

---

---

---

---

# Reclamation and Fabrication Jobs in Pig Casting Machine of Blast Furnace Department - Visakhapatnam Steel Plant

(Winner of **MDBSP Award** for reclamation and repair welding in Steel Plant in **NWS 2010**)

## A. Pandi

Assistant General Manager, Blast Furnace (W), Rashtriya Ispat Nigam Limited, Visakhapatnam Steel Plant, Visakhapatnam - 530 031, Andhra Pradesh Email: apandi@vizagsteel.com

### ABSTRACT

The necessity of the study is to improve the machine reliability by doing the reclamation and fabrication jobs of equipment and structures, since the area is bound to have the heat, water and steam, the connected equipment and structures are getting damaged easily. To improve the machine hours and increase the production, there is a need to strengthen the equipment.

Some of the machines, components and its structure were identified as corroded, eroded and deformed. To repair these items, a lot of spares and time is required, but at the same time, production should not be lost. Therefore, reclamation and fabrication becomes a vital role for strengthening. The components required for reclamation are drive sprockets, chain links, rollers and pig guards. The important fabricated items are columns, floor beams, cooling headers, pipe lines and chutes, etc.

The condition of the machine parts were critically analyzed and cost benefit analysis was done to do the reclamation work. The reclamation work involved cleaning, pre heating, cutting, welding and machining. A lot of built up was done on eroded items by Arc welding method.

Selection of electrodes, method of welding and fabrication are main parts to improve the reliability of the pig casting machine and increase the production. Fabrication of the items within the specified norms through cutting, and welding of structures reduces the wastages, and saves cost. The outcome of this study is to save cost by reducing the wastage and improve the machine availability and productivity by means of reclamation and fabrication jobs.

**Keywords:** Reclamation, fabrication, reliability.

### INTRODUCTION

In Visakhapatnam Steel Plant, Blast Furnace is the heart of the plant which produces hot liquid iron to make the steel. It is one of the most modern Blast Furnaces, which consists of the following areas:

1. Burden handling system
2. Furnace proper
3. Top charging system
4. Slag granulation plant
5. Gas cleaning unit

6. Auxiliary units such as Ladle repair shop, Masses and compound shop, Slag and Pig storage unit and Pig casting machine, etc.

#### Pig casting machine

The pig casting machine serves for pouring of molten pig iron brought from the blast furnace in to moulds, for cooling of the iron pigs and for loading of the solidified pigs directly on the railway wagons. These pigs are used in

foundries.

The double stand pig casting machine consists of stand, runners, inclined plates, conveyor chain with drive, lime sprayer unit, pig loading unit, water piping, installation of rollers, and 120 ton hot metal ladle tilting device.

The principle of its operation is as follows. From the blast furnace, the hot pig iron is brought by iron ladle cars to the pig casting machine stand which serves as the support for the ladle

during tilting. The steel stands are installed at the lower pouring end of the sloping conveyor at a fixed distance from the railway track of the iron ladle car, so that during tilting of the ladle, its paws sit on the corresponding pins of the stand. These pins now become the axis of tilting of the ladle. The tilting of the ladle is done by means of a special mechanism. The ladle hook of the tilting mechanism engages with the pin of the lug at the bottom of the ladle. While the hook is lifted slowly, the ladle is emptied at a uniform rate.

The poured out metal falls on to the brick lined metal runner placed on the platform. From the spout of the runner, the metal evenly falls on to the moulds. The moulds, being bolted to the conveyor chains, move up along with the links of the conveyor chain. The slope of the conveyor and the mould construction is such that over filling of the moulds or spilling of iron under the moulds does not take place.

The moulds with the hot metal move up to the pig loading units of the machine. Approximately, from one third of the way up, the moulds carrying iron are subjected to intensive cooling with the aid of water pipes located over the conveyors. When the conveyors move further, the chain links turn back with the drive station sprockets, the moulds are tilted and the solidified pigs fall out of the mould on to the pig loading chutes. Along the slope of the chutes, the pigs roll down to the railway wagons. Here, water is also sprayed on the railway wagons.

After getting freed from the pigs, the tilted moulds travel back with conveyor chain links to the place of pouring. At the middle of the return way, the inner surface of the moulds are coated with a thin layer of liquid lime, which protects

the moulds against corrosion by liquid iron and prevents sticking of the pigs to the moulds. This is done with the aid of sprayers installed under each conveyor separately.

When conveyor moves further, the moulds again come under the pouring runner and the cycle of operation is repeated till the ladle is emptied.

Each conveyor has got separate drive. This permits operating any one conveyor when the other is under maintenance.

The wagon marshalling equipment helps in positioning the empty railway wagons directly under the chutes and to remove the loaded wagons away from the machine. This is operated by means of a winch located in separate room.

### The need of reclamation

The structure and equipment are found to have heat, water and steam. Due to corrosion and deformations, changing and replacing the components in all time is quite expensive and time-consuming job. To improve the machine hours and increase production, there is need to

strengthen the equipment by means of welding and reclamation.

Some of the pig casting machine components are drive sprockets, tail end sprockets, chain links, rollers, pig guards, chutes, etc. The condition of the machine parts were critically analyzed, and cost benefit was done to do the reclamation work. The reclamation work involved cleaning, preheating the surfaces, cutting, welding and machining. The built up work is done on worn out components by arc welding method.

### Reclamation jobs

- a) Sprocket reclamation
- b) Chain links reclamation
- c) Rollers reclamation

### Sprocket reclamation:

The sprocket is used to drive the chain by electric motor. There are two types of sprockets. This is made of cast steel and mounted on a shaft made of C-45, Gr 230-450, IS: 1030. The following figure (Fig.1) shows views of the sprocket.

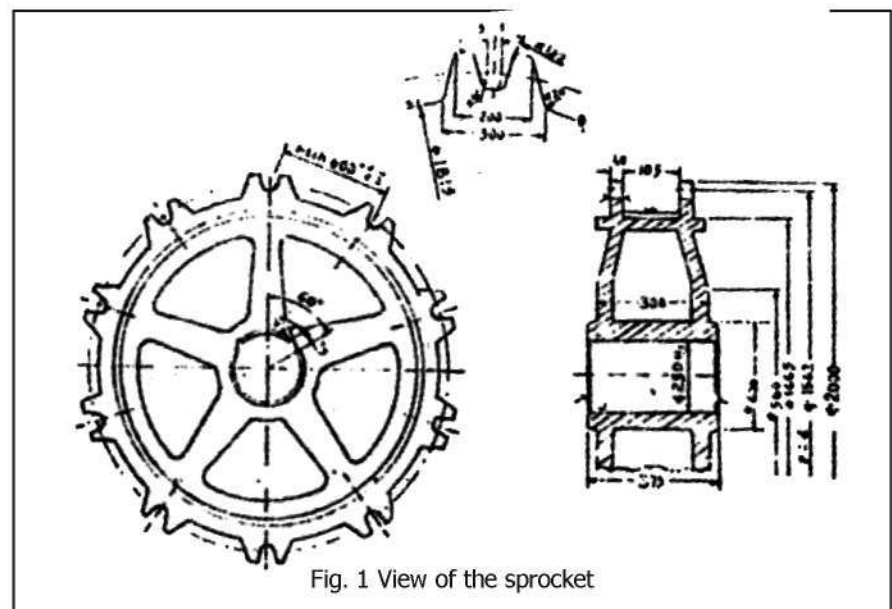
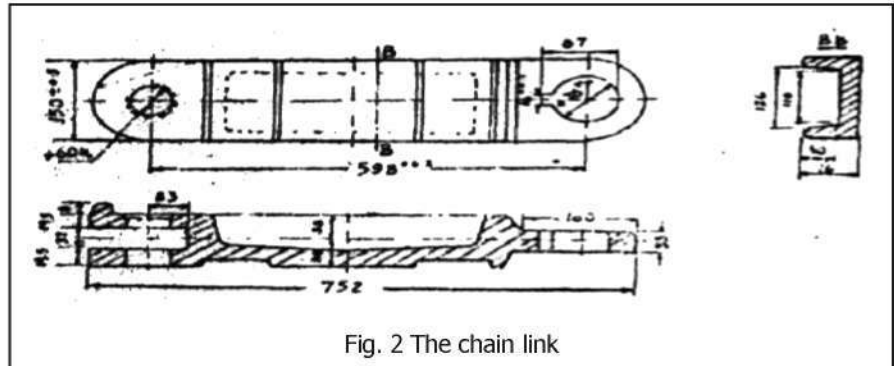


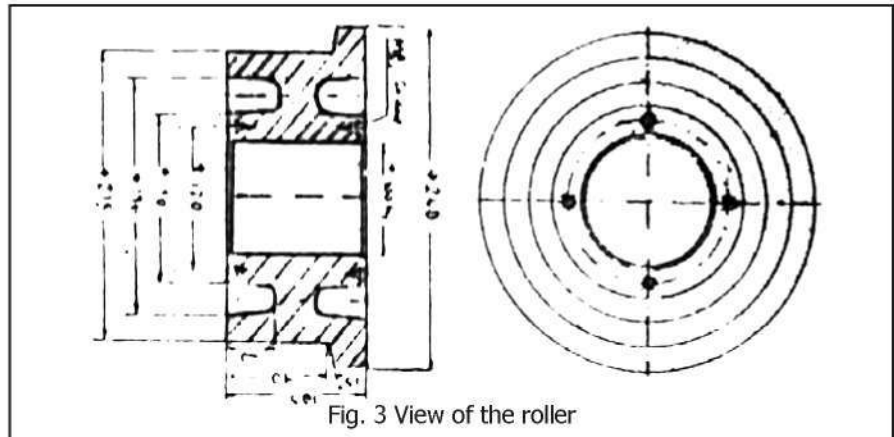
Fig. 1 View of the sprocket

The sprocket is getting worn out and rusted. Since the arrangements are heavy, reclamation is very difficult in position. Therefore, the sprockets are removed from position, built up is being done on the teeth, and maintained same profile by using arc welding method. The edge finishing is done through grinding.



**Chain links:**

This is one of the components which connects the belt and made by C-45 material. It travels on the rollers. Due to metal spillage, heat condition and friction, this will be getting worn out. This is to be removed and measured for required tolerance and the reclamation is done by using suitable welding electrodes. Fig. 2 shows the chain link.



**Rollers:**

These are rotating elements while the belt is driven. It is made of C-40. The rolling surface is hardened to a depth of 5 to 8 mm or it can be induction hardened by an inductor. The roller is mostly getting worn out on the rolling surface. This is being cleaned and taken for reclamation work. The roller rolling surface built up is done by arc weld method and machined for accuracy. All are machined leaving 4mm allowance on bore and 0.5 to 1 mm allowances on faces and on rolling surfaces. The figure (Fig. 3) shows the roller.

**Electrodes:**

Various electrodes used for reclamation are listed in Table 1.

Table 1. Various electrodes used for reclamation			
Sl.No.	COMPOUND	MATERIAL	ELECTRODE USED
1	Sprocket	C.S. Gr 230-450W IS:1030 250BHN	Terroweld-35 or its equivalents
2	Chain link	C-45	Low Hydrogen & hard facing
3	Roller	C-40	Low Hydrogen & hard facing

**Steps to be followed during reclamation job**

1. To analyse the cost involved and its worthiness
2. To select the component
3. To clean the component
4. To select suitable electrodes as per the parent metal
5. To control the job for perfectness (deformation, distortion, etc.)
6. To control the required volume
7. To ensure the required accuracy and

hardening

**Benefits of reclamation**

1. It saves the cost and reduces the inventory of spares
2. It saves the time and improves the skill of the people.
3. It brings the maintenance reliability
4. It enables fixing the close assembly tolerance of the components.
5. It facilitates system improvement and reliability.

## FABRICATION JOBS IN PIG CASTING MACHINE

The fabrication involves all foundation frames, beams, columns, brackets, rails, chutes and pipe lines.

### Fabrication of foundation frames

In order to withstand the designed load, stress and impact, the correct single foundation frame is to be fabricated by using the cutting and welding technique. There are five basic types of welded joints used in fabricated jobs:

### Steel used for fabrication

Types of steels used for fabrication in pig casting machine are shown in Table 2.

### Hydrogen- a concern in fabrication jobs

The area is full of water on belt, lime coating on mould and water cooling on chutes and pigs, and hydrogen plays a vital role for cracking of welding. Therefore, special care is to be taken during fabrication and erection of components as hydrogen contributes to delayed weld and/or heat affected zone cracking. Hydrogen combined with high residual stresses and crack sensitive steel may result in cracking hours or days after the welding has been completed.

### Role of preheating

Preheating the steel to be welded and the cooling rate are to be controlled. This may be necessary to avoid cracking of weld metal or heat affected zone. The need for preheat increases with steel thickness, weld restraint, the carbon alloy content of steel, and the diffusible hydrogen of the weld metal. Preheat is commonly applied with fuel gas torches

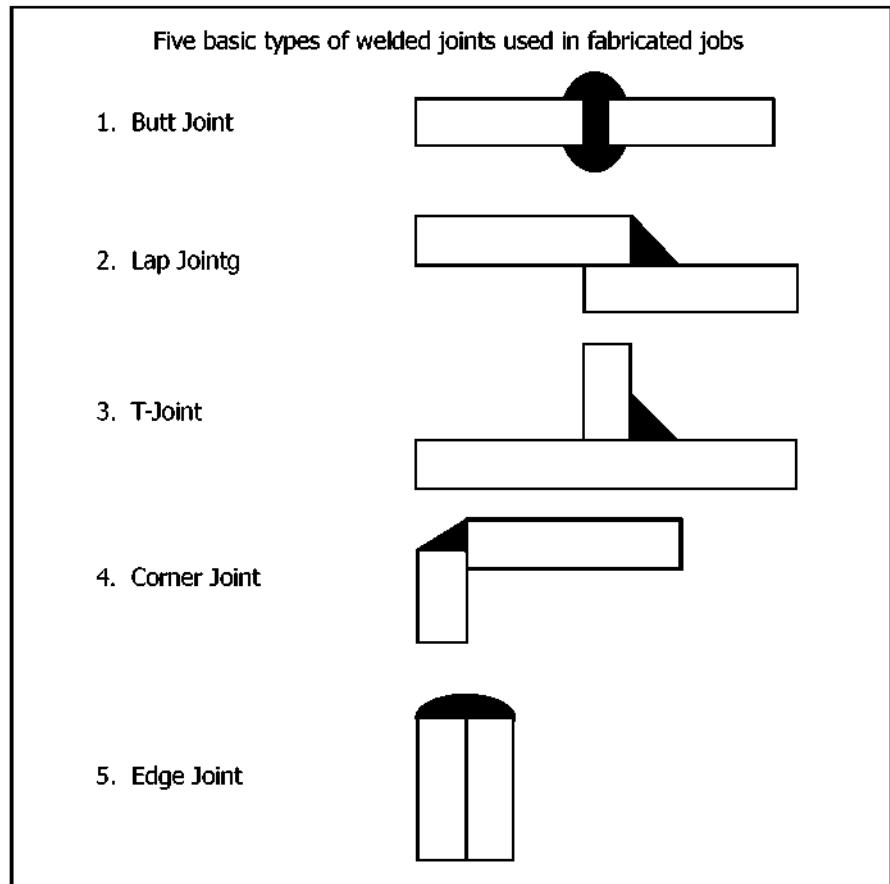


Table 2. Types of steels used for fabrication

Sl. No.	STEEL	USAGE
1	Low carbon steels 0.1 to 0.3%	Machine components
2	Medium carbon steel 0.3 to 0.5%	Building structures
3	High carbon steel	Wear & liner plates
4	Fabrication of bends and joining of pipes	All water cooling system

or electrical resistance heaters.

### Fabrication jobs involved in pig casting machine (PCM)

The following are some of the important fabrication items:

1. Chute
2. Rail
3. Roller beam
4. Stool for sprocket
5. Foundation frame

### 6. Pipe bend

#### Chute

This is being fabricated with mild steel of various thicknesses from 12 mm to 40 mm. Each machine has two fixed chutes and tilting chutes. To prevent the wear out of the chute, wear resistant liner plates are fixed on top of the chute. The dimensional control is maintained within +/- 5 mm.

---

---

---

---

---

---

## Rail

It is used below the metal runner to guide to belt. It is a connector from fixed beam to cantilever beam. Due to chain link contact, the rail will be worn out after certain interval. Sometimes, premature failures occur due to metal jam.

## Roller beam

It is fabricated by 12 mm thick MS plate with various widths of flanges. The beam top flange will have more width to take care of the roller position. It is mounted on floor beams by means of welding. The welding thickness and joints are maintained as per the standard.

## Stool for the sprocket

A triangular shape stool is fabricated to support the sprocket which also connects on floors beam. It is made of different thicknesses of MS plates, welded as per the standard. The fabrication allowances are as per standard (approx 3 to 5 mm).

## Foundation frame

The gear box and motor are mounted on fabricated foundation frame which connects the floor beams by bolting arrangements. In general, the foundation frames are grouted by concrete to avoid the vibration.

## GENERAL PROBLEMS DURING FABRICATION

1. Lack of fusion
2. Porosity

## Causes and prevention

### Causes of Lack of fusion

The principal causes are too narrow a joint preparation, incorrect welding parameter setting, poor welder technique and magnetic arc blow. Insufficient cleaning of oily or scaled surfaces can also contribute to lack of fusion.

### Prevention

- To use a sufficiently wide joint preparation.
- To select welding parameters (current, arc length, weld speed etc.).
- To promote prevention of the joint side wall without causing flooding.

### Causes of porosity

Poor welding techniques, contaminated base material or electrode, lack of proper gas shielding are the possible causes of porosity. Due to absorption of nitrogen, oxygen and hydrogen in the molten weld pool which is then released on solidification to become trapped in the weld metal.

### Prevention

- To seal any air leak
- To avoid weld pool turbulence
- To use filler with adequate level of deoxidisers
- To reduce excessively high gas flow.
- To avoid draughts
- To dry the electrode and flux
- To clean and degrease the work

piece surface

- To clean the joint edges immediately before welding.

### Safety while doing the fabrication

Most of the fabrication jobs are done by arc welding method in pig casting machine. To avoid accidents, the following points are to be followed.

- Using dry hole free welding gloves on both hands
- Turning of the power at the end of the work
- Not to drag live leads to the work
- To use dry, fire resistant insulation
- To use voltage limited welding power.
- Avoiding the no. of joints on the welding cable.
- Using the space free area for fabrication work
- To maintain good ventilation
- To maintain the house keeping on work place area.

## CONCLUSION

The selection of electrodes, method of welding and fabrication are main parts to improve the reliability of the pig casting machine and to increase the machine availability. Minimization of wastages while fabricating the items is needed to save the cost by using standard fabrication norms. Reclamation and fabrication are very widely used in pig casting machine due to its nature of operation. Hence, there is a need to strengthen the equipment and structures.