

# Research Paper on Productivity Improvement in Rear Header of Scorpio

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**Abstract**— The project title is “Productivity Improvement in Rear Header of Scorpio”. The project is based on the process of ‘Spot welding’ which is used in the assemble Mahindra Scorpio rear header part. In Mahindra CIE Automotive Nasik Welding of DG0020N takes place at the sub assembly shop. The DG0020N part is the product of welding together two parts. Whenever there is a welding operation, resistance spot welding is used. It aims at developing a pneumatic system in place of a manually operated system to reduce cycle time and operator fatigue of the process and quality of the product. The previous process is completely dependent on the operator’s judgment, which makes it prone to many defects. It is also possible that these defects are not detected visually on the quality checks, but reduce the life of the weld. Aim of this Project is to replace existing traditional hand clamps by pneumatic clamping system. This reduces the time and subsequently increases productivity and reduces operator fatigue.

**Key words:** Scorpio, Spot Welding, Pneumatic System, Productivity, Rear Header

## I. INTRODUCTION

The title of project is “Productivity Improvement in Rear Header of Scorpio”. The project is associated with automatic clamping of the assembly device comprising of spot welding process. The process has several advantages compared to conventional techniques that are usually practiced in the company. It is technology used for application of advance mechanical systems in combination for betterment of processes, manufacturing and control systems. The design accounts for increased safety for the entire operation, increased productivity, flexibility, workers fatigue, effectivity and reduction in consumption of time.

The Mechanism is basically designed by taking in to account the clamping that is required to be hold the part. The Parts required to be assembled are mounted on the mechanism and then clamped using air operated toggle clamps. Then welding operations are performed and finally the assembled part is unclamped and unmounted. This project thus increases productivity by reducing cycle time and reduces operator fatigue by reducing his motion. Finally, project covers the cost analysis which resembles the future expansions as well as scope.

## II. PROBLEM STATEMENT

In the previous conventional process of spot welding, the parts required to clamped for the complete process. For this purpose, toggle clamps are used which are actuated manually. There is much time required of those clamps to get clamped. In this process, one worker is required, who first mounts the parts then clamp them performs spot welding then manually unclamps the part. For the purpose of welding he will have to

walk almost complete round of Mechanism. Time required to complete this process is more.

## III. CYCLE TIME ANALYSIS

Following table shows time required for existing system which is noted by using stopwatch.

Reading no.	t1 (sec)	t2 (sec)	t3 (sec)	Cycle time (sec)
1	6.59	5.73	8.18	90.15
2	6.84	6.12	8.05	93.06
3	7.02	6.06	8.20	92.17
4	6.92	6.09	8.06	92.88
5	7.12	6.17	7.86	94.84
Average	6.89	6.03	8.07	92.82

Where,

t1= time required for manual clamping

t2= time required for operator movement and rotation of gun

t3 = time required for manual unclamping

t4= time required for clamping and unclamping using pneumatic actuators

These times t1, t2, t3 are unwanted and can be reduced by using pneumatic actuators.

Reduction in cycle time = [current cycle time - (t1+t2+t3) + t4]

= [93 - (21) + (3 to 6 sec)]

=72 + (3 to 6 sec)

By above calculations it can be seen that by using pneumatic actuators we can reduce cycle time by 15 to 18 sec.

## IV. METHODOLOGY

To eliminate unnecessary operations and to achieve best method of performing the operations procedure, method study is very much standardized which is discussed as follows.

- 1) Select:- select approximate job or process based on economic and cost effective consideration, technical consideration and human consideration.
- 2) Record: - Record all relevant data about the job of process using most suitable data collecting techniques so that data will be more convenient form to be analyse later.
- 3) Examine: - recorded all fact are analysed critically and challenge everything to be done which include purpose of activity place where it is perform sequence in which it is done, person who is doing it and time required for completion of activity.
- 4) Develop:- develop most economical method taken into account all the circumstance such as contribution of manager supervisor worker and other specialist
- 5) Evaluate: - Evaluate result attend by improve method, compared with quality of work involved and calculate stander time for it.

- 6) Define: - Define new method and related time to present it to all those concerned either verbally or in writing using demonstration
- 7) Install: - Install new method provide necessary training to those involve has an agreed practice with allocated time of operation to be carry out.
- 8) Maintain: - maintain new stander practice by monitoring the result and compare them with original target.

## V. SOLUTION

Taking into account all above disadvantages of conventional method we came to the conclusion that this method should be modified. For spot welding process it is necessary to clamp the parts. It is found that, there are two main constrains which comes under the process, first is the parts should be properly clamped and second is it clamps should stay firm throughout the process.

We decided to make the clamping mechanism that should satisfy above two conditions. There are two alternative solutions in front of us, these are

- 1) Hydraulic operated clamping mechanism, but hydraulic system is bulky and time consuming.
- 2) Pneumatically operated clamps which are compact and easy to use.

Due to the drawbacks in the first solution, the second solution outweighs the first for following reasons,

- 1) Availability of compressed air.
- 2) Pneumatic system is compact as compared to hydraulic system.
- 3) Similar methods are used before on other assembly stations so it will a good asset as a reference point of view. Thus we finalized this mechanism.



## VI. DESIGN OF PNEUMATIC ACTUATOR

Pneumatic actuators are the devices used for converting pressure energy of compressed air into the mechanical energy to perform useful work. In other words, Actuators are used to perform the task of exerting the required force at the end of the stroke or used to create displacement by the movement of the piston. The pressurized air from the compressor is supplied to reservoir. The pressurized air from storage is supplied to pneumatic actuator to do work.

## A. Calculations for bore and stroke of pneumatic actuators

### 1) Available data:

Inlet pressure: - 6 bar

Required clamping force: - 820 N {source: company data}

As we know,

$$F = P \times A$$

$$A = F / P$$

$$= 820 / (6 \times 1.013 \times 10^5)$$

$$= 1.34 \times 10^{-3} \text{ m}^2$$

$$\text{So, } D = 41 \text{ mm}$$

Hence, selecting nearest standard size for actuator bore which is 40 mm.

From clamping mechanism required stroke size is 100 mm.

Now we have to select an actuator with bore = 40 mm and stroke = 100 mm and working pressure = 6 bar.

## VII. RESULT

Comparison of Old system and New System:

Total Available Time

Shift duration = 8 hours = 480 min.

Lunch time = 30 min.

Tea time = 07 min.

Total available time = 443 min.

Cycle Time

1) Old system= 93 sec. = 1.55 min. ( From table 1.1)

No. of parts assembled by old system = (Available time / Cycle Time)

$$= (443 / 1.55)$$

$$= 285 \text{ parts per shift}$$

2) New system

From page no. 43 & 44, Piston Speed = 80 mm / sec Piston stroke = 100 mm

Time required for clamping, rotation, Unclamping =  $1.25 \times 4 = 5 \text{ sec}$ . Cycle time = [Cycle time - (t1+t2+t3) + (t4) ]

$$= [ 93 - ( 21 ) + ( 5 ) ]$$

$$= 77 \text{ sec.}$$

Here,

t1= Time required for manual clamping

t2 = Time required for operator movement and rotation of gun

t3 = Time required for manual unclamping

t4= Time required for clamping, rotation and unclamping by pneumatic actuators

No. of parts assembled by new system=  $395 / 1.2833 = 308$  parts per shift

### A. Increase in Productivity

$$\% \text{ increase in productivity} = ((308 - 285 / 308) \times 100) = 7.467 \%$$

## VIII. CONCLUSION

We were given an opportunity to undergo a project titled "Productivity Improvement in Rear Header of Scorpio (DG0020N) part". As per company's requirement, we were supposed to simplify the spot welding procedure by avoiding manual clamping and unclamping of parts and minimize the required time for both processes also it was required to increase spot weld quality by orthogonal engagement of spot welding gun with part surface.

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