**SOP FOR**

1. **PURPOSE: Safe maintenance of Pig casting machine for optimum Performance.**
2. **SCOPE:** **Pig casting machine.**

1. **RESPONSIBILITY: Engineer In Charge & workmen at job**
2. **PROCEDURE: MAINTENANCE OF PIG CASTING MACHINE**

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PPE –s to be used:

* Helmet, Safety shoes, Dust masks, Hand gloves and goggles, completely sealed goggles (for lime area).

**LIST OF TASKS COVERED**

* Work No 1 : Roller changing
* Work No 2 : Mould changing.
* Work No 3 : Drive gearbox changing
* Work No 4 : Chain link changing
* Work No 5 : Chain links tie pipe & pin changing.
* Work No 6 : Lime pump changing
* Work No 7 : Lime spray cleaning/changing.
* Work No 8 : Lime stirrer maintenance...
* Work No 9 : Lime pump gland replacement.
* Work No 10 : Working on Diverter Chute.
* Work No 11 : Replacement of Pneumatic Cylinder of Diverter Chute
* Work No 12 : Repair of discharge chute.
* Work No 13 : Rectification of chain derailment
* Work No 14 : Replacement of head sprocket.
* Work No 15 : PCM Strand Stringer Replacement.

Aspect – impact

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| Oil Spillage | Land contamination & Resource Depletion |
| Scrap generation | Resource Depletion |
| Oil traced waste generation | Land contamination & Resource Depletion |

Hazards identified

Mechanical Hazard

1. Trapping between two objects.
2. Fall of material, equipment, hammer, tools, slinged items, bolts.
3. Fall of person from platform.
4. Entanglement in moving PCM, link, rollers, hoist pulley, wire rope
5. Impact of moving / slinged items
6. Trapping in between cranes & hoist (100/20T, 5T & 2T hoist) and structure.
7. Trapping in between earth moving machineries like wheel loaders, truck, back hoe, etc.
8. Failure of link.
9. Fall of mould from sling.
10. Roll back of link chain
11. Wire rope snapping of 5 & 2 ton hoist.
12. Wheel nut of hoist falling on person from height.
13. Contact with hot metal when working in PCM tail end during ladle pouring
14. Fall of person while working on diverter chute.
15. Trapping of body parts in between diverter chutes while working on diverter chute/pneumatic cylinder
16. Flying of pig iron chips from the discharge chutes and hitting a person.
17. Fall of pigs on person when diverter chute is operated

Physical Hazard

1. Noise, pressure, temperature
2. Burn injury from hot metal, hot mould
3. Fall of chips in eyes / ear / body
4. Fall of chips while chipping the bolts of mould.
5. Graphite and dust falling in eyes while working
6. Burn injury due to gas cutting set flame
7. Burn injury due to hot metal spillage on ground

Chemical hazard

1. Fall of lime powder in eyes, nose, mouth

Electrical hazard

1. Shock in welding

Human Behaviour

1. Workmen under influence of alcohol
2. Violation of procedure
3. Not wearing PPE’s
4. Not concentrating while working
5. Horseplay
6. Violation of Covid 19 Pandemic protocol

**Note**: Incase job has to be carried at PCM tail end then it is mandatory that

* Drive keys of both the PCM should be taken from PCM operator and retained with the concerned mechanical engineer till the job is completed .
* Tilter shall be kept in a slightly lifted manner & drive keys shall be retained by the concerned mechanical engineer.

**Work No 1: Roller changing.**

1. Take clearance from Operation in charge. and take the work permit.
2. Take electrical shutdown by switching off isolator and locking padlock on the isolator provided in PCM  (LOTO).
3. Note: Only authorized Electrical engineers are allowed to switch OFF isolators and ~~provide~~ Put the LOTO by isolation officer and requesting officer.
4. Position the jack below the link near the roller, which is to be replaced.
5. Take proper care to avoid slipping of the jack as PCM structure is inclined in position.
6. Ensure to check the condition of screw/ hydraulic jack before use. Lift the chain using screw / hydraulic jack.
7. Remove the roller
8. Replace old roller with new one,
9. Remove the jack by loosening the screw for screw jack ~~&~~/ releasing the hydraulic pressure for hydraulic jack.
10. Do the housekeeping.
11. Clear the electrical shutdown by removing the LOTO ~~and clear the workpermit.~~
12. Request operator to take trial of PCM, maintenance technician, to monitor for one complete round and then give clearance.
13. After normalcy of the Equipment Clear the Work Permit.

**Work No 2 : Mould changing**

1. Take clearance from operation dept and take the work permit.
2. Fix electrical shutdown , LOTO of ~~both~~ the PCM’s Put the LOTO by isolation officer and requesting officer and should be retained till the job is completed.

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1. Cut the bolts using gas-cutting set as per SP44 and ~~punch~~ remove the bolts.
2. Hold the mould with tested sling/chain.
3. Remove the cracked moulds one by one by using ~~2~~3T hoist. Use tested standard chain/sling for lifting the mould.
4. Shift the mould away from PCM & lower it at pre identified location .
5. Lift the new mould from the lot using ~~2~~ 3Ton hoist & shift it to the position.
6. Refit the new mould in position.
7. Ensure there is2-3 mm gap between mould overlapping surfaces as shown below , if needed , washers can be used to adjust the gap.



Maintain 2-3 mm gap between the 2 faces.

1. Tighten the bolts & tag weld all the nuts.
2. After completion of the job including removal of slings, stoppers (if any welded), Attend the housekeeping jobs , inform the shift engineer production. Clear electrical shutdown by removing the LOTO ~~and also the work~~ ~~permit.~~
3. After normalcy of the Equipment Clear the Work Permit.
4. Shift all old scrap moulds to store at space provided for scrap mould near PCM.
5. Note down all the installation date of new moulds and removed moulds. Provide the details to concerned operation engineer or concerned G shift operation incharge.

**Work No 3: Drive gearbox changing.**

1. Take clearance from Operation dept. by taking work permit .
2. Take electrical shutdown of the equipment Put the LOTO by isolation officer and requesting officer .
3. Decouple the gearbox with sprocket & input motor.
4. Loosen the foundation bolts & remove one by one .
5. **Note**: wt. of gear box with oil approx. **4.5 ton.**
6. Remove the roof sheets & necessary roof purlins & keep aside.
7. Using external telescopic crane of minimum 80Ton capacity with necessary boom lengths lift the gear box from its position & lower it on the ground.
8. Using the same crane lift spare overhauled/new gear box & fit at its location.
9. Align the gearbox with sprocket assembly as well as motor.
10. Tighten the foundation bolts.
11. Check the oil level of the gearbox as per the level indicator.
12. Install drive end & Non drive end coupling guard.
13. Give clearance to electrical for clearing clear the *shutdown ~~and clear the~~* ~~workpermit also.~~
14. Take trial and hand over the machine.
15. RE fix the purlins & sheets back in position.
16. After normalcy of the Equipment Clear the Work Permit.

**Work No 4: Chain link changing.**

1. Take clearance from operation dept by taking work permit.
2. Select the portion required for chain link changing.
3. Position the same below the 3 Ton hoist approach if possible .
4. Take electrical shutdown by switching off isolator and locking padlock on the isolator provided in PCM  (LOTO) Tie chain link with 5T capacity sling in two places to avoid slipping of links on rollers (towards tail end side).
5. Connect 2 chain blocks on either side and take load of sling on the chain blocks.
6. Remove the mould above the link to be replaced.
7. Remove the cotter pin & remove the tie rod.
8. Replace the old chain link with new one on one side.
9. Take the 3 Ton hoist to other side. Replace the other side chain link.
10. Ensure that tie ~~pipe~~ rod & cotter pin is fitted in its place.
11. Look for any looseness in the subsequent links at the male – female joint, once the new link is fixed.
12. Release the Sling and remove.
13. Put the mould back in position with new bolts and tag welding.
14. Do the housekeeping.
15. Remove the loto lock.~~and clear the work permit.~~
16. Take trial and handover the PCM.
17. After normalcy of the Equipment Clear the Work Permit.

**Work No 5: Chain links tie rod& sleeve replacement.**

1. Take clearance from Operation dept.
2. Follow steps 1 to 17 for replacement of work no. 4

**Work No 6: Lime pump changing.**

1. Take electrical shutdown after taking clearance from operation dept and take workpermit
2. Use completely sealed protective goggle for working in lime area
3. Close suction and discharge valve.
4. Remove the coupling guard.
5. Remove the foundation bolts & decouple th pump with motor
6. Remove the pump & position the new pump fit all the bolts nuts and gaskets of suction and discharge line.
7. Fit back all the guards back to the position.
8. Tighten all the bolts.
9. Fit back the coupling guard .
10. Clear the shutdown & take trial of the pump ~~and clear the workpermit,~~
11. Hand over the ~~machine~~ pump to operation.
12. After normalcy of the Equipment Clear the Work Permit.

**Work No 7: Lime spray changing/cleaning.**

1. Inform the PCM engineer production and Take electrical shutdown by switching off isolator and locking padlock on the isolator provided in PCM  (LOTO) & and take workpermit..
2. Use completely sealed protective goggle for working in lime area.
3. Take shutdown of Lime pumps.
4. Remove the spray outside the lime collecting bucket.
5. Clean the same and flush with water else replace it with spare nozzle.
6. Inspect gasket and bolts for proper fitting.
7. Put back sprays in to the position.
8. Clear the pump shutdown.
9. Take trial.
10. Put back the key and inform production engineer in charge.
11. After normalcy of the Equipment Clear the Work Permit.

**Work No 08: Lime stirrer maintenance.**

1. Take shutdown of the Lime stirrer (agitator) after taking clearance from Operation in charge and take workpermit..
2. Use completely sealed protective goggle for working in lime area.
3. Remove all the covers.
4. Check oil level by removing oil plug.
5. Check/change lime stirrer assembly. .
6. Check all foundation bolts.
7. Put back the cover and clear the shutdown ~~and workpermit.~~
8. Take trial & Clear the Work Permit.

**Work No 9 : Lime pump gland replacement.**

1. Take shutdown of the equipment and take workpermit.
2. Use completely sealed protective goggle for working in lime area.
3. Close inlet valve of the line.
4. Remove the gland seal & completely remove the old gland.
5. Replace it with new graphite asbestos rope.
6. Replace the gland seal & tighten the bolts.
7. Open the inlet valve.
8. Clear shutdown ~~and take workpermit, handover after taking trial.~~
9. After taking trial of the Equipment Clear the Work Permit.

**Work No.10 : Working on diverter chute.**

1. Take work permit from operation PCM in charge on working at discharge end.
2. Ensure that no one works at discharge sprocket ( pig removal, hammer work, etc) while working on diverter chute .
3. Take proper electrical shut down of PCM by using the LOTO locking system.
4. Keep the diverter chute in retracted position .
5. Close the air supply valve to actuator for diverter chute movement
6. Ensure that actuator is in neutral position
7. Remove the hose at supply to actuator, to make the line free of air supply
8. Lock the diverter chute if necessary, to avoid free movement over the shaft
9. After completion of work, put back the hose and open the air supply valve
10. ~~Clear the work permit and open the LOTO lock before handing over PCM to production.~~
11. Clear the Shutdown ,take trial & after normalcy clear the workpermit.

**Work No 11 : Replacement of Pneumatic Cylinder of Diverter Chute**

1. Take work permit from PCM area engineer on working at discharge area.
2. Ensure that no one works at discharge sprocket ( pig removal, hammer work, etc) while working on diverter chute
3. Take proper electrical shut down of PCM by using the LOTO locking system
4. Close the air supply valve to actuator for diverter chute movement
5. Ensure that actuator is in neutral position
6. Remove the hose at supply to actuator, to make the line free of air supply
7. Lock the diverter chute to avoid free movement over the shaft
8. Remove the air inlet and outlet hose pipes
9. Detach the extension rod on diverter chute for pneumatic cylinder mounting and trunion mounting plates.
10. Replace the pneumatic cylinder with the new assembly, finish the welding for mounting parts and connect the air inlet and outlet hoses
11. After completion of work, put back the air supply hose and open the air supply main valve
12. ~~Clear the work permit and clear electrical shutdown before handing over PCM to production.~~
13. Clear the Shutdown ,take trial & after normalcy clear the workpermit.

**Work No 12 : Repair of discharge chute**

1. Take work permit from PCM area engineer on working at discharge area.
2. Ensure that no one works at discharge sprocket ( pig removal, hammer work, etc) while working on diverter chute
3. Take proper electrical shut down of PCM by using the LOTO locking system
4. Close the air supply valve to actuator for diverter chute movement
5. Ensure that actuator is in neutral position
6. Remove the hose at supply to actuator, to make the line free of air supply
7. Lock the diverter chute to avoid free movement over the shaft
8. Remove the air inlet and outlet hose pipes.
9. Carry out necessary repairs like liner plate replacement , square bar replacement , plate repairs etc….
10. ~~Clear the work permit and clear electrical shutdown before handing over PCM to production.~~
11. Clear the Shutdown ,take trial & after normalcy clear the workpermit.

**Work No 13 : Rectification for chain derailment**

1. Take work permit from PCM area engineer
2. Take proper electrical shut down of PCM by using the LOTO locking system
3. Use 3Ton chain block (qty. to be decided based on the length that has got de railed) for vertical lifting of chain.
4. Similarly connect 3Ton chain block for horizontal pulling of chain .
5. Now slowly start hoisting vertical lifting chain blocks simultaneously till the links have got lifted slightly above roller height.
6. Now slowly start adjusting on horizontal chain block to place the links in its position.
7. Once the chain is placed in its position , check for sufficient tensioning of chain, roller wear , mould to mould fitment to prevent re –occurrence of de railment.
8. Remove all chain blocks from position .
9. Clear electrical shutdown, and take trial of PCM , initially with very slow speed and then gradually increasing to max speed.
10. Clear work permit and give clearance to Operation dept.

**Work No 14 : Replacement of head sprocket.**

1. Take formal electrical shutdown by switching off isolator and put loto lock.
2. Remove the mould 15 no’s by using 3T hoist ,use tested standard chain/sling for lifting mould.
3. Temporarily clear the shutdown and start the belt and mould removed portion should place to top portion of sprocket.
4. Take electrical shutdown of the equipment.
5. Release the tension of link by loosening the tensioning device at the tail end of PCM
6. Lock the chain(link) both top and bottom side using 3 ton chain block and 1 meter wire rope sling(lock RH &LH both top and bottom at required position).
7. Remove the output coupling guard.
8. Transfer/mark radial and axial alignment reading of existing shaft onto the nearby structure
9. Now using a tested 3 ton sling , lock the link on top side with 3 ton chain block on either side to dismantle it.(mould removed link).
10. Remove the cotter pin, tie rod and sleeve .
11. Slowly release the chain block to free the link and remove the link from sprocket.
12. Remove the output coupling bolt and disengage it with gear box.
13. Hold the sprocket with crane.
14. Loosen and remove the foundation bolt of plumber block. If needed gas cutting to be used to cut the bolts.
15. Lift the sprocket, full assembly (plumber block + coupling ) with crane and lower it
16. .Lift new sprocket full assembly with crane and place it in position.
17. Put the plumber block bolt and match coupling with gear box coupling.
18. Align sprocket to gear box and gear box to motor.
19. Tight the base bolt of plumber block ,gear box, motor and release the crane.
20. Re-position the link on sprocket using crane and connect link using chain block.
21. Ensure total area is free from any obstacles.
22. Fix back the coupling guards.
23. Release the electrical shutdown.
24. Take trial run of strand at very low speed initially and later speed can be increase gradually if everything is found to be OK
25. Take electrical shutdown by switching off isolator and put loto lock.
26. Fit the removed mould .(positioning link below 3T hoist).
27. Clear electrical shutdown .(Remove loto lock and switch on isolator).
28. Take trial run of strand.
29. Clear work permit and hand over machine to operation department.

**Work No 15 : PCM Strand Stringer Replacement.**

1. Take clearance from operation dept and take the work permit..
2. Take electrical shutdown , LOTO-V of PCM’s Put the LOTO by isolation officer and requesting officer and should be retained till the job is completed.
3. Lift the link of Selected length by hydraulic jack/3T Hoist/chain block of required capacity , Also provide Packing(Box up channel) to the lifted Link on both Ends for Carrying & for return packing by ISMC 100(C Type frame).
4. Take proper care to avoid slipping of the jack as PCM structure is inclined in position.
5. Ensure to check the condition and certification of screw/ hydraulic jack before use.
6. Remove the roller & roller bracket from the area where stringer is to be replaced.
7. Mark the Position of stringer of selected length .
8. Dismantle the Stringer of Selected length using gas-cutting set as per SP44 and remove the stringer.
9. Position the New stringer manually at the required level and once the levelling is done. lock it in its position.
10. After locking (By splice plate welding on web of Stringer) complete welding is to be done..
11. Fix the roller brackets & rollers.
12. Align rollers by using water level tube & line Dori on the stringer.
13. Alignment of rollers will be checked by Maintenance team.
14. After alignment of rollers, lower the chain links.
15. Temporary release the shutdown of PCM Strand & Trial to be taken by Maintenance team.
16. Lower down the hoist/remove hydraulic jack/ chain block.
17. After completion of the job including removal of slings, stoppers (if any welded), Attend the housekeeping jobs , inform the shift engineer production. Clear electrical shutdown by removing the LOTO
18. Temporary release the shutdown of PCM Strand & Trial to be taken by Maintenance team.
19. After normalcy of the equipment, no load trial is to be taken.
20. Clear the Work Permit and hand over equipment to user department.

* **Carry out housekeeping as per procedure** [**WI/MAINT/91**](file:///C:/Users/Vaaman%201/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/7451Z5P9/WIMAINT91%20HOUSE%20KEEPING.doc)**.**

**DO**

* Use tested chain blocks & slings only.
* Cordon the total workable area of pig casting machine.
* Use proper hammer for punching cut bolts.
* Return back all scrap to store.
* Avoid oil spillage while lubricating the machine. Use oil tray while carrying out lubrication activity
* Use completely sealed goggles while cleaning the machine with compressed air.
* Follow work instruction [WI/MAINT/12](file:///C:/Users/Vaaman%201/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/7451Z5P9/WIMAINT12%20MATERIAL%20HANDLING%20.doc) for material handling
* Stay away from the lifted mould or other lifted items.

**DO NOT**

* Work at PCM tail end when ladle is placed on tilter.
* Cool the mould using water.
* Stand below the hoist during operation.
* Operate the hoist in inclined position.
* Keep Cutting set hoses haphazardly on walkway.

**REFERENCES: Operation & Maintenance manual**

**Amendement Record**

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| **Date** | **Manual Section Ref. & Para** | **Brief details of Revision** | **New Rev.** |
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| --- | --- | --- |
| **Prepared By:**  Area Engineer | **Reviewed & Issued By:**  Management Representative | **Approved By:**  Mechanical Head |
| **Signature:** | **Signature:** | **Signature:** |
| **Review Date: 15.09.2022** | **Review Date: 15.09.2022** | **Review Date: 15.09.2022** |