Machine Maintenance Safety in Die Casting

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NADCA Safety Series

• 4 parts
  • Basic Safety
  • Machine Maintenance Safety
  • Electrical Safety
  • Managing Safety
• General safety information
  • Visitors, new employees, refresher
• Can supplement, but does not replace plant safety training
Outline

- Control of Hazardous Energy
  - Purpose
  - Who is Involved
  - Equipment
  - General Energy Control Procedure
- Secondary Safety Measures
- Machine Guarding
  - Purpose
  - Types of Safety Devices
  - Machine Hazards
  - Auxiliary Equipment
Control of Hazardous Energy

• Protect workers from machine hazards while working in and around machines (repair and servicing)
Types of Hazardous Energy

- **Electrical** – Drive electric motors on pumps and interlocks between pieces of equipment

- ** Mechanical** – Kinetic energy from moving components and stored energy

- **Hydraulic** – Pressurized fluid used to provide power to move machine components
Who is Involved?

- Authorized
  - The worker(s) doing the repairing or servicing of the machine
  - Trained on maintenance procedures for machine being worked on
  - Responsible for initiating lock-out/tag-out before starting work on a machine
Who is Involved?

• Affected
  • Worker(s) who normally operates the machine that is locked or tagged out
  • Could be operator of adjacent machine if that machine needs to be locked or tagged out also
  • Should be notified that the machine is being repaired or serviced
Who is Involved?

• Other
  • Any employee who may enter the area of locked or tagged out machine.
  • This can be a:
    • Custodian cleaning the floor around the machine
    • Parts handler transporting parts through that area
    • Quality inspector checking parts nearby
Equipment

Lock-out Devices

• Every authorized employee has their own lock (lock will have some identification on it)
• Authorized employee must lock-out all relevant hazardous energy before beginning work on a machine
• After work is complete authorized user must remove all locks and lock-out devices that belong to them
Equipment

Tags

- Tags may be utilized if a device cannot be locked out
- Tag must be placed as close as possible to the de-energized location
- When tags are used it is recommended to use the buddy system to ensure the machine is not re-energized accidentally
Multiple Lock-outs

- Multiple energy isolation locations require multiple lockouts.
- Lock-out boxes useful for groups working on the same machine or in same cell.
- Locks on isolation devices cannot be removed until all locks are removed from lock-out box.
General Energy Control Procedure

• De-energizing
  1. Notify all affected employees
  2. Shut down the equipment by the normal procedure
  3. Isolate the equipment from its energy source
  4. Lock-out or tag-out the energy isolating device
  5. Check for exposed personnel and then try to operate the equipment to make sure it will not operate (return to neutral or off position)
General Energy Control Procedure

• Re-energizing
  1. Check area around equipment to ensure that no one is exposed
  2. Remove all tools, reinstall machine guards, and remove all lock-out/tag-out devices
  3. Operate the energy isolating device to restore energy to the equipment

If more than one person is performing work on the machine each person will need to remove his/her lock from the hasp on the energy isolating device
Specific Control Procedures

- Most machines have specific control procedures
- Specific control procedures should be made available to necessary workers
  - Written procedures are located at the machine/work area
  - Procedures should be specific to job functions (i.e. cleaning the robot cell vs. setting up the die)
  - Electronic devices can be used to provide work instructions
  - Pictures and/or videos provide details of hard to explain instructions
Additional Safety Measures

• Zero energy state does not mean there are no hazards
• Use proper safety equipment and procedures when working on machines
• Some situations that require additional safety measures:
  – Working between die halves
    • Die Cast Machine
    • Trim Press
  – Working at heights
  – Working under machines or heavy components
Between Die Halves (DCM)

• When working between die halves a safety bar placed on the tie bar to prevent the die from closing if it is re-energized
Between Die Halves (DCM)

• Die casting machine components can be hot
  – Especially die halves if die was running
• Be aware of possible snag or pinch hazards
• Wear proper Personal Protective Equipment (PPE)
  – Natural fiber clothing (Long sleeve, no cuffs)
  – Safety glasses
  – Leather or heat resistant gloves
  – Steel toed boots (metatarsal guards may be required)
  – Hearing protection
  – Hard hat or bump cap may be required
Between Die Halves (Trim Press)

- Trim press dies are heavy and can be suspended in the open position while working on the trim press.
- Potential for the trim press die to close even when locked out.
- Use Safety Columns to prevent dies from closing:
  - Similar to safety bar on die casting machine.
  - Acts as a spacer between die halves.
Working at Heights

• Proper fall protection must be used when working at 6 feet or higher above the lower surface
  – Railings on elevated platforms or scaffolding
  – Personal fall arrest system (harness) when railings or platform not available
  – Proper use of ladder
  – Floor covers or rails around openings
• Fall protections can be combined when needed
Working Under Machines

• When possible, find alternative to working under a machine or heavy object

• If no alternative, use proper precautions
  – Inspect joints/fasteners supporting the machine or object
  – Insert brace(s) to help support machine or object
Machine Guarding

- Prevent any part of worker’s body or clothing from making contact with moving parts
- Be attached so that workers cannot easily remove, tamper with, or circumvent the guard
- Prevent falling objects from falling into moving parts
- Cannot create a new hazard
- Should not interfere with the work process
- Should allow safe lubrication of the machine
- Removed for maintenance or repair must be replaced before machine is restarted
Types of Safety Devices

- Many ways to protect operators from machine hazards
- Multiple safety devices may be appropriate for a specific application
- Choose best device for the work being done or a combination of devices
Fixed

- Provides a barrier
- Easily constructed for specific applications
- Inexpensive and can be manufactured in-plant
- Can interfere with visibility
- Limited to specific operation
- Adjustments and repairs can be difficult or time consuming
Interlocked

- Shuts off or disengages power or prevents machine starting when guard is open
- Can provide maximum protection
- Allows access to machine
- Requires adjustment and maintenance
- May be easy to disengage
Adjustable

- Adjustable barrier to fit multiple applications
- Used for different sizes of parts
- Can fit varying applications
- May allow operator to bypass guard
- Body may enter hazard area when adjusting guard
Photoelectric

- Interrupts machine cycle or prevents starting of machine while light field is broken
- Allows operator free movement
- Operator has access to area between cycles
- Offers no protection against mechanical failure
- Limited to machines that can be stopped
Pullback

- Operator’s hands pulled out of danger area at beginning of machine cycle
- Eliminates need for auxiliary barriers
- Limits movement
- May obstruct work-space
- Adjustments for each operator
Two-hand Control

- Concurrent use of both hands prevents operator from entering danger area
- Operator’s hands in a predetermined location
- Hands are free after start of cycle
- Requires a partial cycle machine with a brake
- Can be manipulated by the operator
- Protects only the operator
Gate

- Provides barrier between danger area and operator
- Prevents entering into danger area
- May require frequent inspection/maintenance
- Can interfere with operator’s vision
Automatic Ejection

- Parts are ejected by air or mechanical means
- Eliminates operator involvement in danger area
- May create hazard with blowing dust or chips
- May require frequent inspection/maintenance
- Air ejection will increase noise level in plant
Robots

- Perform work usually done by operator
- Prevents operator from entering danger area
- Suitable for operations with harsh environments
- Becomes a new hazard
- Can require frequent maintenance
Machine Hazards

High Pressure + High Temperature = Hazards
Toggle Linkage

- Opens and closes die
- Locks die closed prior to metal injections
- Guards deter entry into toggle linkage area
- Post sign to warn against disabling or by-passing guards
Injection Sleeve & Tip

- Inject metal into die at high velocity
- Cold chamber – metal can splash as it is poured in and can spit out back of shot sleeve if plunger is loose  
  - Plunger becomes a shear hazard when it moves past pour hole
- Hot chamber – nozzle can become loose and spit metal
Safety Ratchet

- Prevent accidental closing of die casting machine
  - Safety conditions met before safety ratchet lifts
- Hazard for someone working on top of the machine
Operator’s Door

• Prevents operator from entering machine during operation
• Protects operator from metal spitting from parting plan
• Protects operator from exploding biscuit
Mechanical Ladles

- Performs hazardous task of transporting molten metal from furnace to shot sleeve
- Can be hazardous to workers entering area where mechanical ladle is operating
Hydraulic Trim Press

• Hydraulic force used to shear gates, runners and overflow from castings
• Can crush any part of the body that is caught between trim dies during operation
• Operators need access to danger area between cycles
• Light curtains, pull-back devices and two-handed control (maintain hold) are commonly used
Casting Extractors, Conveyors and Hoists

- Prevent operators from working in hazardous areas or assist with transporting equipment or material
- Employees should be kept clear of extractors
- Conveyors need guards on pinch points
- Hoists should have a clear path when moving objects
Questions

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