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Process Design and Development of Engine Block

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Abstract: **Tolerance synthesis and machining parameter have been recognized as key issue for process design and development. Manufacture of product in desired shape with desired characteristics and properties depend not only on design of product but also on selection of appropriate manufacturing process. This paper describes process selection methodology, cycle time calculation machine selection.**

This paper i.e. Process Design and Development of Engine Block is related to process design. When a company has to introduce number of products, once decision on design and product is made then, one of the crucial step that the company has to take is how to manufacture that product, comes under process design. Process design tells us thoroughly how product is made, which machines are used, cutting parameter etc.

The purpose of this process is to design process for engine block with weekly production at 3 blocks without affecting existing production of KV block with capacity of 113 blocks per week, arrange flow of part at shop floor in order to minimize the loss of time. Scheduling in production management is therefore very basic function in manufacturing and it has to be well match with process planning.

Keywords: **Process design and development, cutting parameter, cycle time.**

1. INTRODUCTION

It would not be economical to design process plans which need equipment not available in the company, which would incur unnecessary expense or which would entail the use of machinery which is vital for other manufacturing operations. If one intends to produce economically, it is therefore extremely important to achieve an optimal balance between occupation of machinery and queuing times of in-process material.

Also, the wasting of time by long handling transfer periods between machines is undesirable. The purpose of production control is to supervise the flow of parts at the shop floor in order to minimize such losses of time and, at the same time, to respect the delivery dates of products. Scheduling in production management is therefore a very basic function in manufacturing and it has to be well matched with process planning. The trend in process planning developments is more and more to integrate the two functions of process planning and production planning in order to achieve better productivity.

2. PROBLEM STATEMENT

Design and develop process for new product development.Company is currently manufacturing KV engines in three production lines namely HOMMA, PEGARD and FINAL LINE. The use of these KV Engines is reduced these days as they are not efficient enough to use for the modern machines. So company has developed new Engine named as QSK60. Engine which is more efficient and powerful than KV Engine and we have to design and develop process for the same. We have to maintain capacity of both KV and QSK60 engine block

3. OBJECTIVE OF THE PRESENT WORK

The objective of this paper is to design process for new product development. Which factor needs to be considering while selecting machine .How to select machine at their fullest capacity.How to release cycle time.

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- Design the process to carry out production of QSK 60 engine blockwithout affecting regular production.
- Maintain the capacity of regular production (KV block) as 113 blocks per week whereas capacity of QSK block 3 blocks per week.
- Release cycle time and make documentation of standard operating procedure.

4. FUNDAMENTAL RULES FOR SELECTION AND PLANNING OF MANUFACTURING PROCESS

1. The process must assure a product that meets all design requirements of quality, function and reliability requirements of quality, function and reliability

2. Daily production requirement must be meeting. 3. Full capacity of the machine Full capacity of the machine and its tooling should be utilized

4. Idle operator and idle machine time must be reduced to minimum

5. The process must provide the maximum utilization of the minimum amount of material

6. The process should be flexible enough to accommodate reasonable changes in design.

7. The process should be designed to eliminate any unnecessary operations and combine as many as possible.

8. The process must be designed with the protection of both the operator and the work piece.

9. The process should be developed so that the final product will be produced at a minimum cost.

5. PROCESS DESIGN

Industry employs a set of procedures in the design of manufacturing processes. Generally speaking this activity starts with the receipt of the product specifications and ends with the final plans for the manufacture of the product. In a broad sense this pattern of activity is uniform, regardless of the kind of product or the type of manufacturing involved. The steps involved in process design are as Follows:

- A careful review of the product design and specifications to make sure that economical
- Manufacture is feasible.
- Determination of the methods of manufacture that will result in the optimum manufacturing cost.
- Selection or development and procurement of all machines, tools, and other equipment required for the manufacture of the product at the required quality and rate of production.
- Layout of the production area and auxiliary spaces, and installation of the manufacturing facilities.
- Planning for and establishing the necessary control of materials, machines, and manpower to ensure the effective utilization of the manufacturing facility for the economical production of the product

Basic factor affecting process design

- The volume or quantity of the product to be manufactured.
- The required quality of the product.
- The equipment that is available, or that can be procured, for the manufacture of the product.

The volume to be manufactured must always be considered as the volume to be produced within a given period or as the rate of production. In this manner it can be related to the capacity of the manufacturing equipment under consideration and the best methods selected accordingly.

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6. PROCESS PLANNING SHEET (STANDARD OPERATING PROCESS)

The whole information determined by the process planning is recorded in a tabular form in a sheet called process planning sheet. This document is provided to the shop personnel for their use. The character of this sheet will vary for different organization depending upon the production conditions and degree of details required.

In general the following data is listed for each component of the product in the process sheet.

- Information regarding the main product, of which the component being manufactured is apart *i.e.*, name and part number of the main product.
- Name, part number, drawing number of the component and number off *i.e.*, no. of Components required per product.
- Operations are listed in proper sequence along with the shops in which these operations will be performed.
- Information regarding machines used for each operation.
- Inspection devices needed for inspection.
- Cutting data *i.e.*, speeds, feeds & depth of cut for each machining operation.
- Elements of standard time such as set-up time, handling time and machining time for the job.

The process planning sheet is prepared by the process engineer in consultation with the tool engineer, industrial engineer, or methods engineer.

7. DESIGN INTERPRETATION

The first step in preparing the process plan for any component or product is to consult the engineering drawings.The drawing of the component under consideration will contain a variety of information which can help assess the processing requirements. The interpretation of the drawing will include assessing the Part geometry, Dimensions and associated tolerances, Geometric tolerances. Surface finish specifications, the material specification and the number of parts required. From this interpretation, the critical processing factors can identified.

The specific aim of the process planning activity is states as the selection and sequencing of processes and operations to transform a chosen raw material into a finished component, that is, the detailed processes required manufacturing a part. The main input to the process planning activity is the product design and in particular the detail design in documentation. Although there are a number of other major inputs Therefore, the first step for the manufacturing engineer is preparing the process plans is to consult the engineering drawings of the parts under consideration. Although some knowledge of the production of engineering drawings is assumed. An introduction to the types of engineering drawings used will be included. Identifying which are the most appropriate for process planning. There will also be brief coverage of the systems of projection employed.

The drawing interpretation will require knowledge of the standards and symbols used for both dimensional and geometric tolerances. These will also be covered with reference made to the appropriate standards. The interpretation of the drawing should include considering the geometric shape, Dimensions and associated tolerances, Geometric tolerances, Surface finish specifications, Material, The raw material size. Finally the drawing interpretation should help identify the critical processing factors. These should give some indication of candidate manufacturing processes.

The drawing interpretation is carried out from the perspective of identifying the critical processing factors. In doing so, the drawing interpretation consists of three distinct analyses. That is, geometric analysis, Manufacturing considerations and material evaluation. The output of these analyses is correlated to form a list of critical processing factors. These will then be used for the purpose of identifying the material evaluation and process selection

8. AIMS AND OBJECTIVES

The aim of this chapter is to identify the relevant drawing information that helps the process planner identify critical processing factors as follow:

1) Identity appropriate supplementary information from the drawing to aid the process planning.

2) Identify and interpret dimensional information from the drawing.

3) Identify and interpret geometric information from the drawing.

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4) Identify the critical processing factors for the component from the Dimensional and geometrical information

9. MACHINE SELECTION

After finalizing all the details of Product Design, manufacturing planning is to be carried out. Machine selection is an integral part of manufacturing planning. Machine selection consists of determining the sequence of the individual processing and assembly operations needed to produce the part.

Product manufacturing requires tools and machines that can produce a product economically as well accurately. Economy depends to a large extent on the proper selection of the machine or process for thejob that will give a satisfactory finished product. The selection of the machine is influenced, in turn both quantity of items to be produced. Usually there is one machine best suited for a certain output. However, a special purpose machine should be considered when large quantities of a standard product are to be produced.

Many of the special-purpose machines or tools differ from the usual standard type in that they have built into them some of the skill of the operator. The selection of the best machine or process for a given product requires knowledge of all possible production methods. Factors that must be considered are:

(a) Volume of production (Quantity to be produced) *i.e.*, no. of components to be produced.

(b) Quality of finished product, and

(c) Advantages and disadvantages of the various types of equipment capable of doing the work

10. CUTTING PARAMETER & TOOL SELECTION

Relative motion is required between the tool and work to perform a machining operation. The primary motion is accomplished at a certain cutting speed. In addition, the tool must be moved laterally across the work. This is a much slower motion, called the feed. The remaining dimension of the cut is the penetration of the cutting tool below the original work surface, called the depth of cut. Collectively, speed, feed, and depth of cut are called the cutting conditions. They form the three dimensions of the machining process, and for certain operations, their product can be used to obtain the material removal rate for the process.

Following Cutting parameter need to be designed:

1. Speed(RPM)
2. Feed(mm/min, mm/rev)

Cutting speed for some critical operations provided by casting vendor and for rest of operations we choose cutting speed from tool material. We have used carbide tool so the range of cutting speed and feed should be as follows:

SR.NO	PARAMETER	RANGE
1	CUTTING SPEED	10-100(mm/min)
2	FEED	0.1-0.5(mm/rev)

Feed is an important parameter to select. It impact directly on tool life. As we increase feed/rev, load on tool increase and if tool diameter is less then there are chances of breaking of tool. So always provide low feed/rev to small diameter tool and proportionally high feed per/rev is given to big diameter tool. Ranges of Carbide tool material for feed/rev are as follow.

SR.NO	DIAMETER	RANGE (FEED/REV)
1	10-20	0.1-0.15
2	Greater than 20	0.15-0.25

$Vc= \pi DN/1000$

Where,

Vc = Cutting speed provided by cutting vendor.(mm/min)

d= Diameter of tool.

Feed (mm/rev)=Feed(mm/min)/N(rpm)

Tool selection:

All cutters that are used in milling can be found in a variety of materials, which will determine the cutter's properties and the work piece materials for which it is best suited. These properties include the cutter's hardness, toughness, and resistance to wear. The most common cutter materials that are used include the following:

- High-speed steel (HSS)
- Carbide
- Carbon steel
- Cobalt high speed steel

The material of the cutter is chosen based upon a number of factors, including the material of the workpiece, cost, and tool life. Tool life is an important characteristic that is considered when selecting a cutter, as it greatly affects the manufacturing costs. A short tool life will not only require additional tools to be purchased, but will also require time to change the tool each time it becomes too worn.

We have use carbide tool for machining, because of its following advantage over HSS and COBALT STEEL

1. Hardness is good
2. High resistance to wear
3. Tool life and Feed rate is high as compared to other.

11. CONCLUSIONS

We come to know machine selection and Tool selection heavily impact on the quality of product produced. Operational efficiency is mostly dependent on cutting parameter such as cutting speed and feed. So setting correct speed and feed is important. Carrying out two product on one line ia really a tough job for that we manage the cycle times of machine and following graph shows the exect condition of cycle time

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