts of other parts are added to most alloys of this type. This type of aluminum alloy is a treatable heat type. Using deposit hardening or plating, the mechanical properties of this alloy can match the properties of mild steel. However, its corrosion resistance is low compared to other types of alloys. Weldability is also not good because this type of alloy is usually used in rivet construction and is widely used in aircraft construction, such as duralumin (2017) and super duralumin (2024).

Huda *et al.* [16] also assume that aluminum alloy 2024 has high fracture toughness, high fatigue performance, high formability, and super plasticity to meet the needs of lower structural weights higher damage tolerance, and higher durability. This is because aluminum alloy 2024 has high strength. Its ductility is not significantly reduced during the heat treatment of reinforcement so that it can be used as the primary material in the manufacture of aircraft parts, especially D-Nose Panel parts.

PT. Dirgantara Indonesia is a company engaged in the production of aircraft and being supported by experienced specialists and skilled technicians with international standards, this company is also supported by manufacturing technology that can meet the needs of the production process. The manufacturing technology used is mostly based on CNC (Computerized Numerical Control) systems.

The Spirit Aero System (SAS) Program Department has sub-contracted with Spirit Aero System UK, which is working on manufacturing components for the Airbus A320, A350, and A380. The A320 and A321 programs produce the IOFLE (Inboard Outer Fixed Leading Edge) section, which consists of several components: the D-nose Panel component. The machines used to produce these parts are as follows.

1. CNC Profiling Machine Cincinnati Milacron DGMP
   The Cincinnati Milacron brand CNC Profiling machine DGMP type is a machine made in the United States. The location of the factory that produces this machine is in the city of Cincinnati, Ohio, United States of America. The Cincinnati Milacron DGMP CNC Profiling Machine is used to process materials with a high complexity of work, accompanied by five axis facilities. PTDI has 2 Cincinnati Milacron DGMP machines in one workstation, which can cut, punch holes, and shape materials at speeds < 3000 rpm. Because this machine can be set at a low speed, it can be used to process materials made not too hard, such as wood, plastic, copper, aluminum, and others.
2. CNC Profiling Machine Cincinnati Milacron DGAL
   The Cincinnati Milacron CNC Profiling Machine type DGAL is a machine made in the United States. The location of the factory that produces this machine is in the city of Cincinnati, Ohio, United States of America. The Cincinnati

Figure 10: CNC Profiling Machine Cincinnati Milacron DGMP and DGAL

Milacron DGAL CNC Profiling Machine is the same as the Cincinnati Milacron DGMP. It is used to process materials with a high complexity of work, accompanied by five axis facilities. PTDI also has 2 Cincinnati Milacron DGAL machines in one workstation, which can cut, punch holes, and shape materials, but at a faster speed of > 4000 rpm. This machine is used specifically to process materials made from Aluminum alloy.

3. CNC Vertical Jig Boring SIP 720
   CNC Vertical Jig Boring SIP 720 is a Swiss machine made in 1986. This machine is used for the material punching process, which has a high level of precision because it is based on CNC (Computerized Numerical Control) and, of course, must be supported by a careful machine operator. Jig Boring is used for hole finishing processes that require high-precision results. If the hole size is small, it can be processed directly in this section, but if the hole size is large enough, the hole is cut first in the CNC Profiling Machine with a small amount left for finishing using a jig. Boring so that the results are more precise, it aims to speed up the production process due to the cutting ability and speed of the boring jig machine, which is not too high.

a) Machine specification:
   - Worktable: dimensions 1600 x 1240 mm, maximum load 2500 kg, distance from floor 1000 mm
   - Working capacity: X-axis 1500 mm, Y-axis 1000 mm, Z-axis 300 mm
   - Has one spindle: power 5.9 kW, speed 40-2000 rpm
b) Preparations to be made:
   - Check coolant level
   - Check fabricated oil level
   - Clean the way cover


Figure 11: CNC Vertical Jig Boring SIP 720

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- Clean the spindle
- Check wind pressure
- Make sure the temperature is average (using AC)

c) Key characteristic of precision hole making:
- Sharp playing cutter
- Setting playing cutter on boring head
- Cutting depth
- Use coolant

4. Coordinate Measuring Machine (CMM)
The Coordinate Measuring Machine (CMM) is a machine used for the quality inspection process; inspection using this machine is carried out automatically using program assistance, can match the dimensions of the part with the part layout in the program carefully (level of accuracy 1 micron), can check the contours on the surface of the region such as roughness and slope accurately. The production program input used on this machine uses the design results from the Catia application. This machine is sensitive to dust and temperature, so the room must be clean and have an average temperature (not hot). Information from the machine computer regarding dimensional inspections, namely measurement dimensions, theoretical dimensions, deviation values, upper tolerances, and lower tolerances, can be seen that the part has passed the examination or must be reworked.

Figure 12: Coordinate Measuring Machine (CMM)

Coordinate Measuring Machine (CMM) Specifications:
- Type: Delta Tutor P. For Windows
- Max measuring volume:
  X axis: 11m
  Y axis: 1.8m
  Z axis: 1.0 m
- Accuracy: 0.001 - 0.002 mm

5. CNC Profiling Mach Deckel Maho DMC210U
CNC Profiling Mach Deckel Maho DMC210U is a milling machine owned by PT. Dirgantara Indonesia, which uses a computer-based automatic control system, is called Computerized Numerical Control (CNC). This machine is a high-speed technology (High-Speed Machining), with this high speed capable of cutting material at high speed. It will save machining time and produce products that smooth the surface and are more precise sizes according to the program entered into the machine's computer. The function of this machine is to manufacture medium-sized aircraft components, such as in the manufacture of FWD Rib Member components in the manufacture of Pylon Airbus A320 and A321.

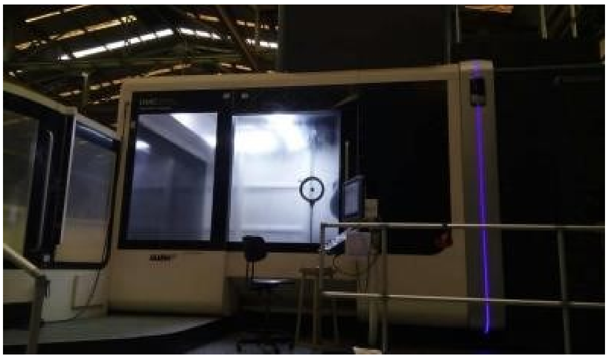

Figure 13: CNC Profiling Mach Deckel Maho DMC210U

3.0 PRODUCTION PROCESS OF D-NOSE PANEL AIRBUS A-350 AIRCRAFT WINGS

The manufacture of components of the D-Nose Panel, is to use changing the shape. The shape change production process is a process in which there is a shape change process to get additional value or benefits compared to the previous input. The material used in the manufacture of D-Nose Panel components is Aluminum Alloy 2024. Using Operation Process Chart (OPC), which is a diagram that describes the sequence of operations and inspections of initial raw materials to become components and contains the information needed for further analysis.

The first part of the operation carried out in producing the D-Nose Panel was Remark. The remark is a warehouse or material storage area for aircraft components, namely alloy metal materials including aluminium, titanium, steel, and stainless. Of these four materials, the most dominant material in aircraft manufacture is aluminium alloy. This part of the operation includes re-checking the D-Nose Panel measurements, such as checking the points and vector lines that have been previously measured. In addition, this operation section also makes changes, such as revising the hole diameter tolerance at the end of the D-Nose Panel.

The next part of the operation is Material Inspection. Material Inspection is an excellent process to re-check the condition of the material to be processed to the next stage. This process will also record what materials will be used to manufacture the required parts, lots, batches, and serial numbers. After checking the condition of the material, the operation continues to the Guillotine Cutter, where this process cuts material to a predetermined size. Such as the width of 2400mm and length of 2650mm. This site has been determined according to the company's instructions and standards (AIPI and AIPS).

The next stage is the Light Alloy Thermal Dry Furnace "Kraft". This process is heating the material to a specific temperature, then holding it for a while, and slowly cooling it. This process aims to increase the material's ductility so that it is not easily brittle. Before heating the material, the material will be cleaned first to reduce production defects.

Heat Treatment Inspection is an exemplary process for assessing the response of materials to the heat treatment testing process to certify materials by the provisions set by the company. This process also records material data such as mechanical properties, corrosion resistance, defects, etc.

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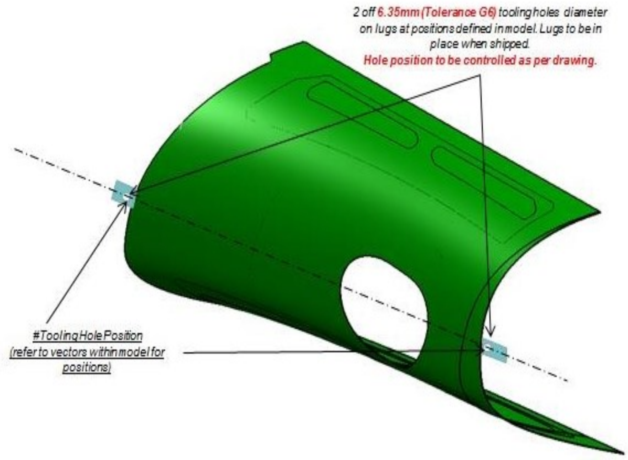

Figure 14: Stretch forming sheet at D-nose panel airbus A-350

Stretch forming sheet is a sheet metal deformation process (Figure 14). The sheet metal is intentionally stretched and simultaneously bent to change shape using a Cyril Bath machine. Things that are done in this process are:

- tool preparation,
- material preparation,
- clamping the material on the griper,
- shaping the material, and
- making holes in the material.

Tool preparation includes cleaning the surface of the tool with air pressure and cloth and ensuring the surface is in good condition. Furthermore, preparing materials such as checking raw materials for scratches on the material's surface and cleaning the material with air pressure. After the tools and materials have been designed, the material is clamped on the gripper, and the material begins to be stretched and shaped according to AIPI 03-10-005 and AIPS 03-10-005. Then drill the middle (2 holes) with a diameter of 6.35mm and a tolerance of G6 according to the instructions and rules of AIPI 03-11-003 and AIPS 03-11-003.

The next step is to return to the Light Alloy Thermal Dry Furnace "Kraft" process, where this process aims to increase the material's ductility so that it is not easily brittle. Before heating the material, the material will be cleaned again to reduce production defects, followed by Heat Treatment Inspection and Stretch Forming Sheet.

Fitter Machining is valuable for removing sensitive parts resulting from previous machining results and smoothing the sharp details. The operator carries this process in the fitter room using a fitter machine. Then enter the Sheet Metal Forming Inspection process, where this process is a re-check of the material after it has been formed.

Chemical Cleaning for Aluminum is a chemical cleaning process for D-Nose Panel components. Cleaning is carried out before Masking, which is carried out according to AIPS 09-03-001. This process is carried out by the operator in the Surface Preparation Room. Before entering the Masking stage, the material will be re-checked in the Aluminum Treatment Inspection process and recorded again. In the Masking process, the entire surface of the D-Nose Panel is polished and marked before going through the cutting/tracing process.

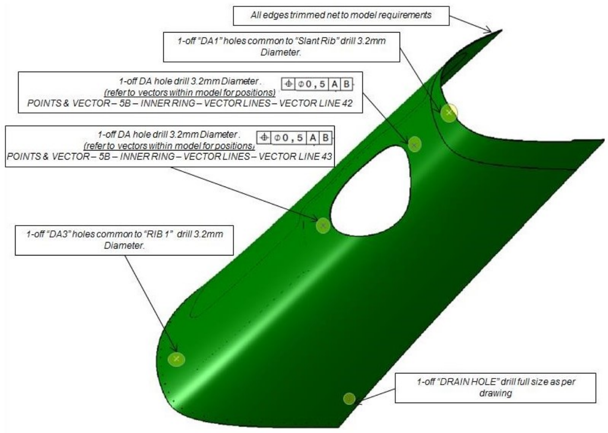

Figure 15: Fitter process at D-nose panel airbus A-350

Fitter is a process of checking the contour and cutting as well as providing further holes on the D-Nose Panel. These holes will later act as a merger between the D-Nose Panel and other parts. Next, the D-Nose Panel is rechecked for resistance and conduction whether it is appropriate or not. The fitter process at D-nose panel airbus A-350 can be seen in Figure 15.

Penetrant Inspection, this process is carried out by dipping the component into a penetrant substance to remove small defects detected such as color defects that are not in accordance with AITM 6-1001, then recording data on form F-AE704.06-10. After this process is complete, the D-Nose Panel component must be cleaned or protected immediately.

Chemical Conversion Coating is a temporary protection process on D-Nose Panels using alodine (aluminum coating) to prevent corrosion in accordance with AIPI 02-05-001 and AIPS 02-05-001. And continued with Aluminum Treatment Inspection, this process is carried out to adjust the results of the previous operation, namely Chemical Conversion Coating. If it is finished before operating, the inspection is carried out according to PIC.ST/AB/CCC-AL-03, then data is recorded from F-DP704.12-05.

The next process is Marking. After the entire painting process is complete, marking is carried out on the process document containing the component JID in the T code section (marking the ink). This marking is done by writing down the original weight of the component. After that, do the varnish process using clear paint over the marking on the marked area so that it is not easily erased.

Final Inspection, this last stage of inspection is carried out by inspecting the components in general and overall. The inspector checks whether the component is in accordance with the technical drawing used as a reference, and measures roughly the dimensions of the component. In addition, this process also checks data from existing component documents and ends with the final stamp as a sign that the entire process for making the D-Nose Panel component has been completed.

4.0 CONCLUSION

Based on the results of the discussion regarding the production process of the D-Nose Panel on the Airbus A-380, it can be concluded that the process from beginning to end of the D-Nose Panel component requires several stages, namely:

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Remark, Material Inspection, Guillotine Cutter, Light Alloy Thermal Dry Furnace, Heat Treatment Inspection, Stretch Forming Sheet Cyril Bath, Light Alloy Thermal Dry Furnace, Heat Treatment Inspection, Stretch Forming Sheet Cyril Bath, Fitters for Stretch Forming, Sheet Metal Forming Inspection, Chemical Cleaning for Aluminum, Aluminum Treatment Inspection, Masking, Cutting / Tracing, Chemical Milling for Aluminum, Masking, Chemical Milling Inspection, Fitters for Stretch Forming, Sheet Metal Forming Inspection, Hardness and Conduct Inspection, Chemical Cleaning for Aluminum, Penetrant Inspection, Chemical Conversion Coating, Aluminum Treatment Inspection, Marking and Final Inspection.

The materials commonly used to manufacture aircraft parts are aluminum alloys, titanium, steel alloys, and composites. The primary material in the manufacture of D-Nose Panel is aluminum alloy 2024. The method used in the production process of the D-Nose Panel component is to use a shape change production process. The shape change production process is a process in which there is a shape change process to get additional value or benefits compared to the previous input.

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