Fabrication of Fixture for Machining Grooves on an Electrical Actuator Cover on HTC-600 Horizontal Machine Centre

Mr. S. Mathivanan[1], Adhithya Sylesh[2], S. Akash[3]
1-Assistant Professor,
2,3- Student,
Department of mechanical Engineering
Hindusthan Institute of Technology, Coimbatore

Abstract:- **The main idea of the project is to fabricate a fixture for machining grooves on an Electrical Actuator (E.A) cover plate on HTC-600 horizontal machining centre. The fixture aims at reducing machining time with the increase in accuracy and precision throughout the machining process. Where A fixture is a work-holding or support device used in the manufacturing industry. Fixtures are used to securely locate (position in a specific location or orientation) and support the work, ensuring that all parts produced using the fixture will maintain conformity and interchangeability.**

INTRODUCTION

Increasing the productivity and accuracy are the two basic aims of mass production. As we know the solution to this is by reducing the set-up cost of the machine and also reducing the manual fatigue. In this case the device that caters our needs is the use of jigs and fixtures. Let us take one example. Accuracy is the main problem in such cases. Hence using of fixtures to position is preferred rather than using scribers, square, straighteners or centre punch etc. Thus the productivity is increased which is done by eliminating individual positioning, marking and frequent checking. Interchangeability is the chief advantage here.

ACTUATORS

A hydraulic or pneumatic system is generally concerned with moving, gripping, or applying force to an object. Devices which actually achieve this objective are called actuators. The actuator can be of linear or rotary type.

FIXTURE

A **Fixture** is a work-holding or support device used in the manufacturing industry. Fixtures are used to securely locate (position in a specific location or orientation) and support the work, ensuring that all parts produced using the fixture will maintain conformity and interchangeability.

IMPORTANT CONSIDERATIONS WHILE DESIGNING JIGS AND FIXTURES

Designing of jigs and fixtures depends upon so many factors. These factors are analysed to get design inputs for jigs and fixtures. The list of such factors is mentioned below:

a) Study of workpiece and finished component size and geometry.
b) Type and capacity of the machine, its extent of automation.
c) Provision of locating devices in the machine.
d) Available clamping arrangements in the machine.
e) Available indexing devices, their accuracy.
f) Evaluation of variability in the performance results of the machine.
g) Rigidity and of the machine tool under consideration
h) Study of ejecting devices, safety devices, etc.
i) Required level of the accuracy in the work and quality to be produced.

FIXTURE ELEMENTS

1. BASE

Base plate is the solid flat surface of the fixture. It is the horizontal surface which holds the fixture, and equally levels the fixture at right angles. The base plate is basically a square or rectangular thick metal piece flat at both ends. The surface plate is often used as baseline for measurements.

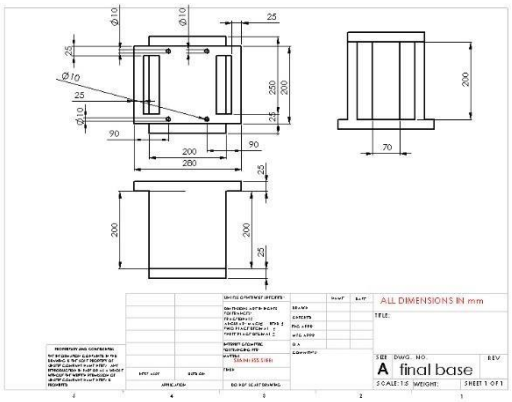

Fig 1-Orthographic view of base

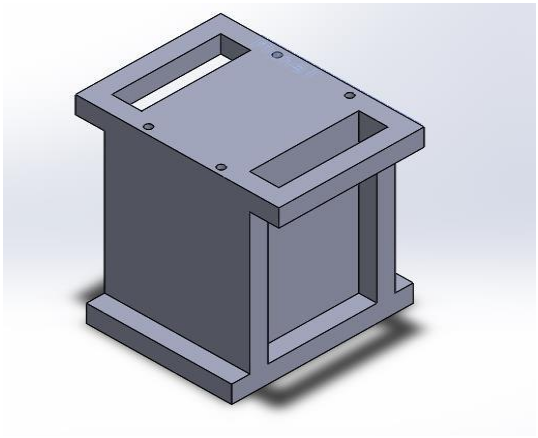

Fig 2- Three dimensional view

2. WORK HOLDING FRAME

The work holding frame is the most important part of the fixture. It holds the work piece rigidly in place for quick loading and machining of the work piece. Frame is a square structure which is welded together in the correct dimensions of the work piece. The frame holds the work piece without shaking it during machining.

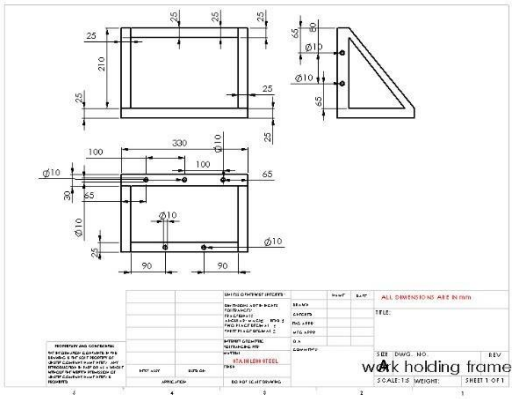

Fig 3-Orthographic view of work holding frame

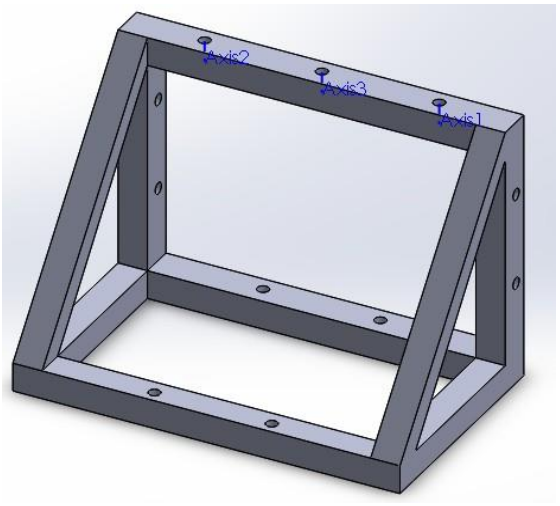

Fig 4- Three Dimensional view

ASSEMBLED FIXTURE

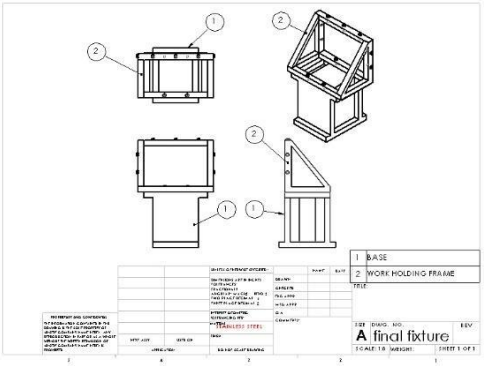

Fig 5- Orthographic view of fixture

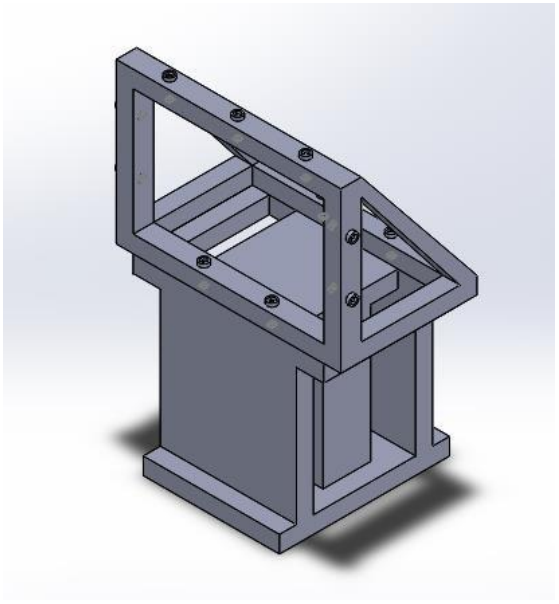

Fig 6- Three Dimensional view

MACHINING SEQUENCE

1. Initially base plate machining operations are carried out.

2. The four supporting blocks are milled

to the required size and are surface grounded.

3. Followed by chamfering operation on four supporting blocks were done.

4. Proper fabrication of base plate and frame supporting blocks are performed by welding technology.

5. Cast iron are cut into required dimensions.

6. To ensure the fool-proofing drilling operation are carried out in the work holding frame.

7. Tapping operation are performed on the drilled holes for the smooth functioning of fasteners.

8. There after fabrication of workpiece holding frame is carried out by welding technology.

9. The welded parts are grounded.

10. Assembly of work holding frame and base block were done by using fasteners.

CALCULATION

$$T_C = L_C / S_M$$

Where,

L_C=Total length of travel of the job

$L_C = L_W + A + O + D_C/2$

L_W =Length of the workpiece A,O=Approach and Over Run (5 to 10 mm)

D_C=Diameter of the cutter, mm S_M=Table Feed, mm/min

$S_M = S_O * Z_C * N$

Where S_O=Feed per Tooth, mm/tooth Z_C=No of teeth of the cutter N=Cutter speed, rpm

CALCULATION OF MILLING TIME IN NC MACHINE (HTC 600)

$T_C = L_C / S_M$

T_C=Time taken for cutting Where,

L_C=Total length of travel of the job

$L_C = L_W + A + O + D_C/2$

L_W =720 mm A,O=2 mm

D_C =63 mm

$L_C = 720 + 2 + 2 + (63/2)$

$L_C = 755.5$ mm $S_M = S_O * Z_C * N$

S_M=Table Feed, mm/min Where

S_O=0.5, mm/tooth

Z_C=8

N=750, rpm

$S_M = 0.5 * 8 * 750$

$S_M = 3000$ mm/min

$T_C = L_C / S_M$

=755.5/3000

T_C =15.11 sec

CALCULATION OF GROOVING TIME IN NC MACHINE (HTC 600)

$T_C = L_C / S_M$

T_C=Time taken for cutting Where,

L_C=Total length of travel of the job

$L_C = L_W + A + O + D_C/2$

L_W =661 mm A,O=2.7 mm D_C =4.7 mm

$L_C = 661 + 2.7 + 2.2 + (4.7/2)$

$L_C = 669.35$ mm $S_M = S_O * Z_C * N$

S_M=Table Feed, mm/min Where S_O=0.5, mm/tooth

Z_C=2 N=1000, rpm

$S_M = 0.5 * 2 * 1000$

$S_M = 1000$ mm/min

$T_C = L_C / S_M$

=669.35/1000

T_C =40.161 sec

COST ESTIMATION

Sl No	Cost Associated	Cost
1	Material cost a) 50kg-Stainless Steel b) Welding electrodes	 2000 2070
2	Machining cost **Milling Machine** a) Base(3 hr) b) Supporting blocks(12 hr) c) Top base plate(3) d) Work holding frame(10 hr) e) Side cross (6 hr) **Drilling Machine**	 13600 800
3	Total cost	18470

CONCLUSION

After design and fabrication of the fixture we found that, the machining time for cutting the groove on the actuator cover when compared with the conventional machining process (without using a fixture) is 30 minutes slower than the unconventional machining process (with fixture).

It is found that without a proper fixture the time taken to machine the groove is about 45 minutes, and with a proper fixture the taken for machining is about 25 minutes,

20 minutes less than what was require earlier.

Hence it was found that with the use of a proper fixture, the machining time is decreased by about 20 minutes.

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