

A DETAILED REVIEW ON GENERAL PARAMETERS OF DEVELOPMENT OF PART XL-200

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Abstract : Development of Part XL-200 is a very critical process with designing and manufacturing of types of fixtures, as well as PFMEA, control plan and process flow. Through which important parameters such as safety, support location, failure modes and their effects, controlling actions and also the path of various operations. Objective of this work is to ensure safety achieving efficiency within allowable limits. In industry especially for mass production fixtures play important role. Due to fixture optimum use of available time is possible also workers efficiency increases and reduces fatigue during inspections. For improvement of overall plant efficiency by eliminating errors with the help of PFMEA and control plan. Control plan helps in reducing errors occurring in various processes. This is done by analyzing data and method study. In this paper we are going study various parameters for designing fixtures, General information of PFMEA and control plan.

IndexTerms - Fixture design, PFMEA, Control plan, Process flow.

I. INTRODUCTION

The modern age demands fast production of structures. Production with the help of jigs and fixture is an efficient process where jig provides repeatability, accuracy and interchangeability in the manufacturing process and fixture is used to fix the location of the job. An ideal fixture should not only provide the machining repeatability and high productivity, it should also offer a solution which reduces work piece. Distortion due to clamping and machining forces. Now a day's all manufacturing industries attempts to bring down the manufacturing time and resources. For that purpose they have in search of various types of specific manufacturing systems. Fixtures are one of the mean that it accomplishes this need effectively. Fixture is a special purpose tool which is used to facilitate production (machining, assembling and inspection operations) when work pieces are to be produced on a mass scale. Fixtures provide a means of manufacturing interchangeable parts since they establish a relation, with predetermined tolerances. Once a fixture is properly set up, any number of duplicate parts may be readily produced without additional set up fixtures for holding the work piece in the proper position while machining operations is being done on the part due to which rejection rate is high. Also the time spent in this activity can seriously affect the production. These problems can be overcome by making the performance of fixture. Providing the proper work holding platform is an important issue in any kind of operations performed on the work component. In this way automation has played a vital role in providing a reliable and fast clamping system which will reduce the cycle time of clamping with the increase in accuracy thus decreasing the possible damages to the work piece. The present paper consists of ideology of minimizing the work time and work effort by creating fixtures, as well designed optimum process flow and control plan. This work is related to manufacturing of part XL-200 shown in Fig.1 The industry receives a raw casted product on which various different operations are to be performed to develop the final product with minimum defects, lowest possible production time and highest attainable accuracy.



Fig.1 Raw Casted Part XL-200

1. LITERATURE REVIEW

Tohidia & AlGeddawyb [1] concluded that Designing and fabricating fixtures is a significant portion of manufacturing costs which should be considered in lean manufacturing systems. By increasing products' varieties in today's competitive world, researchers will pay more attention to flexible fixture designs that can handle different workpieces with different geometries. In this paper, a hole pattern modular fixture was used in a mid-volume, mid variety production system in order to hold a variety of geometrically different products in a robotic assembly system. The modular cradle has a hole-pattern on its adapter plate for jiggling-pins to be inserted. Rearrangement of pins enables fixing different product geometries. However, the larger the number of changed pins, the more the productions' lead time increases. In this study, to minimize the total number of pins which have to be changed to fix different parts, an optimization model was developed to determine the best locations for placing different products on the cradle and the best locations for inserting pins or fix them. This model enables the system to take all the possible parts' translations and rotations into consideration. To evaluate the performance and to prove the efficacy of the proposed models, three different numerical examples with different sizes were solved. The results state that the model can significantly reduce the number of pins' replacements, which reduces the fixture's associated time.

Förstmann et al.[2] concluded that the result of shorter product lifecycles and faster, more agile approaches for product development, production planning is facing the struggle of developing manufacturing resources with higher quality and greater variety in a shorter time frame in order to reach time, cost and quality goals. The approach presented in this paper aims to provide a fixture concept which is developed with the objective of being an automatable design. By use of design rules which allow to be implemented in algorithms, the design freedom of additive manufacturing and construction kit elements, potentials for providing manufacturing resources arise. Next steps include the development of the underlying algorithms and the implementation of this approach into a software tool. Further research needs to be conducted regarding the transfer of this approach to more complex fixtures like those used for milling.

Konguraja & Gobi [3] concluded that the result on the utilization of service FMEA in supply chain operation. The motivating factors for these companies to apply quality control come internally from the management and parent company or externally from customer. The objective of this paper is to guide facility managers through the Failure Mode, Effects and Analysis (FMEA) process, directing them how to apply this type of analysis to command, control, communications, Computer intelligence, surveillance and reconnaissance (C4ISR) facility. Road map is given to identify the potential design and process failures before they occur and to minimize the risk of failure by either proposing design changes or proposing operational procedures. Identify the equipment or subsystem, To access risk or the likelihood of significant trouble shoot problems. Once the investigation of the sub processes are completed, performance measures can be quantified and suggestions for change in process. By implementing FMEA failure reduced thereby rework eliminated and delivery improved which affects productivity of company.

3. FIXTURE

A fixture is a device for locating, holding and supporting a work piece during a manufacturing operation. Fixtures are essential elements of production processes as they are required in most of the automated manufacturing, inspection, and assembly operations.[1]

a. General Requirements of a Fixture:

- **Deterministic location:** - A work piece is said to be kinematically restrained when it cannot move without losing contact with at least one locator.
- **Total constraint:** - A work piece should be fully constrained at all times to prevent any movement. Clamps should provide locking forces to hold the work piece in place -once it is located.
- **Contained deflection:** - Work piece deformation is unavoidable due to its elastic/plastic nature, and the external forces impacted by the clamping actuation and machining operations.
- **Geometric constraint:** - Geometric constraint guarantees that all featuring elements have an access to the datum surface.

b. Fixture Design Fundamentals:-Fixture design consists of a number of distinct activities: fixture planning, fixture layout design, fixture element design, tool body design, etc.

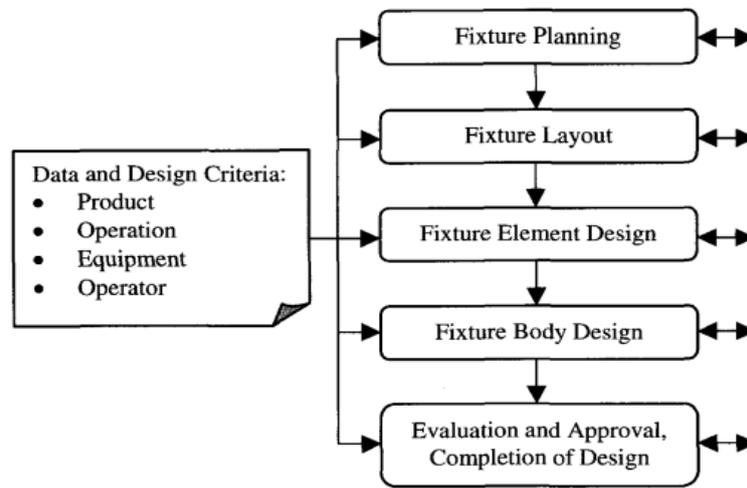


Fig.2 Various Aspects of Fixture Design[1]

c. Fixture Design Criteria: - The following design criteria must be observed during the procedure of fixture design:

- Design specifications
- Factory standards
- Ease of use and safety
- Economy

d. Locating Principles :- One of the principal purposes of a machining fixture is to locate the workpiece surfaces for performing a machining operation. This is usually done with respect to a number of factors to be considered such as the reference datum, supporting surfaces, features that are likely to obstruct the tool movement or access direction, etc.

e. Restrictions on the Degrees of Freedom of a Work piece :- For prismatic parts, the general principle of 3-2-1 location is most commonly employed. For achieving greatest stability, the first three points of location on the primary surface should be as far apart as possible, or the area enclosed by the three points as large as possible. **For larger cast work pieces, the 4-2-1 locating principle** is frequently used.

Clamping Principles:- In every machining operation, clamping of workpieces is an essential requirement. A clamp can be defined as a device for providing an invariant location with respect to an external loading system. In other words, the process of clamping induces a locking effect which, through frictional or some other forms of mechanism, provides a stability of location which cannot be changed until and unless external loading is able to overcome the locking effect.

4. PROCESS FLOW :- It is a type of diagram that represents an algorithm, workflow or process. Flow charts use special shape to represent different types of actions or steps in a process. Lines and arrows show the sequence of the steps and the relationships among them. Process flow diagram is commonly used in process engineering to indicate the general flow of plant processes such as operation, inspection, delay, transportation and storage.

It provides the chronological sequence of all the operations and inspections that occur in manufacturing process. It also shows materials used and the time taken by the operator for different elements of work.

Uses:

1. Improved plant layout.
2. for specifying the basic manufacturing system.
3. To introduce manufacturing system to new technical personnel.
4. for determining the sequence of assembly.

5. CONTROL PLAN:-

Control Plan provides the operator or inspector with the information required to properly control the process and produce quality parts or assemblies. The use of Control Plans helps reduce or eliminate waste in a process. Businesses today must reduce waste everywhere possible. The Control Plan improves product quality by identifying the sources of variation in a process and establishing controls to monitor them. Control Plans focus on the product characteristics most important to the customer and the business. By focusing on what is critical to quality during the process, you can reduce scrap, eliminate costly reworks and prevent defective product from reaching the customer. Manufacturing efficiency is improved and your company's bottom line is impacted in a positive manner. It is a plan developed by the team to control the process and ensure the process produces quality parts that meet the customer requirements.

6. PROCESS FAILURE MODE AND EFFECT ANALYSIS:-

Process Failure Mode and Effects Analysis (PFMEA) looks at each process step to identify risks and possible errors from many different sources. The sources most often considered are:

- Man
- Methods
- Material
- Machinery
- Measurement
- Earth (Environment)
- Process FMEA identifies potential process failure modes by ranking failures and helping to establish priorities according to relative impact on the internal and external customer.

The PFMEA also tracks improvements through Risk Priority Number (RPN) reductions. By comparing the before and after RPN, a history of improvement and risk mitigation can be chronicled.

Stages of FMEA documentation:

1. Specifying possibilities.

- Functions of products.
- Possible failure modes.
- Root causes.
- Effects.
- Detection and preventive ability of failure.

2. Quantification of risk.

- Severity of effect.
- Occurrence of failure (probability of cause).
- Reflection (effectiveness of control prevent cause).
- Risk priority number (RPN).

3. Correcting high risk causes.

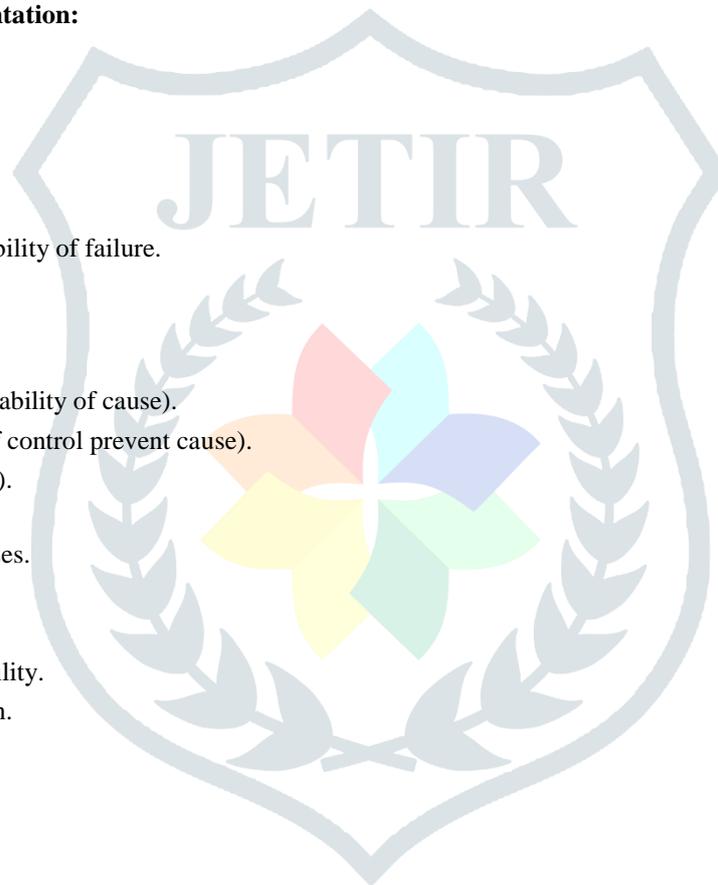
- Prioritizing work.
- Detailing action.
- Assigning action responsibility.
- Check points on completion.

4. Re-evaluation of risk.

- Re-evaluation of RPN.

7. METHODOLOGY:

1. Group formation and site visit.
2. Project statement definition.
3. Study of various parameters related to fixture design, control Plan, PFMEA and material properties.
4. Design and validation of fixtures, PFMEA and control plan.
5. Implementation and changes according to report.
6. Generation of report, Report validation by institute.



(A). **Design of Fixture:-** As per requirement, we decide the layout of fixture two for holding and one for checking in order to achieve precise manufacturing of part with less fatigue and high production rate. While designing the fixtures mainly our approach are likely to minimize the standard time and increase the inspection rate which is achieved by simple structure of plates, dwell pins and clamps. Selection of material for both fixtures play important role as various types of steels are available in market by considering hardness values, compositions and properties we select EN-31 (53-60 HRC) for checking & EN-8 (30-35 HRC) for holding if any case design of part will be changed so we will machine and modify the holding fixture.

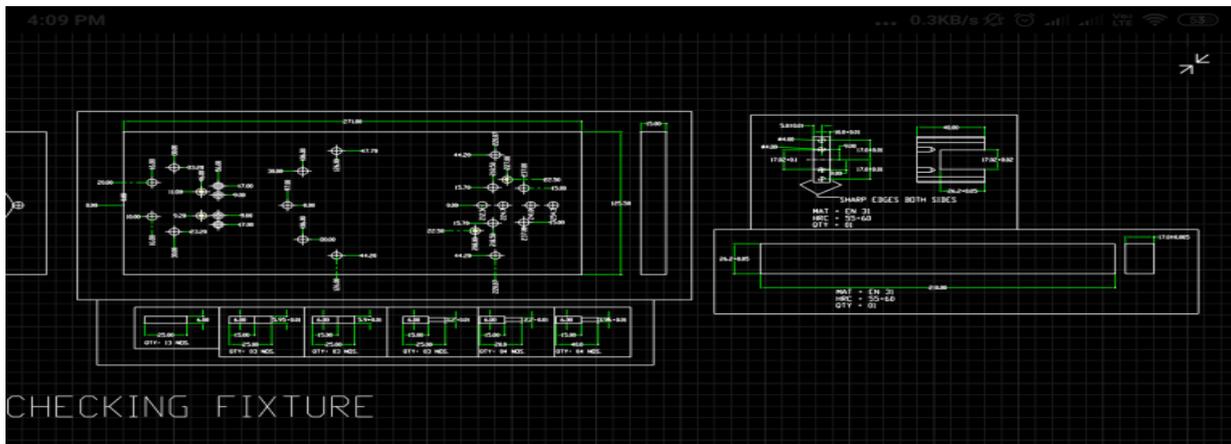


Fig 3 Checking Fixture in AutoCAD

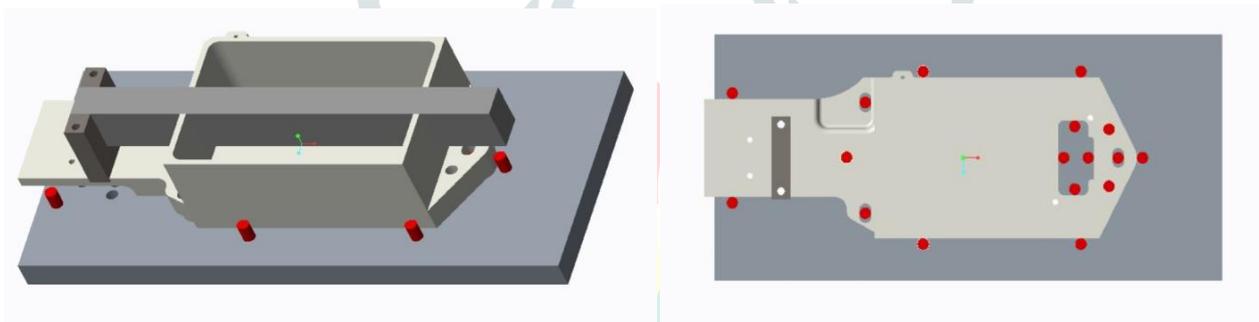


Fig 4 Assembly of Fixture & Part (Box Application)

(B) **Process Flow :-** In industry, we make process flow diagram for better understanding of process, by making this we standardize a process for optimal efficiency and repeatability. It helps to eliminate the unnecessary travels of material, bottlenecks and other inefficiencies and model a better process flow. with the help of symbols it make easy to understand the path and sequence of operation of product.

PROCESS FLOW DIAGRAM							MACHINE(s) / EQUIPMENT(S) USED	CYCLE TIME (hr:min:sec)	LOADING/UNLOADING TIME (min:sec)
Part No.:	100333								
Part Description:	Part XI-200								
Rev. No.	7								
Process No.	Activity	Symbols							
		Opr.	Inspect.	Deci.(wait)	Transport	Store			
10	Raw Material Receiving						Storage Racks		
20	VMC 1st set up	●	■				VMC Machine	01:54	01:00
30	VMC 2nd set up	●	■				VMC Machine	01:45	01:00
40	VMC 3rd set up	●	■				VMC Machine	03:33	01:00
50	VMC 4th set up	●	■				VMC Machine	14:11	01:00
60	VMC 4th set up	●	■				VMC Machine		
70	VMC 5th set up	●	■				VMC Machine	02:45	01:00
80	VMC 6th set up	●	■				VMC Machine	12:10	01:00
90	VMC 7th set up	●	■				VMC Machine	09:25	01:00
100	VMC 8th set up	●	■				VMC Machine	20:41	02:55
110	VMC 9th set up	●	■				VMC Machine	01:10	01:46
120	VMC 10th set up	●	■				VMC Machine	02:48	01:40
130	VMC 11th set up	●	■				VMC Machine	03:25	01:00
140	VMC 12th set up	●	■				VMC Machine	01:30	02:00
150	Deburring & Polishing	●	■				Pnumatic sander & Files	05:30	
160	Inspection Before Chromotising	●	■				Inspection Instruments	05:00	
170	Chromotising	●	■				Outsourced		
180	Masking	●	■				Masking Tape, files	10:00	
190	Black Powder Coating	●	■				Outsourced		
200	Removal of Masking & Part Cleaning	●	■				Manually	02:00	
210	Inspection & Re-tapping .Reaming	●	■				Reamer, Tap, Measuring Instruments	14:30	
220	Cleaning & packing	●	■				Colin Spray, Cotton	10:00	
230	Dispatch				●		As Per Schedule		
		21	22			1		02:03:28	16:21
Prepared by: CFT							Approved by : Abhay Naik		

Fig 5 Process Flow Diagram

(C) Control Plan :-In order to keep a efficient hold on the PFMEA a process needs a control plan.The team designed a control plan for the production process.Every failure mode is taken into consideration in the control plan, process parameters, tools required for the inspection, mode of inspection and recommend essential corrective actions, etc points were covered in our control plan related to the part.It helps to reduce scrap, labour fatigue and hyped the economic growth of industry.The production cycle becomes easier with the reference of control plan as solution and reason behind every failure mode is designed recovery optimistically.

(D)RESULT:-**FOR HOLDING FIXTURE: -**

PARAMETER	BEFORE IMPLEMENTATION OF FIXTURE	AFTER IMPLEMENTATION OF FIXTURE
LOADING/ UNLOADING TIME	MORE(26.11 min/job)	LESS(16.21min/job)
MACHINE SAFETY	LESS	MORE
PRODUCTIVITY	LOW	HIGH
ACCURACY IN WORK	LESS	MORE
INITIAL COST	LESS	MORE

FOR CHECKING FIXTURE: -

PARAMETER	BEFORE IMPLEMENTATION OF FIXTURE	AFTER IMPLEMENTATION OF FIXTURE
INSPECTION TIME	MORE (approx. 44 min/job)	LESS (approx. 5 min/job)
SKILLED WORKER	REQUIRED	NOT NECESSARY
INSPECTION QUALITY	LOW	HIGH
ACCURACY IN WORK	LESS	MORE
OPERATING COST	MORE	LESS
FATIGUE TO OPERATOR	MORE	NEGLECTIBLE

8. CONCLUSION :- By making the fixtures we reduce cycle time for checking as well as holding also minimizes the fatigue of worker to check the critical dimensions of part after that implementation of the process flow chart the shop floor staff achieved the target of cycle time reduction and optimum utilization of the working space and available resources, this in turn helped the staff to control the production parameters using control plan. For further elimination of the potential failure modes the progressive work on PFMEA is ongoing and the objective will be archived.

REFERENCES

- [1] Ossein Tohidia, Tarek AlGeddawyb Coordinative Generation of Machining and Fixturing Plans by a Modularized Problem Solver, CIRP Annals-Manufacturing Technology, 1998, 47(1), pp. 437-440.
- [2] R. Förstmann; J.Wagner a; K. Kreisköther a; A. Kampker a; D. Busch, A functional approach for the formalization of the fixture design process, International Journal of machine tools and manufacture, 46, 2006, 683–697
- [3] G.Konguraja & K.Gobi, "Implementation of process failure mode effect analysis (PFMEA) in a small and medium scale pump industry." International Journal of Scientific Engineering & Applied Science (IJSEAS) Volume 1, Issue 9, December 2015 ISSN 2395-3470.
- [4] N. P. Maniar, D. P. Vakharia, "Design & Development of Fixture for CNC –Reviews, Practices & Future Directions" International Journal of Scientific & Engineering Research Volume 4, Issue 2, February-2013 ISSN 2229-5518.
- [5] Amir Shekhari, Soheilfallahian, Improvement of Lean methodology with FMEA POMS 18th Annual conference Dallas, Texas, U.S.A May 4 to May 7 2007.
- [6] Janki ram, M. & Keat J.B. International Journal of Reliability, Quality & safety Engineering The use of FMEA in process quality improvement, Volume 2, Issue 1, pp,103-115(1995)