Government of Maharashtra

Directorate of Industrial Safety and Health

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Subject: **Safety Guidelines for Steel Rolling Mills.**

Introduction:

In the current situation of Covid-19 lockdown, the inspection of all the factories may not be possible by this directorate. Hence all such type of factories are hereby directed to follow the following safety measures in addition to the provisions of The Factories Act, 1948 and The Maharashtra Factories Rules, 1963.

The given guide lines are not exhaustive in nature; any additional precaution as may be necessary based on specific requirement should be adopted by the factory management for safe manufacturing operation of the factory based on the nature of manufacturing activity

Safety Guidelines for Steel Rolling Mills.

Rolling is the process of Plastically deforming the metal by passing it between a set of rolls revolving in opposite direction. Rolling is the most widely used metal forming process.It is used to convert metal ingots to products like blooms,billets,sheets,plates etc.The main objective of the rolling is to decrease the thickness of the metal & give it a desired profile.

i) **Steps Before Re-starting of Rolling Mill**:-

1) Disconnect all panels from transformer, before switching on of transformer.
2) Check Breakdown Voltage(BDV)value of transformers, do oil filtration if BDV value is less.
3) Switch on transformer, let it be on humming for 8-12 hrs before putting any load.
4) Connect load panels one by one to transformer.
5) Measure temperature rise of transformer for 2 days.
6) Switch on each load (motor, pumps, drives) with some interval between them.
7) Clean (preferably vacuum clean with low pressure) panels before switching on.
8) Observe any temp rise in any section of panel, cables.

9) Dry run all motors for minimum 2 hrs with temp and noise observation.
10)Grease all bearings before switching on rotation motion.
11) Ensure oil viscosity of lubricating oil.
12) Ensure heat exchangers are working properly for all oil cooling system.
13) Check all pneumatic system leakages.
14) Switch on compressors and drain any water in reservoir.
15) Run complete mill without hot material for minimum 2-3 hrs at full speed, observe any undue load, vibration, friction, heat etc.
16) start rolling using single single piece for couple of hrs.
17) After one shift start producing normally.

ii) **Raw Material :-**

a) Raw Materials Storage shall be in covered shed to avoid use of wet or damp raw materials in to the charge mix during melting in the furance.

b) Raw materials shall be fee from Oil, grease and moisture and if required, pre-heating system shall be provided.

c) Pre-heat the charge and ensure that Slag spoon and furnace tools are dry before use.

d) Dedicated team for scrap sorting. Special identification card shall be given to them. They shall be so spectator that there will not be any chance of mixing scrap and sorted scrap.

e) Scrap shredding machine to be provided.

f) Scrap press machine to be provided.

g) Scrap size shall be maximum up to $1/3^{rd}$ of the furnace inside diameter.

h) Do not charge heavy material in the molten metal bath and if required charge it at the start of melting.

i) Proper care should be taken while segregating/shorting of the Raw material Scraps .

j) Do not charge sealed containers, sections of tubing or piping in to the mix.

k) Do not charge bulky scrap in to the empty furnace directly to avoid furnace lining failure due to sudden or cumulative effect of physical shock.

iii) Induction Furnace :- .

a) Every new lining shall be of right refractory material based on the operating temperature of the furnace and type of metal to be melted.

b) New furnace lining and sintering cycle should be done as per refractory lining material manufacturer's procedure with supervision.

c) Monitor the lining condition visually for any abnormal erosion, daily.

d) Monitor and record the inner lining dimensions of the crucible, weekly.

e) Refractory lining material manufacturer's procedure to be followed for cooling and heating of the furnace during weekly off to avoid furnace lining failure due to sudden or cumulative effect of thermal shocks.

f) Overheating of the melt shall be avoided by monitoring and taking the temperature of the liquid metal.

iv) **Induction Furnace Maintenance Safety Precautions:-**

a) Daily check De Mineralized(DM) water conductivity to be maintained below 20 m.S (Micro moh).

b) Daily check hardness of soft (coil) water.

c) check flow switches & pressure switches working weekly.

d) check weekly de mineralized water conductivity if exceed 20 m.S (Micro Moh), then open the gate valves of de-ionizer i.e. flow through cartridge. If conductivity not improved, then replace complete DM. water.

e) Weekly clean the contacts of change over or D.C. switch with Solvent like CTC & brush.

f) Weekly ensure that there is no hydraulic oil leakages.

g) Check the oil level in transformer conservator & top up with dry oil if required, monthly.

h) Check the alarm & trip contact of relay, winding temperature sensor, oil level indicator sensor & transformer oil temperature indicator sensor, monthly.

i) Check transformer for nay oil leakage, monthly.

j) Heat exchangers plates cleaning shall be done 6 monthly.

k) Check yearly furnace coil and reinsulated coil of the crucible if required.

l) Servicing of Air Circuit Breaker shall be done atleast yearly.

m) Transformer & Oil circuit breaker oil checking for dielectric strength shall

be done at least yearly.

n) Log Book shall be maintained for above points and shall be produced whenever asked.

v) **Induction Furnace General Safety Precautions:-**

a) Ground leak detector system shall be checked frequently. Leak detectors shall be interlocked electrically as per manual so that supply power to furnace will be cut off.

b) Every time, proper protective clothing and eye protection shall be used by Operators.

c) Daily, ensure sufficient water in water storage tank supply water to coil.

d) Back up cooling system for furnace cooling such as diesel pump or a D.G. Set shall be provided, if normal pumps fails to operate.

e) Daily, ensure over head emergency water tank is full.

f) Daily ensure cooling power fan is running.

g) Furnace spillage pit shall be cleaned at least once within 6 months.

h) Excessive temperature and bridging of the scrap in to the furnace shall be avoided by manual poking of charge material when liquid metal is ¾ th ready in furnace.

g) Furnace shall be emptied out completely in the event of prolonged power Failure, loss of coolant event and prolonged furnace shutdown to avoid furnace Lining failure due to sudden or cumulative effect of mechanical stress.

h) Do not charge bulky scrap in to the empty furnace directly to avoid furnace lining failure due to sudden or cumulative effect of physical shock.

i) For every induction furnace dry spill pit shall be provided to contain safety any molten metal spilled from the furnace as a result of accident; run-out or dumping of furnace in an emergency. Pit capacity of each furnace shall be large enough to hold 150% of its furnace's capacity Pits shall be constructed of concrete and lined with fire brick. Area under furnace shall be sloped to carry spilled metal, away from furnace and into deeper holding pit. Area directly in front of the furnace

shall be covered with steel grating. Spill pits must be kept completely dry at all times Spill pits shall be checked daily.

j) Poking machine to be provided near furnace &The poking machine shall be operated by remote control from a cabin away from the furnace.

k) The Over Head Crane shall be operated by remote control from a cabin away from furnace platform &The crane operator shall be facilitated with Screen of CCTV to have 360 degree view while operating the crane. Necessary provision such for hooter/ warning signals shall be provided in the cabin.

l) The number of workers working at one time on the furnace platform to be limited to maximum 8 numbers .

m) Movable Shed shall be provided to use as protection while working on other furnace(preparation of furnace) when the first furnace is operational to avoid splashing of molten metal.

n) While preparing lining of the furnace due care should be taken and periodical inspection of the lining should be carried out after every heat.

o) The furnace should not be in operation than its designated life (Lining life) and immediately should be discontinued and given for maintenance .

vi) **Crucibles/ Ladle Movements :-**

1. Ladle movement shall be through dedicated path restricted for workers movement.
2. Audio /visual alarm shall be provided to alert the persons working nearby.
3. There shall be dedicated place for purging operation with restricted movement of persons nearby.
4. There shall be arrangement to ensure that only inert gas is used purging with proper cylinder manifold arrangement with flow and pressure regulations.
5. Pressure regulating valve, Pressure gauges shall be provided to the nitrogen cylinders and nitrogen purging pipe line.
6. Nitrogen purging operation should have been carried out by trained persons and preferably at the isolated place(NO MAN AREA) at the ground floor.
7. All ladles shall be free from slag and properly maintained for shifting of molten metal into moulds of the ingots.
8. Work permit system to be followed for repairing of ladles/crucibles and other activities near the furnace.

vii) **Personal Protective Equipments :-**

1. Personnel working in molten metal shall be provided adequate personal protective equipments(PPEs).
2. It shall be
    a. Heat/Flame Resistance Protective clothing must be made of fabric that is flame resistant so that it will not ignite and continue to burn after the heat source is removed. Additionally, FR fabrics should shield the wearer from second- and third-degree burns as much as possible.

b. Ability to Shed Molten Metal. The fabric must demonstrate the ability to shed molten metal from its surface without sticking.
c. It shall be satisfy the test criteria as per ASTM F955 Test method or EN ISO 11612 / EN 531.
d. The management should provide special PPES like heat-resistant suit/Aprons, goggles helmets,face shields,safety shoes,gum boots,safety belts, etc to workers working near furnace,CCM ,in mill section and to workers Handling molten metal in the factory.

viii) **Ventilation :-** "Efficient Exhaust Draught" means localised ventilation effected by heat or mechanical means, for the removal of gas, vapour, dust or fumes so as to prevent them (as far as practicable under the atmospheric conditions usually prevailing) from escaping into the air of any place in which work is carried on. No draught shall be deemed efficient which fails to remove smoke generated at the point where such gas, vapour, fumes or dust originate. Where dust, fume, gas or vapour is produced in the process, provision shall be made for removing them by means of an efficient exhaust draught so contrived as to operate on the dust, fume, gas or vapour as closely as possible to the point of origin.

ix) **Testing and examination of ventilation systems**:- (1) All ventilation systems used for the purpose of extracting or suppressing dust as required by this schedule shall be examined and inspected once every week by a responsible person. It shall be thoroughly examined and tested by a competent person once in every period of 12 months. Any defects found by such examinations or test shall be rectified forthwith.

x) A register containing particulars of such examination and tests and the state of the plant and the repairs or alteration (if any) found to be necessary shall be kept and shall be available for inspection by an Inspector.

xi) **House Keeping** - A high standard of housekeeping shall be provided and maintained by the occupier.

xii) **Additional Safety Measures :-**

1. Induction training as well as refresher training shall be given to all permanent and contractual workers at regular interval. Training records to be prepared and maintained.
2. All practicable measures shall be taken to prevent splashing of molten metal fall on the body of the worker working nearby on the Continuous Casting Machine platform and furnace platform.
3. All mechanical moving machine parts are to be barricaded/guarded.
4. Conveyors and cooling beds should be properly Guarded/ barricade should be provided with audio alarm where finish product travels.
5. Safe Operating Procedures & Standard Maintenance Practices shall be prepared in the local language for each operation and displayed in the factory& shall be used invariably.

6. Work permit system shall be strictly followed during working in the factory i.e. height work,Cold/Hot work Electrical work,Maintenance work or Confined Space work.
7. Loto system or removing of fuses where maintenance work is going on and handing over those removed fuses to the supervisor is a must.
8. Proper Preventive Maintenance and Periodical Inspection of all lifting tools and tackles, lifting magnets, chains, ropes,EOT cranes, chain pulley blocks should be done.
9. Cold water should be provided at various places where workers are exposed to heat stress.
10. Periodical checking of all capacitor system and cooling system of induction furnace is essential.
11. The repairs of all refractory lining work shall be carried out by well experienced and skilled person only.
12. Occupational Health Centre(OHC) shall be maintained as Per Rule 73-W of Maharashtra Factories Rules,1963. Medical Examination of workers should be carried out periodically
13. On Site Emergency Management Plan shall be prepared& Mock drills to be conducted at regular intervals.
14. Drinking water facility and clean toilets for workers shall be nearby the site of induction furnace.
15. High noise areas should be identified and proper PPEs should be given to workers.
16. Electrical inspection to be frequently.
17. Earth pit numbering and testing to be done .
18. Designated places for cylinder Storage with shed not exposed to sunlight.
19. Flash back arrestor to be provided to the gas cutting set.
20. Internal safety Audit shall be done regular interval of Time.
21. Hand tools to be checked in every six month.

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