

Design of Manufacture of Fixtures for CNC Machine To Improve Productivity by SMED Concept

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ABSTRACT- The competition in the current business world is marked by torridity demonstration and severe disputation. This agitated situation has made organizations to refresh themselves by marching in different ways like Lean, TPM, TQM etc. to keep them competitive in the market as well to achieve their objectives positively. From the SMED study carried on the CNC machine, it was studied that only few portion of the setup time can be reduced by detaching and transforming the internal operations to external operations. The study of implementation of SMED methodology and propose a set of solutions, gives the optimum sequence, time saving etc. the new proposed fixture designed for plug shell.

Key Words: *changeover reduction, SMED concept, FMEA analysis, productivity Improvement, internal and external functions, Quality Tools etc.*

1. INTRODUCTION

A. Setup reduction

Setup is a set of activities to prepare for the next part to be produced. Setup time is total elapsed time from Completion of the good part from the previous setup to the first good part from the new setup. Set-up reduction is a kind of theory and method to reduce the setup time.

B. SMED (single minute exchange of die)

SMED, also known as Quick Changeover of Tools, was developed by Shingo (1985), who characterized it as scientific study for the reduction of setup times, and which can be applied in any industrial unit and for any machine. SMED is defined as the minimum amount of time necessary to change the type of manufacture activity taking into thought the instant in which the last piece of a previous batch was produced or the first part is produced by secondary operation. The objective of SMED is to try to separate internal Operations to the external operations.

Ramp down time Run down period is the time between the end of a lot production till the batch quantity is completed.

Setup Time Setup time is the non production time in which change over takes from one part to another.

Ramp uptime The time between setup is completed and the full production is achieved.

Single Minute Exchange of Die (SMED) emphasizes on setup time reduction to single minute. The need of SMED is mandatory due to increased demand for variable products and reduced product life cycles. It helps the company to keep reduced inventory and effective utilization of the equipment. SMED study has to be started up with complete process map and time study. It needs analyze everything that occurs during the changeover to understand the possibilities of actions that can be moved outside the changeover casement. Non worth added activities has to be eliminated or to be converted to external If an internal activity is predictable, it has to be simplified with the help of jigs, fixtures etc. accomplishment of SMED starts from identifying the change over process and categorization it into internal and external activity.

Internal activity Activities that are done after stopping the machine.

External activity Operations that can be done without stopping the machine. focus should be on optimizing external activities. Maintaining of 5S is important at each level of implementation.

2. OBJECTIVE OF PROJECT

- To propose the new fixture design that can solve the problem.
- To reduce setup time.
- To improve productivity.
- To improve awareness to customer demand.

3. PROBLEM STATEMENT

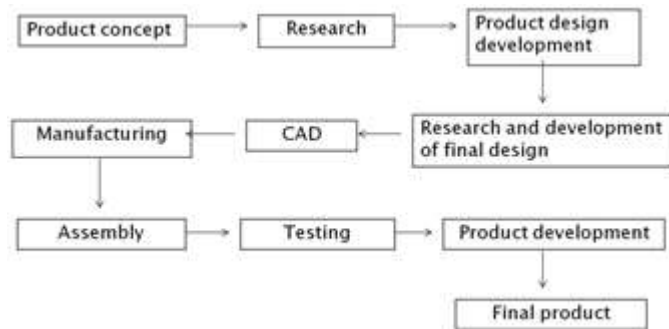
- Higher setup time between parts from similar family of the same part.

- Based on customer demand, most of them want the suppliers to deliver the product right after the order is valid.
- Ovality due to clamping method.

- Outer diameter (D1)=55mm
- Inner diameter (d1)=46mm
- Thread length =25mm
- Outer diameter (D2)=37mm
- Inner diameter (d2)=25mm
- Length of lock nut=60mm

4. METHODOLOGY:

The methodology of the project has been simply explained by following flow diagram. From product concept to final product.



5. DESIGN:

First step in designing fixture is material selection. As mild steel have good tensile strength and corrosion resistance and other significant properties.

- A)Material selection:

Material: Mild Steel

Properties:

- Carbon=0.16 to 0.18%
- Manganese=0.7 to 0.9%
- Silicon=0.4%
- Sulfur=0.04%
- Phosphorous=0.04%
- Modulus of elasticity = 210 GPa
- Density = 7860 kg/m³
- Melting point = 1600^oC

5.1 Dimension

The following dimensions of different parts of new fixture have been taken according to the FEA analysis and type of job size

- ▶ Arbor body:
 - Outer diameter (D1) =160mm
 - Outer diameter (D2)=130mm
 - Tapper diameter(D3)=90mm
 - Taper angle =60 degree
 - Outer diameter of thread =48mm
 - Inner diameter of thread =46mm
 - Thread length =13mm
 - Length of body =180mm

- Lock nut :

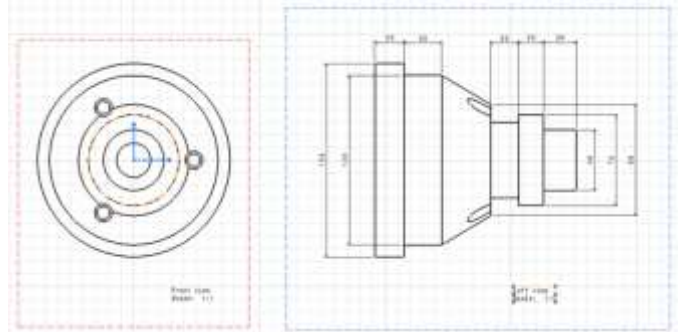


Fig 1. Drafting of Arbor Body

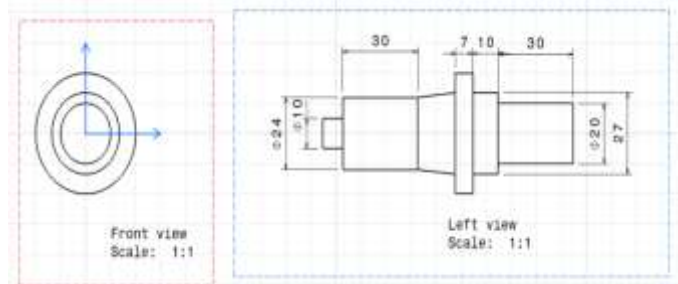


Fig 2. Drafting of Arbor

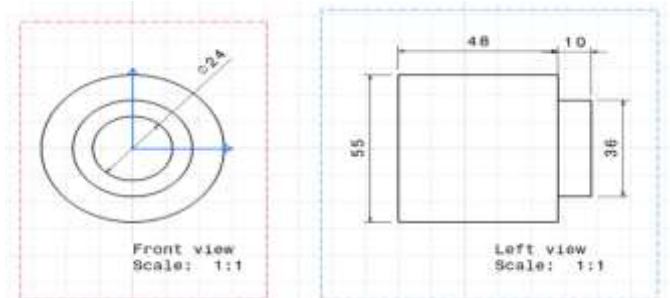


Fig 3. Drafting of Lock Nut

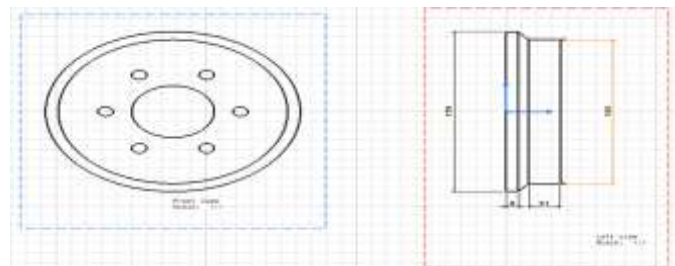
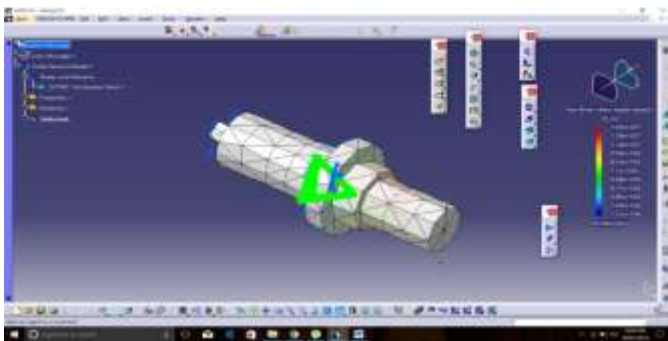
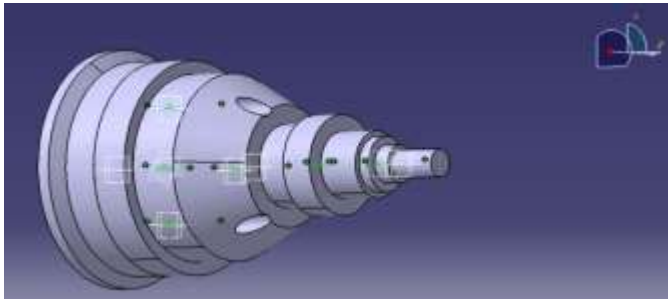


Fig 4. Drafting of Back Plate

After drafting of all parts of fixture, its assembly is done in 3D CAD software which have been shown in the following picture:



After assembly of whole parts. We studied various stresses and its effects, bending moments, deflections, strength, factor of safety etc. and had taken corrective action against them

After all, we started manufacturing of parts one by one as follows:



Assembly of proposed fixture



Fig 5. CNC machine



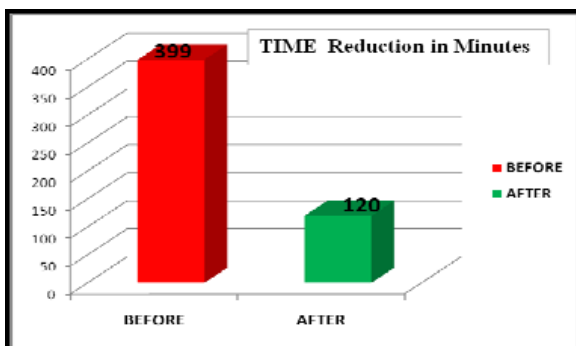
Fig 6. Fixture mount on CNC machine



Fig 7. Old fixture

6. POSSIBLE OUTCOMES

A lot of time was wasted in changing of the fixture, changing the clamping stud and zero dialing it. All this time which was shattered is now saved with the recently designed fixture by reducing the no of settings .It can be concluded that the amount of saving to the company is considerable in terms of time and money.



7. RESULTS

Table 1: Set up time reduction (minutes)

Sr. No.	Setup time before implementation of SMED (min)	Setup time after implementation of SMED (min)	Set up time reduced (min)	Set up time reduced (%)
1	200	95	105	52.5

As a result, the setup time has been reduced from 200 minutes to 95 minutes. Hence 105 minutes has been saved for one setup and 52.5 % Setup change time has been reduced due to successful implementation of SMED methodology in a CNC machine. It is shown in above Table.

Table 2: Numbers of Jobs before and after implementation of SMED

Sr. No.	Total no of Jobs before implementation of SMED	Total no of Jobs after implementation of SMED	Total no of Jobs increased due to implementation of SMED
1	300	380	80

Table shows the improvement of productivity of CNC machine due to successful implementation of SMED

8. CONCLUSIONS

- It facilitates a fast and effective way of converting a manufacturing process from first product to the last product.
- It can be conclude that the amount of saving to the company is considerable in terms of time and money.
- The implemented fixture will satisfy researcher production goal and increase the efficiency.
- It reduces the set uptime and increases the productivity.

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