

## 1. AUTOMATATION SYSTEM FOR PUGGING & JIGGERING STATION

### A. Introduction:

In the manufacturing process of porcelain disc insulators shaping of the body mass is the first step. The green mass as received from the filter press is fed into an extruder for kneading, homogenizing and extruding cylindrical blanks, which are further sent to a preliminary shaping carried out on an SPM – Jiggering machine. This process of handling the extruded blanks from pug mill, conveying, pre-shaping and pick-rotate-place in the moulds is carried out manually. After the shaping operation carried out on jiggering machine the shaped product along with the mould is placed inside a continuous drier. The boundary limits of this stage of process intended for automation is described below along with the photographs of critical process for better understanding.

### B. Description of the process

- Blanks of size 275 x 450 mm is extruded horizontally from Pug mill, approximate weight of the blank is 45 Kgs.



- Each blank shall be individually lifted from the table & placed vertically on the conveyor.
- Care shall be taken to ensure that 'front end' of the blank is placed down & the 'rear end' Up. The blank shall not be deformed or damaged during handling.



- The blanks shall be conveyed near to the Automatic Jiggering Machine located about 10 meters away.
- During transit, the top end of the blank shall be 'shaped' one end conically by a suitable device. Presently, through wire rope cutting, excess material is sheaved off.



- The pre-shaped blank shall be lifted vertically, inverted and inserted into the mould placed on AJM with suitable force. The shaped portion shall fit exactly into the head portion of the mould. The blank shall not be deformed or damaged during handling. The approximate weight of the pre-shaped blank is 35 Kgs.
- Jigging process will be carried out in the existing set up.



- Each one of the jigged article along with the mould shall be lifted vertically from the jigging table, transferred and placed in the chain dryer using a suitable handling device. Empty mould from the chain dryer shall be removed and placed on the AJM table for jigging.
- Care shall be taken to ensure that the Jigged article is not damaged or deformed during any of the above operations.



### **C. Production capacity**

The system shall be suitably designed to give an output in the range 100 to 150 numbers per hour with the desired quality.

In the line of process, from extrusion to pre-shaping and from pre-shaping to jigging, a buffer storage of around 15 blanks shall be provided for each stage.

## **2. AUTOMATED SYSTEM FOR DISC INSULATOR FINISHING**

### **A. Description of the process**

In the process of porcelain disc insulator manufacturing, the stage of finishing the semi dried jiggered article is critical. This process gives the final shape, required dimension and surface finish. This process is carried out on vertical lathes. Presently, manual copy turning lathes are used, along with plain carbon steel or carbide profile cutting tools. It is proposed to automate this process using multi spindle CNC turning station.

The present manual turning process is depicted in the photograph below:



**B. Production Capacity :**

The duration for turning one product is presently about 180 seconds. The capacity required is about 60 numbers per hour per station. It is proposed to use pneumatic / hydraulic manipulators with suitable grippers for loading and unloading of the articles on the CNC station.

Based on the product ratings and size, an indicative equipment size is provided below for reference.

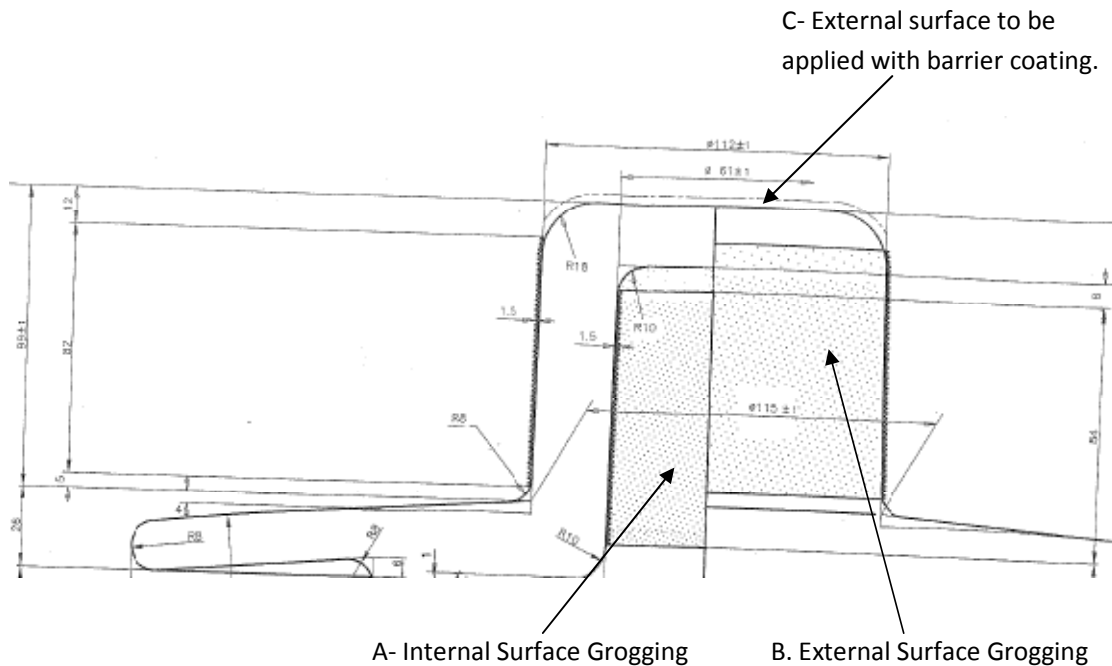
<b>MULTI-SPINDLE CNC VERTICAL LATHE for FINISHING DISC INSULATORS</b>	
<b>MACHINE SPECIFICATIONS</b>	
<b>1. CNC OPERATED TOOL POST SADDLE – 2 Sets</b>	
a. X - axis Travel	200mm
b. Z - axis Travel	600mm
c. Max Rapid rate	4000mm/min
d. Max feed rate	2000mm/min
<b>2. CHUCK SPINDLES – 6 Sets</b>	
a. Chuck Diameter	400mm
b. Chuck speed	400 rpm
<b>3. JOB DETAILS</b>	
a. Max Job Diameter	400mm
b. Max Job Length	600mm
c. Weight before turning	35 kgs
d. Weight after turning	20 kgs
e. Duration for turning a product	~ 180 sec
<b>4. CNC SYSTEM – 2 Sets</b>	
<b>5. OTHER FEATURES AND REQUIREMENTS</b>	
a. One Tool Post Saddle to operate with 3 Chuck Spindles	
b. Linear motion Guide ways for both Longitudinal and Cross axis movement.	
c. Precision Rolled Ball screw for both axes.	
d. High torque drive type pulley/belt for axes	
e. High quality wipers for saddle and cross slide.	
f. Centralised lubricating system	
g. Installation and Commissioning	
h. Job prove out and operator training.	
i. Scrap chute for conveying turned scrap on to a conveyor	

### 3. AUTOMATION SYSTEM FOR GROGGING STATION

#### A. Introduction:

Grogging is a process of applying layer of coarse aggregate on to the identified surface of the green glazed insulator. The grog is made of crushed porcelain and is of approximate size of 1 to 1.5mm. The grog layer is made to adhere to the surface using glue. The boundary limit for this stage of automation system starts immediately after the product is glazed and ends by placing the grogged insulator onto a handling conveyor. The step by step process is described below along with photographs of critical stage as is done manually presently. The proposed system shall carry out these operations with the help of automated systems or devices.

The product at this stage is very delicate; forceful gripping, jerks in motion and even mild impacts can cause it to break. The cross section drawing of the product indicating the surface wherein it has to be grogged is shown below:



#### B. Description of the process

- After Glazing operation, i.e applying thin coat of glaze by wet spray method, the portion indicated in the drawing A and B are to be applied with a layer of glue and then coarse aggregate (sanding grog) is applied on it.



- Initially, the 'A' portion of the article shall be glued to the required dimensions by suitable mechanism. The thickness of the glue shall be controlled. Care shall be taken to ensure that the glue is not spilled on other surface of the article. Grog is applied on the glued surface. Excess grog spilled over shall be removed. In the

present manual process, the grog particles are filled into the cavity after glue application; grog particles adhere to the glue then the whole insulator is inverted to remove free grog particles. During the entire process, the insulator is rotated slowly.



- Similarly the 'B' portion of the article shall be glued to the required dimensions by suitable mechanism. The thickness of the glue shall be controlled. Care shall be taken to ensure that the glue is not spilled on other surface of the article. Grog is applied on the glued surface as specified. In the present manual process, the grog particles are smeared onto the glued surface. The article is kept slowly rotating during the process, the grog particles sticking on to the glue remains and the excess particles falls off.
- Application of barrier coating on portion C indicated in the drawing by using suitable device.



### C. Production capacity

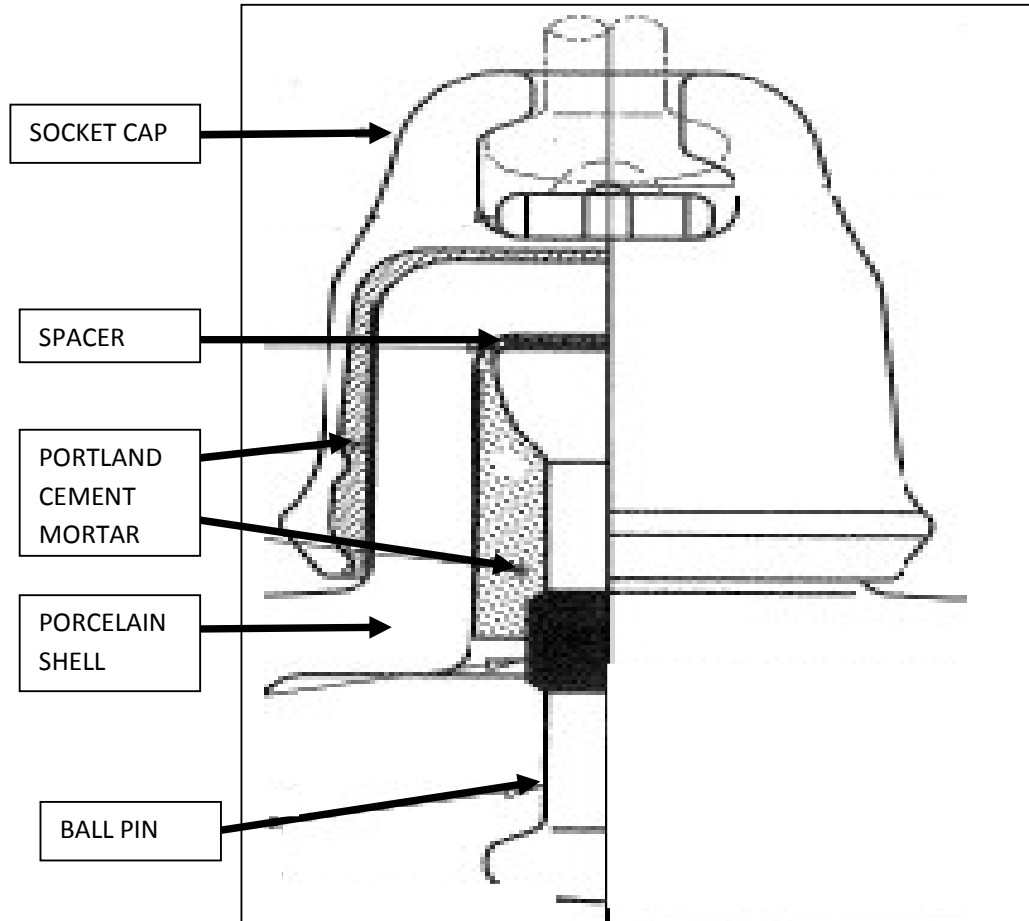
The system shall be suitably designed to give an out put of 300 numbers per hour with the desired quality.

#### **4. AUTOMATION SYSTEM FOR SHELL-PIN-CAP ASSEMBLY**

##### **A. Introduction:**

The final phase of manufacturing of porcelain disc insulators is assembly of porcelain disc shell with metallic socket cap and pin, Portland cement mortar is used as the binding medium. The cross section drawing of the insulator showing different components is shown below. The description of the process as desired in the proposed automated system is given below along with the photographs of the process as carried out manually at present.

The porcelain shell is hard but delicate and can break or chip on impacts particularly the extended surfaces. The metallic cap and pin is galvanized and the coating cannot be deformed during the process. Hence, the handling and gripping device shall be suitably designed to take care of the products. The binder medium – cement mortar being highly sticky, spillage on the in insulator shell or metallic components is likely to stick and cause hardship in removal and may even damage; hence the system shall take care to avoid spillage. Further, the cement dispensing system is to be designed for avoiding setting of cement in the container or dispenser and further facilitate easy and frequent cleaning.



## B. Description of the process

- A Porcelain shell, with a plastic spacer inserted around its head, is picked up from the pallet, inverted and manually placed in the assembling machine.
- The required quantity of cement shall be dispensed automatically in the Ball pin hole cavity.
- A metallic Ball pin (with polymeric cushion pasted on its base) is picked from its location and is forcibly inserted through the cement in the hole. The vertical movement of the pin and the applied force shall be controlled.
- A pin centering device is picked from its location and placed on the assembled pin. This device ensures alignment of Pin with the shell.
- The assembly shall then be vibrated continuously for a minute for leveling the cement and removal of air pockets.





- While the process of vibration is in progress, a metallic socket cap is picked up from its location and placed inside a suitable holder in the machine. Required quantity of cement shall be automatically dispensed inside the cap.
- The shell-pin assembly subjected to vibrations shall be picked up from its location and the head of the shell shall be forcibly pressed through the cement in the cap till the edge of the cap rests on the plastic spacer. The shell is rotated clockwise and anti clock wise in the horizontal plane to ensure uniform distribution of cement in the gap between cap and shell. The vertical and horizontal movements and the applied force shall be controlled.
- The excess cement oozing out of the cap shall be cleaned, currently a wet sponge is swiped to clean.



- Subsequently the complete Shell-Pin-Cap assembly shall be carefully lifted from its location and transferred on to the chain dryer. Care should be ensured not to disturb the assembly.

#### Note on Cement dispenser

The cement mortar in the dispenser shall be continuously stirred to maintain workability. Suitable cooling system may be supplemented for retarding the setting time. The cement container is required to be cleaned after every shift and or every break and hence it shall have suitable mechanism.

#### **C. Production capacity**

The system shall be suitably designed to give an output of 100 numbers per hour with the desired quality.

## **5. AUTOMATED SYSTEM FOR INSULATOR WASHING**

### **A. Introduction:**

The assembled insulators are subject to curing in steam and water; this process causes formation of scale and sedimentation on the surface. Also, the process of assembly with Portland cement mortar causes spillage and smearing of cement. The assembled insulator thus required washing before final testing and dispatch.

The insulators put in the metallic racks and sent for curing in the water tanks and are taken out for washing. The boundary limit for washing system begins from taking out the cured insulator from the rack, wash it thoroughly and send for next process of testing.

The weight of the assembled insulator is maximum 15 kgs.

### **B. Description of the process**

- Assembled insulator is picked up from the curing rack using a suitable handling device, inverted (Ball pin up) and placed in the washing machine
- The proposed washing machine shall clean the insulator by a jet of water and simultaneously scrubbed using non metallic scrubbers to remove dust, cement and other foreign particles. The cleaning and scrubbing action is to be done on both the front and rear side of the insulator.
- The gripping system shall be suitable designed and can hold the insulator either by the cap or pin.
- The use of detergent or solvent as deemed fit may be suitably adopted and shall be thoroughly rinsed to avoid any residue.
- After cleaning, the insulator shall be dried; use of hot air blast or other means may be employed.
- The dried insulator is then transferred to the next process with suitable pick and place device.
- From environmental considerations, the water shall be recycled and the detergent or solvent shall be eco friendly.

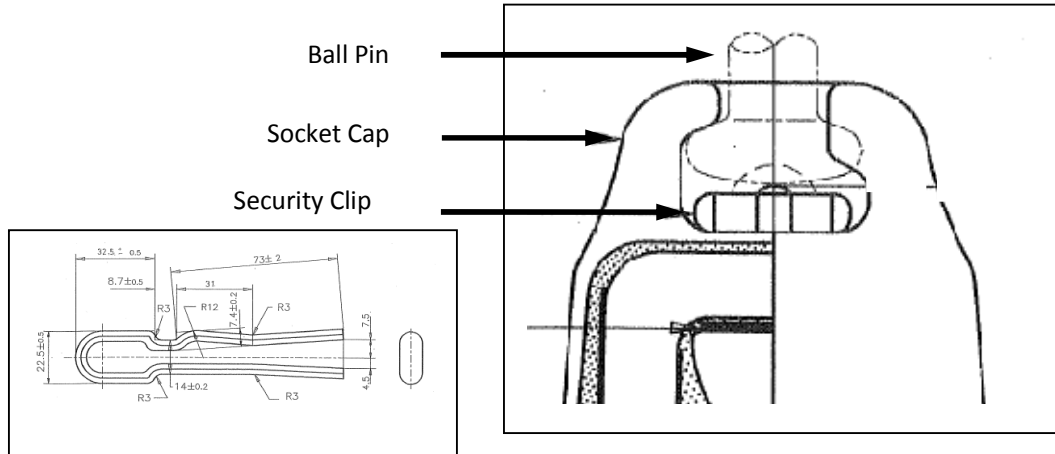
### **C. Production capacity**

The system shall be suitably designed to give an output of 250 numbers per hour with the desired quality.

## 6. AUTOMATION SYSTEM FOR SECURITY CLIP INSERTION

### A. Introduction:

Security clip made of stainless steel is a standard locking device for the socket and ball joint in a disc insulator, refer the sketch shown below. Every insulator is to be inserted with a security clip after the routine electrical testing. The process as followed at present and the broad requirement of an automated system is described below:



### B. Description of the Process

An assembled insulator is picked up from RET (Routine Electrical Test) conveyor & placed on a suitable location/table.

A security clip shall be inserted into the hole of the socket cap & aligned by suitable mechanism.

The legs of the clip inside the socket cavity shall be split open using a suitable tool as per dimensions.

The insulator shall then be removed from the table / location & placed in the packing crate in the orientation indicated.

### C. Production capacity

The system shall be suitably designed to give an out put of 250 numbers per hour with the provision for reducing the production rate down to 100 numbers /hour.

Note 1: The system tooling and fixtures shall be interchangeable to accommodate different range of insulators whose dimensional details will be provided.

Note 2: The system shall have buffer storage of security clips for about 250 numbers.

Note 3: The system shall be designed to operate very smoothly and shall not have any jerks or impacts to avoid chipping and breakage.