

# PRODUCTIVITY IMPROVEMENT ON FILTER DRIER COMPONENT BY REDUCING CAP ASSEMBLY CYCLE TIME

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## ABSTRACT

*The manufacturing of filter drier Component involves the following processes. Cleaning of components (Washing), Brazing the Filter Cup with Bronze Ring (Furnace), Core assembly, Plasma welding, Leak Testing, Cap assembly. The overall output of the Filter Drier component is 820 numbers per shift. Due to the market demand customer requirement increased to 1200 numbers per day. But company unable to achieve the customer requirement in present condition. Cycle time study done for each process of the Filter Drier manufacturing and found that more time (33 Seconds) taking process is the Cap assembly. Then further cap assembly activities were studied the activities are applying rust preventive oil, cap insert, clamp the component in the fixture, apply the torque in one side, rotate the fixture by 180 degrees, apply the torque at another side. In the above said activities there is some unwanted activities present in the cap assembly. The activities are clamping the filter in the fixture, rotate the fixture, applying the Torque in another side and unclamp the component from the fixture. These activities are eliminated by implementing new fixture and designed a new fixture to apply torque on both sides of the component in a single setting also there is no need of clamping and unclamping.*

**Keywords:** Cycle time, cap insert, clamp, fixture, align cap screw, V-block

## 1. FILTER DRIER MANUFACTURING PROCESS

The filter drier is manufacturing by the following process such as washing of cup housings, bracing the connector with cup housing, filter Core assembly, plasma welding, leak testing and cap assembly. Cup housings are placed on the loading conveyor of the washing machine. Cleaning action took place in the washing machine. The washing machine has three zones named by washing zone, rinsing zone and drying zone. Solder ring and connector is placed over the cleaned cup housing. Cup housing is placed on the loading conveyor of the furnace. The conveyor will move at very slow rate of speed (0.3m/min). There are two zone in bracing one is heating another one is cooling zone. The tig welded cup housing assembly is loaded into the plasma welding machine. Plasma welding is done at the circumference of the cup housing inside the plasma welding machine. The main purpose of the plasma welding is to join the two cup housings.

### 1.1 Problem analysis

The cycle time study was conducted on filter drier component for all manufacturing processes by stage wise. Then planned to conduct the cycle time study on maximum size of the filter drier. So 2" filter drier component was selected for cycle time study.

### 1.2 Cycle time study

The cycle time for assembly station 20 seconds, Plasma welding 18 seconds, leak testing 21 seconds and cap assembly 33 seconds. This study was done for an hour. The one hour output for assembly is 180 numbers,

Plasma welding is 200 numbers, leak testing is 171 numbers and Cap assembly is 110 numbers. Also calculated the output per shift considering the working time for shift is 7.5 hours. The put per shift for assembly is 1350 numbers, plasma welding is 1500 numbers, leak testing is 1285 numbers and cap assembly is 820 numbers. After collecting the all cycle time data and studied the cycle the time for each stage and found the cap assembly is more time taking process. Also found cap assembly is the bottle neck process.

### 1.3 Problem identification

The maximum output for the entire assembly line is 820 numbers per shift. But due to market demand customer requirement is 1200 numbers. So we have shortage of 380 numbers. If go for two shifts can be produced 1640 numbers. But it is more than the customer requirement. Also the operating cost will be increase, man hours and machine hours will be increase if go for two shifts per day. So it is not good solution to go for two shifts per day, and fixed a target to increase the productivity at bottle neck area of cap assembly.

## 2. METHODOLOGY

To reduce the cycle time in cap assembly station first each activity was studied and understood in the existing cap assembly. Also studied the tools used for cap assembly and existing cap assembly fixture. Then need to eliminate the unwanted activates if any presence in the existing cap assembly by adapting some technical tools like brainstorming and 4M method Man, Machine, Material and Method.

To reduce the cap assembly cycle time first studied the existing cap assembly activates. Apply the rust preventive oil at the both ends of the threads of the filter drier. Insert the cap at both ends of the threads. The cap had hexagon shape. After inserting the cap clamp the filter drier in the fixture between the two V-blocks. One is fixed V-block and another one is movable. The movable V-block will move forward by rotating the threaded rod and the component is clamped between the two blocks. Applying the torque at top of the cap by using pneumatic torque tighten. After torque tighten at top side rotate the fixture by 180 degree. Apply the torque at another side, then move the V-block backward by using threaded rod and remove the component from the fixture.

## 3. FIXTURE DESIGN

Successful fixture designs begin with a logical and systematic plan. With a complete analysis of the fixture's functional requirements, very few design problems occur. When they do, chances are some design requirements were been forgotten or under estimated. The work piece, processing, tooling, and available machine tools may affect the extent of planning needed. Preliminary analysis may take from a few hours up to several days for more complicated fixture designs.

### 3.1 Idea of new fixture

The fixture sketch was made for new cap assembly. The new fixture has a base plate at its bottom to fix the adaptor for torque wrench socket and guide block at top to support the component. Both base plate and guide block has connected with four guide pin. The adaptor as a square shaped to hold socket.

### 3.2 New cap assembly fixture

New cap assembly fixture has base plate made of mild steel. It is the base for the fixture and it bottom has four number of Lugs made mild steel. It is fastened by four number of M8 align cap screws. The top and bottom face of the lug made of fine surface finish. Over the base plate four support rods is located and it is made of mild steel. It is fastened by four number of M6 align cap screw. The guide plate is placed over the support rod and it is made of Nylon. It will guide the component while torques tighten of the cap. The adaptor is placed at center of the base plate and it is made of EN8. It is fastened with one number of M6 align cap screw at center of the base plate. The adaptor will hold the bottom cap while torque tighten of the cap.

## 4. ACTIVITIES COMPRESSION WITH EXISTING AND NEW FIXTURE

By using new cap assembly fixture some activities were eliminated like rotating the fixture clamping and unclamping the component in the fixture. But applying the rust preventive oil and inserting the cap in the filter are common activities for both new and existing fixture.

Some activities was eliminated by using new cap assembly fixture. The activities are there is no clamping for component, also there is no need of clamping. The adaptor itself acts as a clamp. Torque tightening is done in both sides in a single setting; hence there is no need of rotating the fixture. Now it is very easy to torque tightening of cap in the filter. Also the cycle will be reduced by eliminating some existing activities.

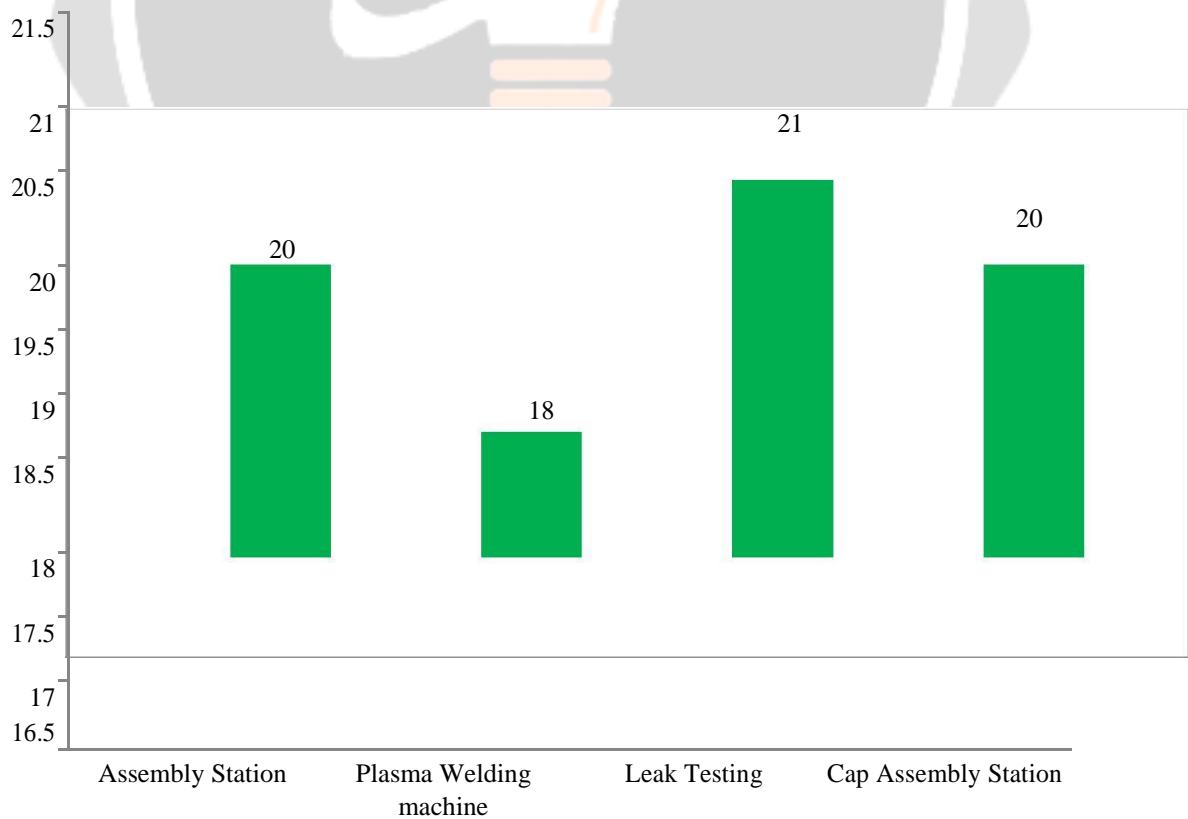
**5. RESULT AND DISCUSSION**

**Table -1 Cycle time study on the new fixture**

Operator-1	Sample	1	2	3	4	5	6	7	8	9	10
	Rust Preventive Oil apply	4	4	4	4	4	4	4	4	4	4
Cap Insertion	7	6	7	6	7	6	6	6	6	6	7
Holder the Filter in the Fixture	2	3	2	3	2	3	3	3	3	2	2
Torque apply in Double side	7	8	7	7	7	7	8	7	8	8	8
		20	21	20	20	20	20	21	20	20	21

The cycle time study was done for 10 numbers on cap assembly by using new cap assembly fixture. Time taken for applying rust preventive oil is 4 sec, for cap inserting at both side is 7 sec. These two activities are common in both for existing and new cap assembly. Time taken for loading the filter drier is 2 sec and torque applying at both sides is 7 sec. The total cycle time for cap assembly is 20 sec.

**Graph -1 New cycle time study on filter manufacturing**



The cycle time was conducted on the entire cap assembly manufacturing process once again. Now the cycle time for assembly station is 20 sec, plasma welding is 18 sec, leak testing is 21 sec these three stations cycle time is same as the old cycle time study. Cap assembly cycle time is 20 sec while comparing with existing cap assembly we reduced 13 sec by using new cap assembly fixture. The cycle time for entire manufacturing is shown in the fig.6.1 also this study was done for an hour. The one hour output for assembly 180 numbers, plasma welding 200 numbers, leak testing 171 numbers, cap assembly 180 numbers. Also calculated the output per shift considering the working time for per shift is 7.5 hours. The output per shift for assembly 1350 numbers, plasma welding 1500 numbers, leak testing 1285 numbers and cap assembly 1350 numbers.

## 6. CONCLUSION

As the result of new cap assembly fixture we reduced the cap assembly cycle time from 33 sec to 20 sec. Resulting this cycle time reduction output of cap assembly was achieved 1285 number per shift in cap assembly station and fulfil the customer requirements by new cap assembly fixture. The existing cap assembly of Filter drier is more time taking 33 sec by using existing fixture. It requires more manual operations like rotating the fixture, clamping and unclamping the component.

**Table -2 final cycle time**

<b>Process</b>	<b>Existing cycle time in sec</b>	<b>Existing fixture production per shift</b>	<b>New cycle time in sec</b>	<b>New fixture production per shift</b>
<b>Assembly station</b>	<b>20</b>	<b>1350</b>	<b>20</b>	<b>1350</b>
<b>Plasma welding</b>	<b>18</b>	<b>1500</b>	<b>18</b>	<b>1500</b>
<b>Leak testing</b>	<b>21</b>	<b>1285</b>	<b>21</b>	<b>1285</b>
<b>Cap assembly</b>	<b>33</b>	<b>820</b>	<b>20</b>	<b>1350</b>

The above said problem is overcome by using new cap assembly fixture. Productivity increased to 820 no's to 1350 no's, by using the fixture some operations are eliminated like rotating the fixture, clamping and unclamping. The cycle time was reduced from 33 sec to 20 sec by using new cap assembly fixture.

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