19MCE401 - PROCESS PLANNING AND PRODUCT DEVELOPMENT

STUDY NOTES

UNIT 2 - PROCESS PLANNING ACTIVITIES

TOPIC 3 – DOCUMENTS REQUIRED FOR PROCESS PLANNING

Handled by:

Dr. T. Prakash M.E., Ph.D.,

Professor & Head,

Department of Mechatronics Engineering,

SNS College of Technology,

Coimbatore - 35.

Documents required for process planning:

Process planning is a critical stage in manufacturing and project management that involves detailing the steps, resources, and strategies needed to produce a product or complete a project efficiently and effectively. Several documents are typically required for effective process planning, depending on the complexity and nature of the project. These documents include:

- Product design and the engineering drawings pertaining to all the components of the product
- Machining/Machinability Data Handbook
- Catalogues of various cutting tools and tool inserts
- Specifications of various machine tools available in the shop/catalogues of machine tools in the shop
- Sizes of standard materials commercially available in the market
- Machine Hr. cost of all equipment available in the shop
- Design Data Handbook
- Charts of Limits, Fits & Tolerances
- Tables showing tolerances and surface finish obtainable for different machining processes
- Tables of standard cost
- Table of allowances (such as Personal Allowance, Fatigue Allowance etc. in% of standard time followed by the company)

Product design and Engineering drawings:

Product design is a crucial phase in the development of any physical product. It encompasses the creative and technical process of conceiving, specifying, and defining the appearance, structure, and functionality of a product. Effective product design aims to meet customer needs, enhance usability, optimize manufacturing processes, and ensure that the final product is safe, reliable, and cost-effective.

Engineering drawings are an integral part of product design and serve as a means of communication between designers, engineers, and manufacturers. These drawings provide detailed visual representations of all the components and aspects of the product, including dimensions, tolerances, materials, assembly instructions, and other critical specifications. They

play a central role in the product development cycle by conveying essential information to various stakeholders, such as production teams, quality control, and suppliers.

Engineering drawings typically include orthographic projections, isometric views, cross-sectional views, and exploded views to illustrate how individual components fit together. Annotations, symbols, and labels convey precise measurements, material specifications, surface finishes, and other essential details. These drawings are essential for ensuring that the product is manufactured accurately and meets the intended design criteria.

In summary, product design is the process of conceptualizing and defining a product's form and function, while engineering drawings provide the technical documentation necessary to guide the manufacturing and assembly of all its components, ensuring that the final product aligns with the original design intent and quality standards.

Machining/Machinability Data Handbook:

A Machining or Machinability Data Handbook is a comprehensive reference resource used in manufacturing and engineering that provides essential information about the machinability of various materials, including metals, plastics, ceramics, and composites. This handbook offers detailed data and guidelines to assist engineers, machinists, and designers in selecting the appropriate machining processes, cutting tools, speeds, feeds, and other parameters to achieve optimal results when working with different materials.

Key components typically found in a Machining Data Handbook include:

1. Material Properties: Information on the physical and mechanical properties of materials, such as hardness, tensile strength, thermal conductivity, and thermal expansion, which are critical factors in determining how a material will respond to machining processes.

2. Cutting Tool Selection: Guidance on selecting the most suitable cutting tools, tool materials, and geometries for specific machining operations, considering factors like material type, workpiece geometry, and desired surface finish.

3. Cutting Speeds and Feeds: Recommendations for cutting speeds, feed rates, and depth of cuts that optimize material removal rates while minimizing tool wear and heat generation.

4. Surface Finish and Tolerances: Data on achievable surface finishes and dimensional tolerances for different materials and machining processes, helping to meet design requirements.

5. Tool Life and Wear: Information on tool wear mechanisms, tool life expectancy, and strategies for extending tool life through coatings, lubrication, and cooling techniques.

6. Machining Process Guidelines: Specific instructions for various machining processes, such as turning, milling, drilling, and grinding, tailored to different materials.

7. Case Studies: Real-world examples and case studies that illustrate successful machining practices and troubleshooting techniques.

A Machining Data Handbook serves as a valuable resource for improving manufacturing efficiency, reducing costs, and ensuring the quality of machined components. It helps professionals make informed decisions in selecting materials and machining strategies, ultimately leading to more effective and precise machining processes.

Catalogues of various cutting tools and tool inserts:

Catalogues of cutting tools and tool inserts are comprehensive references used by professionals in manufacturing and machining industries to explore and select the most suitable tools for specific cutting and machining applications. These catalogues provide essential information about a wide range of cutting tools, including end mills, drills, inserts, and toolholders, designed for various materials, machining processes, and industries.

Key components of these catalogues typically include:

1. Tool Descriptions: Detailed descriptions of each cutting tool or insert, including its type, geometry, and specifications.

2. Material Compatibility: Information about the materials that the tool is designed to work with, such as metals, plastics, ceramics, or composites.

3. Application Recommendations: Guidance on the recommended applications and machining processes for each tool, including cutting speeds, feeds, and depths of cut.

4.Tool Dimensions: Detailed measurements, dimensions, and tolerances to assist in tool selection and integration into machining setups.

5. Performance Data: Data on tool performance, including tool life, cutting forces, and surface finish, to help users assess the tool's suitability for specific tasks.

6. Tool Coatings: Information on any specialized coatings or treatments that enhance tool durability and performance.

7. Cross-References: References to compatible toolholders, inserts, and accessories to ensure compatibility in machining systems.

These catalogues serve as indispensable resources for engineers, machinists, and tool operators, enabling them to make informed decisions when selecting the right cutting tools and inserts for their machining projects. By providing comprehensive information and recommendations, these catalogues contribute to improved efficiency, reduced tool wear, and enhanced machining quality in various industrial applications.

Sizes of standard materials commercially available in the market:

Standard materials available commercially in the market come in a wide range of sizes to meet the diverse needs of industries and consumers. These materials include metals, plastics, wood, and more. Typical size dimensions for metals often involve standard sheet, plate, bar, and tube sizes, with variations based on thickness, width, and length. Plastics are available in sheets, rods, and tubes, with varying diameters and lengths. Wood products, such as lumber and plywood, follow standardized dimensions as well. These standardized sizes ensure compatibility, ease of handling, and cost-effectiveness in manufacturing, construction, and DIY projects, making it convenient for customers to source the materials they require for their specific applications.

Machine Hr. cost of all equipment available in the shop:

Machine Hour (MH) cost is a critical metric used to determine the overall cost of operating and maintaining machinery in a shop or manufacturing facility. It quantifies the expenses associated with running equipment on an hourly basis, encompassing factors such as labor, energy, maintenance, and depreciation. Calculating MH cost involves dividing the total cost of operating a machine over a specified time period by the number of hours it operates during that period. Understanding MH cost is essential for optimizing production efficiency, allocating resources effectively, and making informed decisions about equipment utilization, repair, or replacement to maximize profitability in a manufacturing or shop environment.

Charts of Limits, Fits & Tolerances:

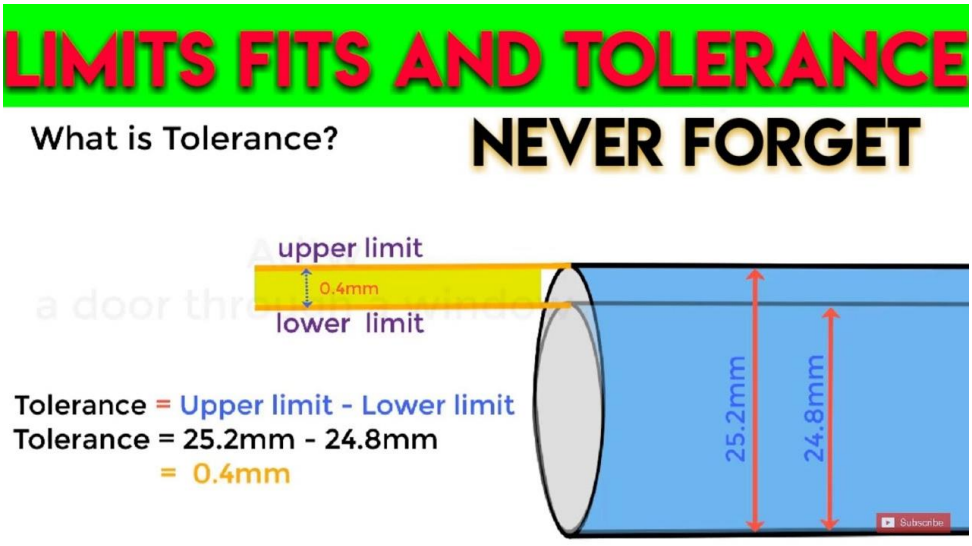
Charts of Limits, Fits, and Tolerances, commonly known as Geometric Tolerance Charts, are essential tools used in engineering and manufacturing to specify the acceptable variation in dimensions and the permissible clearances between mating parts. These charts help ensure proper assembly and functionality of mechanical components.

The chart typically consists of three main elements:

1. Limits: These define the acceptable range of variation for a specific dimension. They consist of two values, an upper limit (maximum) and a lower limit (minimum), which represent the range within which the dimension must fall for the part to be considered within tolerance.

2. Fits: Fits categorize the level of clearance or interference between mating parts. Common fit categories include clearance fits (loose), transition fits (intermediate), and interference fits (tight), each with specific applications and acceptable tolerances.

3. Tolerances: Tolerances specify the allowable deviation from a nominal dimension. They provide a range within which a dimension can vary and still be considered acceptable. Tolerances can be defined as unilateral (one-sided) or bilateral (two-sided) and are typically expressed in terms of plus and minus values.



Video Link: https://youtu.be/joBy4BoJszo?si=_X7_E8AF3q7mfKD9

These charts aid engineers and designers in selecting appropriate tolerances and fits based on the specific requirements of a given application. The goal is to balance the need for precision with cost-effectiveness and functional requirements, ensuring that parts fit and work together

as intended while minimizing manufacturing costs and complexity. Properly applied, these charts contribute to efficient and reliable mechanical assemblies.

Tables of standard cost:

Tables of standard cost are essential tools in cost accounting and financial management. They provide a structured reference of predetermined costs associated with producing goods or services. These standard costs typically include direct materials, direct labor, and overhead expenses. Standard cost tables help organizations estimate and plan their expenses, analyze variances between actual and expected costs, and make informed decisions regarding pricing, budgeting, and cost control. These tables serve as benchmarks for measuring operational efficiency and identifying areas for improvement. By comparing actual costs to the standard costs outlined in these tables, businesses can assess performance, optimize processes, and manage their financial resources more effectively.

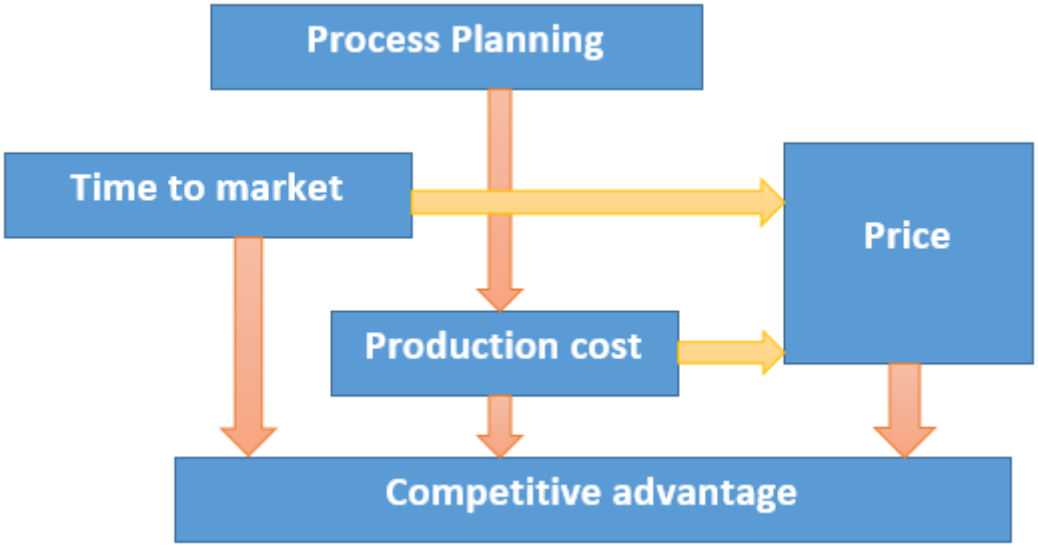


Table of Allowance:

A Table of Allowances is a systematic approach employed by companies in various industries to account for and allocate time for various factors that can affect the production or work process. These allowances are typically expressed as a percentage of the standard time required to complete a task or project. They play a crucial role in work measurement, cost estimation, and scheduling.

Common allowances in such tables include:

1. Personal Allowance: This accounts for the time taken by workers for personal activities such as rest breaks, restroom visits, and brief interruptions.

2. Fatigue Allowance: To compensate for reduced efficiency due to worker fatigue over extended periods of work.

3.Machine Downtime Allowance: Allowing for unplanned machine breakdowns or maintenance activities.

4. Setup and Tool Change Allowance: Time allocated for setting up machines, changing tools, or adjusting equipment before production can begin.

5. Process Variation Allowance: To accommodate natural variations and uncertainties in the production process.

6. Quality Control Allowance: Time needed for inspecting and ensuring product quality.

These allowances are incorporated into the standard time to establish a realistic production schedule, budget, and resource allocation. By considering these factors, companies can enhance productivity, meet production deadlines, and maintain a safe and efficient work environment.

Effective process planning involves the creation, maintenance, and dissemination of these documents to ensure that the production process is well-organized, efficient, and capable of meeting quality and performance objectives. These documents serve as reference materials for workers, help in troubleshooting issues, and facilitate continuous improvement efforts.