INTERNSHIP REPORT
ON

"Work Done In Aerospace Department For Manufacturing of Aircraft Components"

By

Ashish Kumar

&

Mukesh Bansal

(B. Tech Aerospace)
Department of Aerospace Engineering
University of Petroleum and Energy Studies

Under the Guidance of:

Mr. Roshan F. Pinto
(Manager –Aerospace Department)
Maini Precision Products Pvt. Ltd.

1st June – 7th July, 2015

CERTIFICATE

I hereby certify that the work which is being presented in the internship report at "Maini Precision Products Private Limited" in partial fulfillment of the requirements for the internship program to the Department of Aerospace Engineering, University of Petroleum and Energy Studies, Dehradun is an authentic record of my own work carried out during a period from June 2015 to July 2015.

Submitted To:

Mr. Roshan F. Pinto

Manager – Aerospace Dept.

Maini Precision Products Pvt. Ltd.

Submitted By:

Ashish Kumar

Mukesh Bansal

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Acknowledgement

It is distinct pleasure to acknowledge our deep and sincere gratitude to **Maini Precision Products Pvt. Ltd.** for providing us such a wonderful experience of learning and industrial exposure.

We are also grateful to the **Department of Aerospace Engineering**, University of Petroleum and Energy Studies for giving us the permission to carry on the Summer Internship at Maini Precision Products Pvt. Ltd.

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Abstract

The current report describes the work experience gained during the internship at Maini Precision Products Private Limited, Bangalore. The report consists of two projects, activities in the engineering domain and the trainings attended during the internship. The first project is about the complete work in engineering department consisting of the study of Engineering Drawings, Manufacturing Process Sheet, Control Plan and Route Card. It also involves the understanding of basic concepts of manufacturing with the study of various standards of different processes as well as having exposure to the manufacturing of aircraft components in the shop floor. During our training period we also got an overview of Estimation Work. The second project deals with the concept of Metal Optimization using unique methods which makes the routing process more efficient and more profitable. Also we have worked on the NC Part Programming of various parts of GA-8 and C-NM5 for 3-Axis CNC Router Machine.

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List of Abbreviations

MPS - Manufacturing Process Sheet.
CP - Control Plan.
RC - Route Card.
PO - Purchase Order.
BOM - Bill of Material.
FAI - First Article Inspection.
FMEA- Failure Mode Effect Analysis.
PFMEA - Process Failure Mode Effect Analysis.
LE- Leading Edge
CNC- Computer Numerical Control
RFQ – Request for Quotation
FOD- Foreign Object Damage
KC- Key Characteristics
HOP – Handling of Product
NC- Numerical Control

Chapter- 1: Manufacturing of Aircraft Components

1) Introduction

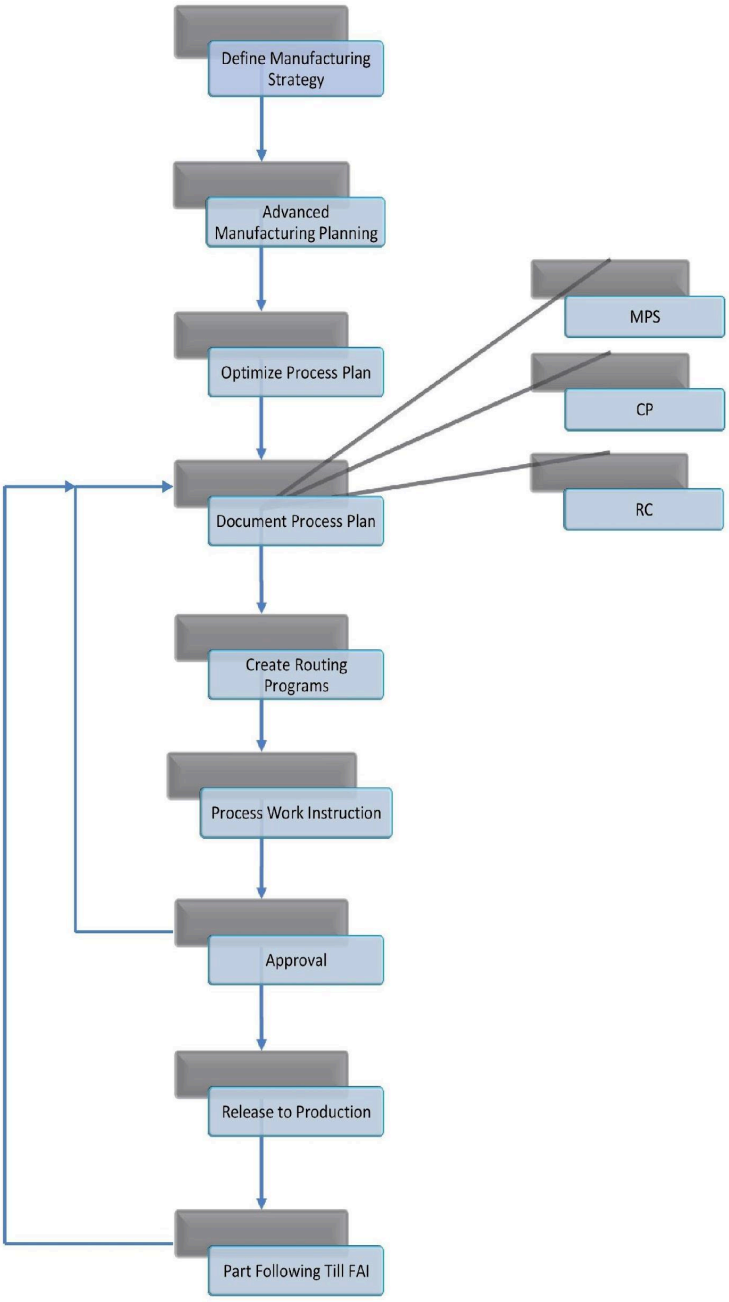
This report gives the details of work flow in Engineering Department for Manufacturing of Aircraft Components. Engineering Department work begins directly after getting a PO from any other company. Engineering Department takes the complete information like soft copy of engineering drawings, 3D models, BOM and manufacturing standards from the Programs Department. Then the complete designing of manufacturing processes takes place which is then followed by preparation of documents consisting of MPS, CP and RC.

2) Defining Manufacturing Strategy:

In this step, Engineering Department evaluates both the design requirements and the manufacturing capabilities and capacities necessary to support the manufacturing strategy. They identify which partners will be required, and any long lead items that will need immediate attention.

3) Advanced Manufacturing Planning:

In this step, people in the engineering department work, as early as possible in the FAI process, using preliminary process information. They create preliminary versions of the manufacturing bill of material (MBOM) and process plans, initiate new tooling requests. Factual feedback or requests for change are also provided to customer in the early stages of Documentation work to improve manufacturability.


Define Manufacturing Strategy
Advanced Manufacturing Planning
Optimize Process Plan
Document Process Plan
Create Routing Programs
Process Work Instruction
Approval
Release to Production
Part Following Till FAI
MPS
CP
RC

4)Optimization of Process Plan:

In this step, Engineering Department creates several manufacturing process alternatives to compare and optimize the manufacturing process. Manufacturing process alternatives can represent either different alternatives in one plant, alternatives between different plants, or make-versus-buy options. Optimization methods typically include line balancing, but can also involve more specialized types of simulation, such as work center simulation or whole factory discrete event simulation.

The engineering approaches for optimization of process plan are as follows:

- Establishing the process objective.
- Collecting all the facts about the problem.
- Planning alternative processes.
- Evaluating alternative processes.
- Developing a course of action.
- Following up to assure action and checking results.

5) Estimation

- Request for quotation, RFQ is received from the Business Development department of the company.
- All the technical data consisting of drawings, standards & other specifications is received.
- Data is studied thoroughly and feasibility check is done.
- The estimation process begins as soon as the feasibility is assured.
- The BOM is then generated carefully.
- Materials required, i.e., tools, raw materials, consumables. Hardware is sent to the purchase department.

- Processes required for each part to be manufactured are identified as per the standards. For e.g. Heat Treatment, Forming, Surface Treatment etc.
- Labor cost &labor timings are then estimated.
- If the requirements demands of outsourcing, then vendors are asked for the quotes.
- Complete tooling cost is calculated which includes the cost of Jigs, Fixtures, Blocks etc.
- Actual prices of the materials required are received from the Purchase Department.
- As per the Packing & Freight demanded by the customer, receive the quotations for packing and freight as well.
- All costs & expenses are compiled. These costs include:

- Raw Material cost.
- Packing.
- Shipping.
- Marching, Metal, Heat Treatment, Surface Treatment.
- Labor Costs.

- The Final cost is then compiled and analyzed by the company.
- The cost is revised after discussions.
- The quotation is sent to the Business Development team of the company on a cost sheet.
- Further revisions are done on the quotations depending on the feedback from the customer

6) Document Process Plan:

Once the process plan is approved by the customer, the engineering department must detail and document the manufacturing processes that have been selected from the previous optimization step. The engineering documentation for a part is consists of:

- Manufacturing Process Sheet
- Control Plan
- Route Card

The documentation process plan for large number of parts is selected by the engineering team keeping in mind the following points:

- Assembly
- Sub Assembly
- Thickness of Material/Part
- Heat Treatment
- Time of Delivery

6.1) Development of Manufacturing Process Sheet:

A form of process documentation that provides detailed information about each stop in the RC. The information of each operation includes details like work centre, reference customer standards, work instructions, tooling and work holding requirements.

These Instructions comprises of the individual Operation details of Estimated Set-Up & Run Time, associated to the various Resource Codes that define the machines and processes provided by the company.

We can describe the entire production process of a product or only part of it in the MPS. The MPS also contains the instructions for the process operators about the individual production steps that need to be performed.

In the MPS, we can:

- Display control information such as instructions for the process operator on how to carry out the production step using operation drawings.
- Display additional notes, such as notes on specific rules that must be followed .e.g. HOP. KC, FOD

6.2) Development of Control Plan:

A Process Control Plan (CP) is a summary of defect prevention and reactive detection techniques. The overall intent of the CP is to control the product characteristics and the associated process variables to ensure capability and stability of the product over time. CP assures a system is in place to control the risks of the same failure modes as identified in the PFMEA. While CPs can be developed independently of PFMEAs, it is time and cost-effective to ink Control Plans directly to PFMEAs. A CP is a natural extension of an FMEA, even though it is not considered officially a part of an FMEA.

- A CP does assure well thought-out reaction plans are in place in case an out-of-control condition occurs and provides a central vehicle for documentation and communication of control methods.
- A Control Plan deals with the same information explored in a FMEA plus more. The major additions to the FMEA needed to develop a Control Plan are:

- Identification of the control factors.
- The specifications and tolerances.
- The measurement system.
- Sample size.
- Sample frequency.
- The control method.

- The reaction plan.

6.3) Development of Route Card:

A form of process documentation that outlines the path for the product as it moves through the creation process, beginning as raw stock and ending as a finished part. These are the packets used to track every part that gets manufactured in the shop floor, from start to finish. It gives:

- The date that the material is released for production.
- The work order number for the batch.
- The part description.
- Raw material.
- Production number.
- Revisions in Drawings, Part No. & MPS.

The subsequent pages contain a section for each operation in the manufacturing process. Each operation has an individual operation number, and a code to tell which machine will do that process.

A short description of each operation is provided, along with any important notes. Next to the description is an Actual Run Time for the operation. As the operations are completed, a stamp is placed. The stamp gives a four digit code for the worker who performed the operation, along with the date of the stamping.

It is used as a means to authorize and instruct the production people to take up the production work. The content and formats of the RC varies from company to company. The RC may or may not contain the details of operations to be performed at different stations. This information identifies how a work under production from work center to work center is done. In this way the RC traces the route to be taken by the job during the production process.

6.4) NC Routing Program:

The NC part program is a sequence of instructions which describe the work which has to be done on a part in the form required by a computer under the control of a numerical control computer program. It is the task of preparing a program sheet from a drawing sheet. All data is fed into the numerical control system using a standardized format. Programming is where all the machining data are compiled and where the data are translated into a language which can be understood by the control system of the machine tool.

6.4.1) Stage 1

The Metal rods and bars are kept in the stores which then undergoes inspection. After the inspection is done, those sheets are collected from the stores and sent for shearing and deburring if required. If the shearing process is not required it is directly sent to the routing which can be CNC or manual.

6.4.2) Stage 2

If the metal is hard, with greater thickness, it needs to be annealed. It undergoes annealing process, heat treatment inspection and then forming. And if the part is simple or it can be formed in less time then the annealing step is skipped and then solution heat treatment is done before forming. The annealing is skipped also in case the material is soft enough or with higher bend angle

Materials that are in TO condition after forming need to undergo solutionizing, hand straightening, heat treatment inspection and ageing and then NDT while a few after forming inspections can directly go to NDT.

6.4.3) Stage 3

Once it comes after the NDT all the finishing processes/surface treatment like alodine, anodizing, painting etc. mentioned in the flowchart takes place and finally all the components are placed in the stores for the final delivery**.**

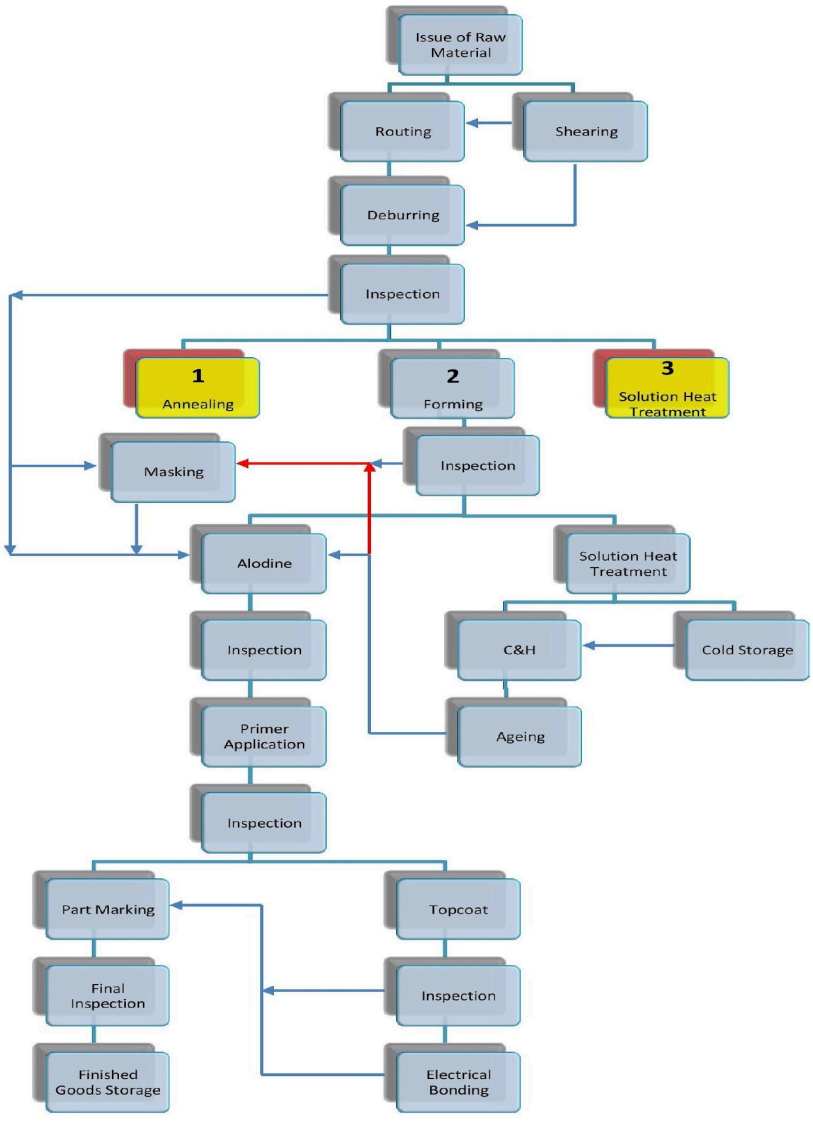
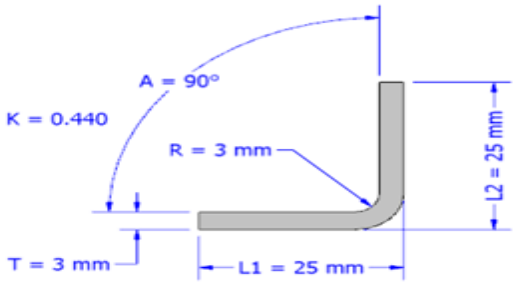


Figure 2: Manufacturing Processes Flow

5.5) Manufacturing Process of a Simple Aircraft Part - Angle:



- Initial condition is Aluminum 7075 T6.
- Surface treatment like primer and CAA is applicable.
- Tolerance in length, diameter and angle are respectively ±2mm, ±.5mm, ±1deg.
- Sheet thickness is 3mm.
- Final Condition is Aluminum 7075 T62.
- Maximum 3 heat treatment is possible.

6.5.1) Issue of Raw Material:

A raw material or feedstock is basic material used in the production of goods, finished products or intermediate materials that are themselves feedstock for finished products. The term "raw material" is used to denote material is in an unprocessed or minimally processed state.

- Issue of raw material from the store according to requirement.
- Verify material specification, condition, batch number, heat number, thickness.

6.5.2) Shearing:

Shearing, also known as die cutting is a process which cuts metal without the formation of chips. If the cutting blades are straight the process is called shearing, if the cutting blades are curved then they are shearing-type operations. The shearing machine exerts shearing force on the metal plate of various thicknesses, and makes the plate split according to the required size

- Shear the material of size 75 mm X 65 mm.

6.5.3) CNC Routing:

We need to cut different profile on metal for different parts of aircraft. So in order to cut this design the router follows the shape while milling the metal. CNC routers are computer-controlled machines that are capable of cutting complex two-dimensional shapes with router bits that spin at high speeds.

- Complete profile is routed along with all 4 pilot holes of Dia. 2 mm as per the NC Program in the CNC Router Machine.

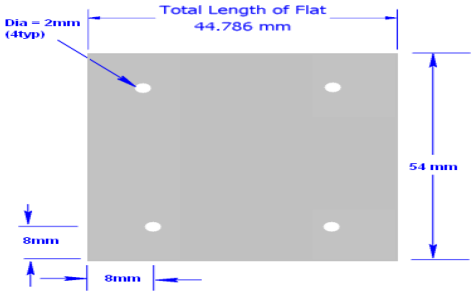


Figure 4: Process Drawing 1

6.5.4) Deburring:

Metal is frequently machined using many processes in order to create pieces of specific shape and size and it may be routed, trimmed, slit or sheared. These procedures often create ragged edges, or protrusions. The raised particles and shavings that appear when metal is machined are referred to as burrs and the process by which they are removed is known as deburring.

- These protrusions or burrs are removed by sand paper. This operation can be done either manually or by a machine.

6.5.5) Inspection:

The measurement process is required for the examination of a 2-dimensional feature or a 3-dimensional object. Inspection is a critical step in product development and quality control. Dimensional Metrology requires the use of a variety of physical scales to determine the accurate dimensions of the object.

- The Routed Blank including the outer contour profile as per the sketch below is inspected with the loft keeping in mind the allowable tolerances.

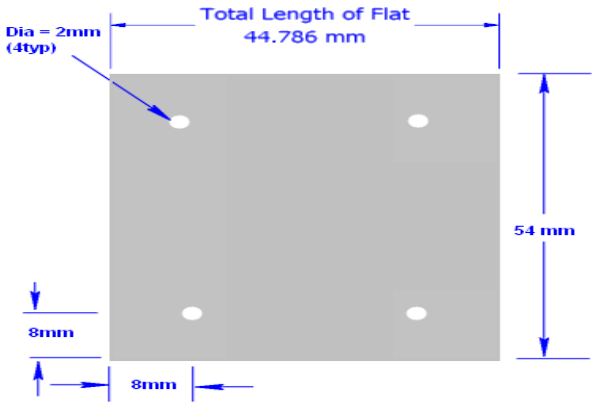


Figure 5: Process Drawing 2

6.5.6) Forming:

Metal bending is the plastic deformation of the work over an axis, creating a change in the part's geometry. Most metal bending operations involve a punch die type setup. There are many different punch die geometries, setups and fixtures. Tooling can be specific to a bending process and a desired angle of bend. Also important is the flange/web length, bend radius, bend angle and location of bend in the work piece.

- The blank is located on the Form block and part is formed on Brake Press to shape using punch & die at:
- Bending Angle = 90 degrees.
- Bending Radius = 3 mm.

keeping in mind the tolerances.

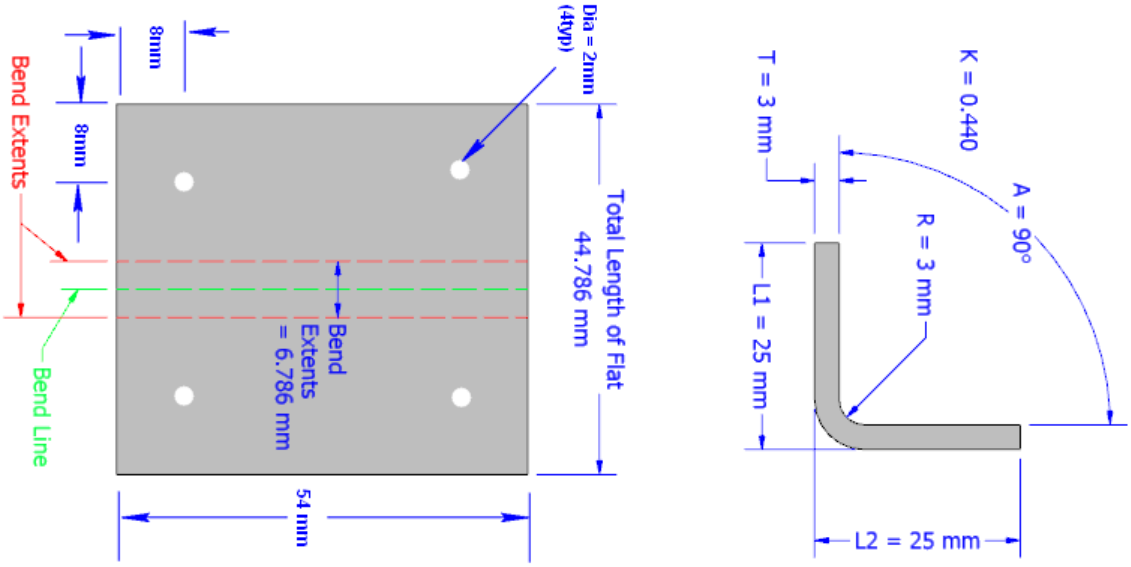


Figure 6: Process Drawing 3

6.5.7) Inspection

- Inspect the part as per the sketch.

5.5.8) Checking & Hand Straightening

- The part is checked for all the dimensional parameters such as bending angle, bend radius etc because the part may have got deformed a little due to sudden temperature drop while quenching.

- Also the part is hand straightened if required.

5.5.9) Alodine:

Alodining is the chemical application of a protective coating on aluminum. Alodine is a strong oxidizer and does a chemical conversion of the surface (oxidizes it) and is the best way to preparing it for painting. The paint is supposed to bond to the alodine surface better.

Chromic acid conversion coating-A chromic conversion coating is used to convert the aluminum surfaces to provide corrosion protection, and offer the ideal adhesion surface for a corrosion protective epoxy primer. A successful coating application will turn the clean bright aluminum surfaces to a light to medium gold color. Rinse well, do not allow the solution to dry on the treated surfaces.

Spray/apply the conversion coating. Mix and apply as per the manufacturer's application and drying time recommendations.

6.5.10) Inspection:

Alodine is a surface treatment operation. In this operation a layer is formed over the surface of metal which can change the thickness, weight of the part and it is also possible that the formed layer over the surface of metal is not uniform throughout. Hence the inspection of surface treatment is required.

6.5.11) Primer Application:

A primer or undercoat is a preparatory coating put on materials before painting. Priming ensures:

- Better adhesion of paint to the surface.
- Increases paint durability.
- Provides additional protection for the material being painted.

6.5.12) Inspection:

Primer is a surface coating operation. In this operation, a layer is formed over the surface of metal which can change the thickness, weight of the part and it is also possible that the formed coat over the surface of metal is not uniform throughout hence the inspection of primer is required.

6.5.13) Part Marking:

Part marking is a process to permanently mark parts with product information including:

- Drawing numbers.
- Part numbers.
- Material.
- Thickness
- Production Order/Purchase Order.
- Company.
- Date codes.

This is done to allow the tracking of parts through the full life cycle. In the aerospace industry an aircraft part may be in service for over 30 years.

6.5.14) Final Inspection:

The final inspection is the last step of process a team of sharp-eyed inspectors gives each part a final careful check-over.

5.5.16) Finished Goods Storage:

When the good is completed as to manufacturing but not yet sold or distributed to the end-user or if there is no processing required in term of the goods, it is called a "finished good". A particular location where the “finished goods” are placed is called finished goods storage.

7) Publishing of Documents/Releasing to Production:

In this step, the final manufacturing processes documents are published in either printed or electronic format. It is the responsibility of Engineering Department to publish manufacturing documents to the production according to pre decided time frame. Documents include MPS, CP & RC. Work instructions are made available to the shop floor in either printed or electronic format. Electronic work instructions can also be used to collect feedback from the actual execution of the process, including results of inspections, deviations, and as-built BOMs.

8) Approval:

In this step published documents are approved by engineering department because it is a legal procedure of a plant and without approval any document can't be released on the shop floor. During the approval process all the documents are checked, technically and legally by engineering manager

9) Following of Part till FAI:

In this step, project executer follows the part till the FAI. The manufacturing activity of a plant is said to be "in control" when the actual performance is within the objectives of the planned performance. When jobs are started and completed on schedule, there should be very little, if any, concern about the meeting of commitments. Optimum operation of the plant, however, is attained only if the original plan has been carefully prepared to utilize the manufacturing facilities fully and effectively.

Chapter- 2

1) Introduction to Computer Aided Manufacturing

1.1) What is computer aided manufacturing?

Most machines need control systems to operate. There are many kinds of control systems, for example, manual control, automatic control, computer control or remote control. For the convenience of mass production, machines need to repeat precise, speedy and automatic actions continuously. These machines may use mechanical, pneumatic and electrical systems to control. However, some fixed procedures, changing procedures or tools may need a lot of time to restore the whole system. As technology advances, electronic and computer technologies have been applied to a lot of production machines to reduce the production time and increase both the quality and efficiency.

Modern factories usually use numerical control machines, simply called NC machines. And an NC machine that comes along with a computer is called a computer control numerical machine, simply CNC machine. A CNC machine uses digital information to control the movements of tool sand parts, for example, the spinning speed, the cutting speed, the moving direction of tools etc.

The production method that requires a computer to control the machines is called a computer aided manufacturing, simply called CAM. It is basically a system that uses computer technology to assist the manufacturing process.

Computer Aided Manufacturing is commonly linked to Computer Aided Design (CAD) systems. The resulting integrated CAD/CAM system then takes the computer-generated design, and feeds it directly into the manufacturing system; the design is then converted into multiple computer-controlled processes, such as drilling, milling or turning.

1.2) The merits of computer numerical controlled (CNC)Machine

There are many advantages of a CNC machine:

- The computer can design the best tool path, spinning and cutting speeds of tools according to the information of the product. This can help decrease the cost and time.
- CNC machines usually have automatic changing tools function.
- CNC machines can control precisely the tools movement in any axis, so it can cut some complicated work piece efficiently.

- With the use of various input devices and the memories of computer, a CNC machine can download and modify program efficiently, so the production procedures can be made quickly.
- In operating the CNC machine, manual adjustment is not needed. Therefore, the CNC machine can run at a high speed, and it requires less skillful workers to reduce the labor cost.
- CNC machine uses various designs to produce feedback, and so it can keep its high reliability and quality, this can help decrease the number of disqualified product and the cost of inspection.

1.3) The restrictions of CNC machine

But, there are some restrictions of CNC machine:

- The cost of the machine is so high that some small factories may not be able to afford.
- Operators need to be trained to compose computer control program.
- The control system is complicated and sophisticated, therefore the maintenance cost is
- high.

2) Components of Computer Aided Manufacturing

2.1) Computer and Numeric Control (CNC)

Conventionally, an operator decides and adjusts various machines parameters like feed, depth of cut etc. depending on type of job, and controls the slide movements by hand. In a CNC Machine functions and slide movements are controlled by motors using computer programs.

2.1.1) Numeric Control NC

- A numerical control, or “NC”, system controls many machine functions and movements which were traditionally performed by skilled machinists.
- Numerical control developed out of the need to meet the requirements of high production rates, uniformity and consistent part quality.

- Programmed instructions are converted into output signals which in turn control machine operations such as spindle speeds, tool selection, tool movement, and cutting fluid flow.

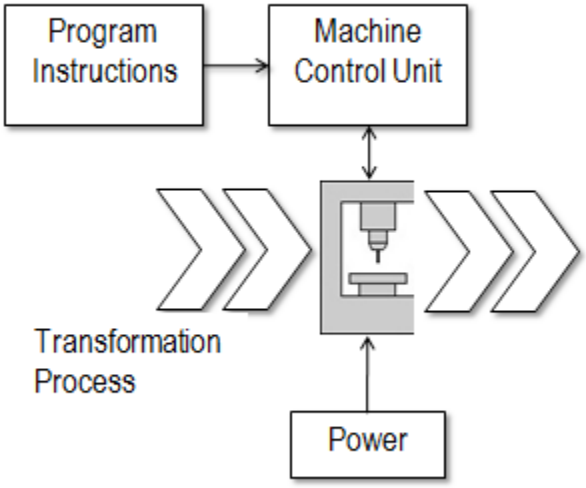


Figure 7: Routing Process

3) Types of Part Programming

The part program is a sequence of instructions, which describe the work, which has to be done on a part, in the form required by a computer under the control of a numerical control computer program. It is the task of preparing a program sheet from a drawing sheet. All data is fed into the numerical control system using a standardized format. Programming is where all the machining data are compiled and where the data are translated into a language which can be understood by the control system of the machine tool. The machining data is as follows:

- Machining sequence classification of process, tool start up point, cutting depth, tool path, etc.
- Cutting conditions, spindle speed, feed rate, coolant, etc.
- Selection of cutting tools.

While preparing a part program, we need to perform the following steps:

- Determine the startup procedure, which includes the extraction of dimensional data from part drawings and data regarding surface quality requirements on the machined component.
- Select the tool and determine the tool offset.
- Set up the zero position for the work piece.
- Select the speed and rotation of the spindle.
- Set up the tool motions according to the profile required.
- Return the cutting tool to the reference point after completion of work.
- End the program by stopping the spindle and coolant.

Hence the methods of part programming can be of two types depending upon the two techniques as below:

- Manual part programming, and
- Computer aided part programming.

4) 3-Axis CNC Router

A CNC router is a router whose tool paths can be controlled via computer numerical control. It is a computer-controlled machine for cutting various hard materials, such as wood, composites, aluminum, steel, plastics, and foams. It is one of many kinds of tools that have CNC variants.

Although there are many configurations, most CNC routers have a few specific parts: a dedicated CNC controller, one or more spindle motors, AC inverters, and a table.

This project is about 3D CNC Routing machine with 3axis. It will have mechanical structure have the capability to move in the three axis which are X, Y, and Z axis. Driving the spindle in this axis

will cause the working piece to be routed. There will be an electronics attached to the structure to drive it. These electronics will handle the electrical signals came from the numerical controller (computer) to drive the structure. The CNC router is run by a computer. Coordinates are uploaded into the machine controller from a separate program. CNC router owners often have two software applications—one program to make designs (CAD) and another to translate those designs into a program of instructions for the machine (CAM). As with CNC milling machines, CNC routers can be controlled directly by manual programming, but CAD/CAM opens up wider possibilities for contouring, speeding up the programming process and in some cases creating programs whose manual programming would be, if not truly impossible, certainly commercially impractical.

There are two Routing machine used at MASPL

- Belotti 3 Axis CNC Routing Machine
- Teckel 3 Axis CNC Router Machine

4.1) Belotti 3 Axis CNC Routing Machine

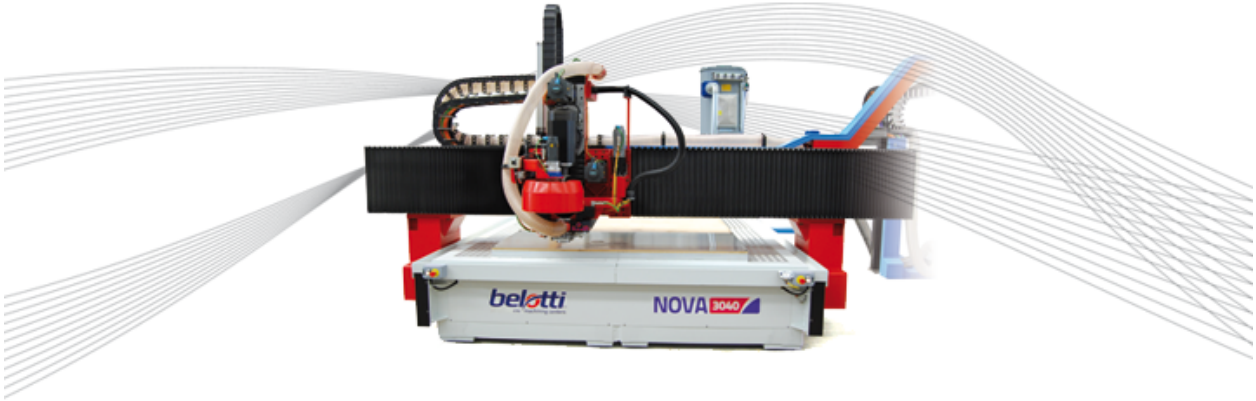


Figure 8: Belloti 3 Axis CNC Router

4.1.1) Specifications of the Belotti Router Machine

Travel	Maximum X-Axis	3000	in mm
	Maximum Y-Axis	4000	in mm
	Maximum Z-Axis	550	in mm

Machine Speed Range	Maximum Spindle Speed	24000	in rpm
	Power	20	in kW
	Torque	80.2	in Nm
Positioning Speed	X Axis	50	in m/mints
	Y Axis	50	in m/mints
	Z Axis	25	in m/mints

4.1.2) Workpeice Material Size

Working Area	Maximum X-Axis	1800 mm
	Maximum Y-Axis	3000 mm
	Maximum Z-Axis	570 mm

5) Application software of 3-Axis CNC Router Machine: Alphacam Router.

Alphacam Router is a full-featured, easy-to-use CAM solution for manufacturers wanting fast, efficient toolpaths and the generation of reliable, machine ready CNC code. Ease-of-use is just one of the reasons that Alphacam is the industry standard and system of choice for programming CNC routers. Tooling and machining techniques unique to this industry are accommodated by Alphacam dedicated Router modules.

Features

All Alphacam modules are built using one core foundation which includes geometry creation commands such as line, arc, circle, rectangle, polygon, ellipse, spline and polyline together with

surface creation options. Import options for DXF, DWG, IGES and a variety of solid model formats ensure compatibility with other CAD systems. There are also various geometry editing functions including undo, redo, move, copy, rotate, mirror, scale, break, trim, explode, join, extend, fillet, chamfer and offset.

Dedicated Drilling Unit

Drilling paths can be optimized for any drill unit using Alphacam's Multi-Drilling command. Holes are matched to the drill diameters and automatically machined.

Nesting

Nested based manufacturing is made easy using Alphacam's automatic nesting functionality. Parts can be selected directly from the screen or as a kit; their orientation fixed, if grain direction needs to be maintained or rotated to any angle. Nesting support stool lead in/out, support tags for small parts.

Post Processors

With manufacturers facing ever increasing global competition, it is essential to maintain maximum machinery efficiency to ensure optimal production throughput. Having an optimized link between Alphacam and your CNC machines, through the use of post processors, is a key component in attaining this efficiency. Having developed post processors for virtually every machine control in use today, Alphacam has the knowledge and experience to fine tune your CNC output ensuring maximum yield and quality in the shortest possible time.

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Chapter-3

Study of Different Departments in Aerospace Production.

1.1 STORE

Store is a place where raw materials are stored .All the raw materials are kept in different shelf. Separate document are provided for receiving inspections of the raw material which are done by the receiving inspector. All debarring and CNC tools are also present in the store. Store contains all trays, raw material, packing material etc. Raw material comes from company in form of bars and they are stored in stores and receiving inspection team check and inspect the material. They the check the proper dimensioning of the material and give the final receipt report. The store has details of every company .It has tools & trading materials. The store also stores and record the cutting waste material. Every material in the store has a unique identity number , one from the customer and one from the company itself. Material are stored in a different manner each having a different colour code for identification purpose. With colour indications bar materials are introduced .In aerospace industry we mostly deals with aluminium allow materials .Most of the material in stores are Raw materials, Packing boxes, trays, Machine tools, Trading materials .With every material a invoice comes which gives all details like Quality, heat number, Weight, Identity number .All these are given by the company and customer. There is a great role of the receiving inspector who make record of everything in the computer and all present and past entry's ,all the deliveries and their details are stored in a separate database.

STORE TRADING MATERIALS

- **Nickel based alloy**

- **Cobalt based alloy**
- **Stainless steel (all types)**
- **Titanium alloy**
- **Alloy steel**
- **Aluminium alloy**
- **Magnesium alloy**
- **Nylon & PVC**

1.2 WIP(WORK IN PROGRESS) AREA

In this area we do rooting of all the parts. If one operation is completed and whenever it is ready for the next operation we check that in WIP area.

Report in WIP area contains the following descriptions

- **Root record**
- **Tool layout**
- **Stage drawing**
- **Control plan**
- **Customer drawing**

Root record- Order number and customer number are written in the root record. Records of number of operations and timing are provided in the root record. After completions of works records of timing of every operation and completion date are also given in the root record. Rejected items with ID number are given behind the sheet. Once any operation is completed it is noted down in the root record along with their operation number and time for completion and processed for further operations.

Tool layout-In tool layout the layout of all the tools and their picture with operation number, movement along with the part's are provided along with them. Every operation procedure is explained in the tool layout.

Stage drawing- It is made by engineering department. In stage drawing all the drawings, process, work and necessary information are given. Every stage tolerance, dimensions, part movement and number of tools required are given.

Control plan- In control plan method of manufacturing, process, time required , program used and operation along with CNC program operation number and machine number are provided

Customer drawing-It contains customer drawing, dimensions and specifications as well as material information, reference number and name of the product are also given. Control plan is attached to customer or stage drawing.

1.3 FINAL INSPECTION AREA

In final inspection area final inspection of all the finished products are done.All the products are thoroughly inspected for checking any flaws in the product and finally the inspected produced are packed and processed to the customer. Inspection is also done through non-destructive testing ,through Vision measuring machine for physical verification and visual imperfection.

1.3.1 MARSHALL ASSEMBLY

Marshall is a big customer for mini production in aerospace. All the marshell components are Packed in a special area. All the marshell products are inspected and cleaned in a separate room which are air conditioned. Production related to Marshall are very complicated.

CYCLE TIME ANALYSIS

In cycle time analysis performed by the mechanical department the number of time taken in each cycle ,each operation ,clock timing, door close and door opening time are recorded ,speed of the tool, rpm, work done in each tool and number of operation required for each tool are recorded. This analysis find out how many production occurs in a day and efficiency is calculated.

CERTIFICATE AWARDED

- Certificate awarded by **NADCAP** for best Non destructive testing

- Certificate awarded by **GOODRICH** for compliance and approval by GOODRICH standards
- Certification awarded by **G.E** for transportation
- Aviation Special Certification

Some Important things which requires to make a company A World Wide Production Company.

5'S TECHNIQUE

5S is the name of a workplace organization method that uses a list of five Japanese words: *seiri, seiton, seiso, seiketsu,* and *shitsuke.*Transliterated into English, they all start with the letter "S". The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new order. The decision-making process usually comes from a dialogue about standardization, which builds understanding among employees of how they should do the work

Seiton[Systematic arrangement]

- Can also be translated as "set in order", "straighten" or "streamline"
- Arrange all necessary items so they can be easily selected for use
- Prevent loss and waste of time
- Make it easy to find and pick up necessary items
- Ensure first-come-first-served basis
- Make workflow smooth and easy
- All above work should be done on regular basis

Seiri[Sort]

- Remove unnecessary items and dispose them properly
- Make work easier by eliminating obstacles
- Reduce chance of being disturbed with unnecessary items

- Prevent accumulation of unnecessary items
- Evaluate necessary items with regard to cost or other factors
- Remove all parts not in use
- Segregate unwanted material from the workplace
- Need fully skilled supervisor for checking on regular basis
- Don't put unnecessary items at the workplace & define a red-tagged area to keep those unnecessary items

Seiso[Shine]

- Can also be translated as "sweep", "sanitize", "shine", or "scrub"
- Clean your workplace completely
- Use cleaning as inspection
- Prevent machinery and equipment deterioration
- Keep workplace safe and easy to work
- Keep work place clean

Seiketsu[Standardize]

- Standardize the best practices in the work area.
- Maintain high standards of housekeeping and workplace organization at all times.
- Maintain orderliness. Maintain everything in order and according to its standard.
- Everything in its right place.
- Every process has a standard.

Shitsuke[Sustain]

- To keep in working order
- Also translates as "do without being told" (though this doesn't begin with S)
- Perform regular audits
- Training and Discipline
- Training is goal oriented process. Its resulting feedback is necessary monthly

Additional Ss

Other phases are sometimes included e.g., safety, security, and satisfaction. These however do not form a traditional set of "phases" as the additions of these extra steps are simply to clarify the benefits of 5S and not a different or more inclusive methodology.

Safety

The phase "Safety" is sometimes added.[3] There is debate over whether including this sixth "S" promotes safety by stating this value explicitly, or if a comprehensive safety program is undermined when it is relegated to a single item in an efficiency-focused business methodology.

Security

The phase "Security" can also be added. To leverage security as an investment rather than an expense, the seventh "S" identifies and addresses risks to key business categories including fixed assets (PP&E), material, human capital, brand equity, intellectual property, information technology, assets-in-transit and the extended supply chain. Techniques are adapted from those detailed in Total security management (TSM) or the business practice of developing and implementing comprehensive risk management and security practices for a firm’s entire value chain.

The Origins of 5S

5S was developed in Japan and was identified as one of the techniques that enabled Just in Time manufacturing.

Two major frameworks for understanding and applying 5S to business environments have arisen, one proposed by Osada, the other by Hirano. Hirano provided a structure for improvement programs with a series of identifiable steps, each building on its predecessor. As noted by John Bicheno, Toyota's adoption of the Hirano approach was '4S', with Seiton and Seiso combined.

Variety of 5S Application

5S is now being applied to a wide variety of industries. It has expanded from manufacturing to health care, education, government, and many other industries. Although the origins of the 5S methodology are in manufacturing, it can also be applied to knowledge-economy work, with information, software, or media in the place of physical product.

IMPROVEMENTS

Health and Safety- Health and safety of each employees and workers must be taken into account to ensure a healthy environment which would lead to more work efficiency. All the employees and workers should weak mask and gloves which doing operations or handling hazardous chemicals.

Time Management-Time management should be taken into consideration. Breakfast and Lunch time should be properly managed for to increase production and work efficiency. Time slot and duration for completion of work should be made more shorter as most of the production are completed before time. Also every areas must be provided time slot under which it should be at particular time and after that it should be immediately processed to other area without wasting any time. Most time of the areas which take unnecessary time should be removed and time of inspection must be shortened by quick periodic inspection after each cycle of operation.

Better Handling-Better handling of raw material during operation and each cycle of time should be done and each time the part must be inspected thoroughly after each cycle. Periodic inspection must be done to prevent production of any scrap item. So proper handling should be ensured.

Regular inspection of machines-Regular inspection of the machines must be done to ensure that there should not be any malfunctioning or irregular movement of machine leading to the formation of scraps. Technician must be always present in the department for quick handling of any issues in the machine.

Work efficiency-Work efficiency during work must be ensured by regular inspection after each cycle of work and fast processing of finished work.

Working environment-Working environment should be made more healthier by maintaining more efficient cleaning. Temperature regulators must be provided along with exhaust fan and heat ejection fan should be present in the department for cool and dust free environment.

QUALITY ENVIRONMENT

The team commit itself to-

- Assure quality in all their process
- Quality execution through integrated management systems at all levels
- Function along their supply chain to achieve their objective
- Prevention of pollution, incidents and ill health
- Exceeding with applicable legal and other requirements
- Conservation of energy and resources
- Follow best practices for safe and healthy work environment
- Periodic review of IMS performance
- Training of all employees through documented IMS
- Communicate to interested parties

CONCLUSION

In review this internship has been an excellent and rewarding experience. It offered us firsthand exposure to the industry. This organization has a superb work culture, great minds and very high quality of work. This internship program offered us a chance to develop skills by observing, recording and interpreting data. It helped us put the theories we have learned in the classroom into practice.

We studied the Engineering Drawings, Manufacturing Process Sheets, Control Plans and Route Cards. We could understand the basic concepts of manufacturing with the study of various standards of different processes. Also we got an exposure to the manufacturing of aircraft components in the shop floor.

We did the study of different Areas present in Aerospace Production department.

We attended the training program given to the diploma holders in which we learnt about Engineering drawing and some factors which effects the production and how to make a company A World Wide Production company.

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