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Standard Practice for Safety Requirements in Metal Casting Operations: Sand Preparation, Molding, and Core Making; Melting and Pouring; and Cleaning and Finishing[1]

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INTRODUCTION

This practice is part of a project started in 1972 under the sponsorship of the American Foundry Society, Inc. Standard for Safety Requirements in Metal Casting Operations—Sand Preparation, Molding, and Core Making; Melting and Pouring; and Cleaning and Finishing.

The metal casting industry shares safety considerations with many other industries requiring the movement of heavy objects, the use of large ovens and melt furnaces, and processing of hot materials. In addition, there are safety considerations common to all industries. The present trend is towards the development of industry-wide standards wherever the need for safety considerations exists. This practice, therefore, is limited to safety considerations of special importance in the metal casting industry operations in which general standards do not exist or are not considered adequate. This practice is not intended to supersede or replace any applicable federal, state, or local governmental safety regulations or requirements, but rather, it is intended to augment and support any such requirements. Operating rules are not included in this practice unless they are vital to safety.

Compliance with this practice should provide a relatively safe environment, which is a fundamental requirement in preventing occupational injuries.

Contents

[1] This practice is under the jurisdiction of ASTM Committee E34 on Occupational Health and Safety and is the direct responsibility of Subcommittee E34.10 on Industrial Safety.

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Contents

1. Scope

1.1 This practice covers the requirements of applying the design, construction, and operation of the machinery and equipment used in metal casting operations—sand preparation, molding and core making, melting and pouring, and cleaning and finishing. This practice does not apply to die casting operations.

1.2 *Purpose*—The requirements of this practice, including the training of supervisors and employees, are intended to minimize the possibility of injury to operating and maintenance personnel while working on, or in the vicinity of, the specified equipment. Compliance with this practice, in conjunction with OSHA regulations, provides a relatively safe environment, which is a fundamental requisite in helping to prevent occupational injuries.

1.3 *Application:*

1.3.1 *New Installations*—After the date of publication, all new installations within the scope of this specification shall be in conformance with its requirements. Any existing machine installation moved to a new plant or another location in the same plant is deemed a new installation when it is installed in the new location. However, an existing installed machine (former installation) that is moved for a short distance, for example, to provide additional aisle space, is not deemed to be a new installation.

1.3.2 *Existing Installations*—After the approval date of this practice, installations existing on, or before, this date, shall be modified as necessary to be in conformance with all requirements of this practice. Where it is not practical to modify an existing facility in conformance with this practice, deficiencies shall be noted and plans for compliance shall be included in any future facility or equipment changes. Those facilities and equipment on order or in the process of construction on the date of publication of this practice shall be considered as an existing installation. This practice applies to existing equipment if it lacks the necessary employee protection (personal protective equipment or administrative controls).

1.4 The values stated in inch/pound units are to be regarded as the standard. The values in brackets are for information only.

1.5 The text of this practice references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate ~~safety~~ safety, health, and ~~health~~environmental practices and ~~to~~ determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1542 Terminology Relating to Occupational Health and Safety

F1002 Performance Specification for Protective Clothing and Materials for Use by Workers Exposed to Specific Molten Substances and Related Thermal Hazards

F1449 Guide for Industrial Laundering of Flame, Thermal, and Arc Resistant Clothing

2.2 *ANSI Standards:*[3]

ANSI A12.64.1 Safety Requirements for Workplace, Floor and Wall Openings, Stairs and Railing Systems

ANSI A58.1 Minimum Design Load in Buildings and Other Structures

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

ANSI B5.35 Machine Mounting for Abrasive Discs and Plate Mounted Wheels
ANSI B 11.6 Safety Requirements for Manual Turning Machines with or without Automatic Control
ANSI B7.1 Safety Requirements for the Use, Care and Protection of Abrasive Wheels.
ANSI B11.9 Grinding Machines, Safety Requirements for the Construction, Care and Use of
ANSI B11 TR3 Risk Assessment and Risk Reduction—A Guide to Estimate, Evaluate and Reduce Risks Associated with Machine Tools
ANSI B15.1 Mechanical Power Transmission Apparatus
ANSI B20.1 Safety Standard for Conveyors and Related Equipment (ASME B20.1)
ANSI/ASME B30.2 Overhead and Gantry Cranes (Top Running, Bridge, Single or Multiple Girder Top Running Trolley Hoist)
ANSI/ASME B30.9 Slings
ANSI/ASME B30.10 Hooks
ANSI/ASME B30.11 Monorails and Underhung Cranes
ANSI/ASME B30.20 Below-the-hook Lifting Devices
ANSI B107.4 Driving & Spindle Ends for Portable Hand, Air and Electric Tools (Percussion Tools Excluded)
ANSI B186.1 Portable Air tools
ANSI Z9.2 Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems
ANSI Z9.4 Ventilation and Safe Practices of Abrasive Blasting Operations
ANSI Z33.1 Standard for the Installation of Blower and Exhaust Systems (NFPA 91)
ANSI Z43.1 Ventilation Control of Grinding, Polishing/Buffing
ANSI Z244.1 Personnel Protection—Lockout/Tagout of Energy Sources—Minimum Safety Requirements
ANSI Z490.1 Accepted Practices in Safety, Health and Environmental Training
ANSI Z535.1 Safety Color Code
ANSI Z535.2 Environmental and Facility Safety Signs
ANSI Z535.3 Criteria for Safety Symbols
ANSI Z535.4 Product Safety Signs and Labels
ANSI Z535.5 Accident Prevention Tags

2.3 *NFPA Standards:*[4]
NFPA 49 Fire Protection Guide to Hazardous Materials
NFPA 68 Guide for Venting of Deflagrations
NFPA 70 National Electrical Code
NFPA 86 Standard for Ovens and Furnaces
NFPA 480 Standard for Storage and Handling of Magnesium
NFPA 484 Standard for Combustible Metals

2.4 *Occupational Safety and Health Administration:*[5]
29 CFR 1910 Code of Federal Regulations, Part 1910 General Industry
29 CFR 1910.23 Guarding Floor and Wall Openings and Holes
29 CFR 1910.94(a) Ventilation—Abrasive Blasting
29 CFR 1910.145 Specification for Accident Prevention Signs and Tags
29 CFR 1910.146 Permit required Confined Spaces
29 CFR 1910.147 Control of Hazardous Energy (LOCKOUT/TAGOUT)
29 CFR 1910.184 Slings
29 CFR 1910.215 Abrasive Wheel Machinery
29 CFR 1910.217 Mechanical Power Presses

NOTE 1—State plan states may have their own regulations.

2.5 *American Foundry Society (AFS):*[6]
Guide for Selection and Use of Personal Protective Equipment and Special Clothing for Foundry Operations Managing the Foundry Indoor Air Environment

3. Terminology

~~3.1 *abrasive blasting, n*—operation in which an abrasive is forcibly applied to a surface by pneumatic or hydraulic pressure or centrifugal force.~~

3.1 For definitions of terms used in this standard, see Terminology E1542.

[4] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.
[5] Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, http://www.osha.gov.
[6] Available from the American Foundry Society, 1695 N. Penny Lane, Schaumburg, IL 60173.

~~3.2 *adjustable barrier guard, n*—physical barrier with adjustable sections that prevents entry of any part of the body into the hazard zone by reaching through, over, under, or around the barrier. The adjustable sections allow different jobs to be run on the equipment.~~

~~3.2.1 *Discussion*—~~

~~This type of guard requires close supervision of use and adjustment or inadequate protection could result. It shall be the responsibility of the employer to establish and follow a program of periodic and regular inspection of power press and auxiliary equipment. Refer to 29 CFR 1910.217(e).~~

3.2 *Definitions:*

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3.2.3 *arc furnace, n*—see *direct arc furnace and indirect arc furnace*

3.2.4 *automatic, adv*—each function in the machine cycle is initiated by the previous cycle and is automatically performed and sequenced, including load, unload, and repeat cycle.

3.2.5 *bail/spreader, n*—hoop or arched connection between the crane hook and ladle or between crane hook and ladle trunnions.

3.2.6 *barrier guard*—see *adjustable barrier guard, fixed barrier guard, and interlocked barrier guard.*

3.2.7 *blast, n*—air or oxygen-enriched air that is blown, under pressure into a cupola for supporting combustion.

3.2.8 *blast compartment, n*—that portion of the blasting enclosure that contains the blasting media propulsion device.

3.2.9 *blow plate, n*—plate affixed to the magazine or blow head of a core- or mold-blowing machine having holes or slots through which sand or other media in the magazine or blow head passes into the core or mold cavity or around the pattern when air or other gas pressure is applied to the machine.

3.2.10 *bottom discharge (pour, tap) ladle, n*—ladle that has its molten metal contents discharged through an opening in the bottom.

3.2.11 *channel furnace, n*—electric induction furnace in which heat is electrically induced in the metal in a refractory channel.

3.2.12 *charge, n*—material introduced into a melting furnace for the production of molten metal.

3.2.13 *charging, v*—process of adding a charge to a furnace.

3.2.14 *control circuit (electrical), n*—circuit of a control apparatus or system that carries the electric signals directing the performance of the controller, but does not carry the main power current.

3.2.15 *controller, n*—device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.

3.2.16 *core, n*—preformed aggregate or collapsible insert placed in a mold to shape the interior or that part of a casting that cannot be shaped by the pattern.

3.2.17 *core binder(s), n*—any material, liquid or solid, which is used to bond core aggregates.

3.2.18 *corebox, n*—a (wood, metal, or plastic) structure, the cavity of which has the shape of the desired core that is to be made therein.

3.2.19 *coreless furnace, n*—electric induction furnace consisting of an induction coil surrounding a crucible or refractory lining in which metal is melted or molten metal is retained.

3.2.20 *core- or mold-blowing or shooting machine, n*—machine for injecting sand or other media into the core or mold cavity by means of compressed air or other gas.

3.2.21 *counterweight, n*—weight that corrects a state of unbalance and establishes static equilibrium.

3.2.22 *crane ladle, n*—ladle handled by an overhead crane.

3.2.23 *crucible, n*—container used for the melting, holding, and pouring of metal.

3.2.24 *cupola, n*—vertical shaft-type furnace for melting and/or producing molten metal by combusting coke or other fuels using a blast, and possibly additional pure oxygen, that is introduced through the cupola tuyeres.

3.2.25 *cupola drop, n*—materials dropped from the cupola at the end of a heat.

3.2.26 *direct arc furnace, n*—furnace in which heat is produced by an electric arc between electrodes and the charge.

3.2.27 *disconnecting means (electrical), n*—device, or group of devices, or other means by which it is possible to disconnect the conductors of the circuit from their source of supply.

3.2.28 *disconnect switch (electrical), n*—switching device used primarily for isolating a circuit or equipment from a source of power.

3.2.29 *drop area, n*—the area directly under the cupola that receives the hot bed coke or other hot materials from the inside of the furnace when the bottom doors or side access door are opened.

3.2.30 *drop zone, n*—the zone adjacent to the drop area that is exposed to drop hazards during the dropping process.

3.2.31 *dross, n*—metal oxides or foreign matter or both that accumulates on the surface of nonferrous molten metal.

3.2.32 *dust collector, n*—air-cleaning device to remove particulate matter from exhaust systems before discharge to the atmosphere.

3.2.33 *exhaust system, n*—system of air-moving equipment and ducts used to remove airborne contaminants from affected areas.

3.2.34 *explosion vent, n*—a device that is engineered as part of an enclosure, container, or vessel that is designed to release pressure rapidly.

3.2.35 *finishing, v*—attainment of a desired surface finish or finish characteristics by such means as abrasive impingement, grinding, or polishing.

3.2.36 *fixed barrier guard, n*—securely attached physical barrier, not readily removable, that prevents entry of any part of the body into the hazard zone by reaching through, over, under, or around the barrier.

3.2.37 *flame detector, n*—device, which senses the absence or presence of flame, for the purpose of controlling fuel line valves.

3.2.38 *flask, n*—container, without top or bottom, used to contain the sand or other media while it is being formed. It is made in two or more parts, the lower part called the drag and the upper part called the cope. Intermediate sections, if any, are called cheeks.

3.2.39 *flask lifting device, n*—chains, rods, bails, cables, slings and other materials used to support a load such as a flask for turning, inverting, or transporting.

3.2.40 *fuel-fired equipment (enclosed), n*—specially heated chamber such as core oven, drying oven, thermal sand reclamation, sand heater, or annealing oven.

3.2.41 *gas handling system, n*—the collective group of equipment that draws cupola gas from the furnace.

3.2.42 *guarded, adj*—shielded, fenced, enclosed, or otherwise protected by means of suitable enclosure, covers, casing, shield guards, trough guards, barrier guard, railing guards, or guarded by location, or other protective devices, so as to reduce the possible risk of personnel injury from accidental contact or approach, or in the case of spill guards, so as to reduce possibility of personnel injury from material being spilled into the area protected. Where it is not feasible to guard against the hazard, or where the guard itself creates a hazard, the potential hazard shall be marked prominently to warn of its existence.

3.2.43 *guarded by location, adv*—to be guarded by location or position in accordance with the height above a walkway, platform, or workspace, any moving part shall be at least 8 ft (2.46 m) above same. However, pinch points of all descriptions and moving projections shall not be guarded by location unless they are a minimum of 9 ft (2.74 m) above the pertinent floor. When moving parts are remote from floors, platforms, walkways, other working levels, or by their location with reference to frames, foundations, or structures that minimize the probability of accidental contact by personnel, they shall be considered to be guarded by position or location. Remoteness from regular or frequent presence of public or employed personnel, in reasonable circumstances, constitutes guarding by location.

3.2.44 *hazard, n*—a condition or series of conditions, either continuous, intermittent or instantaneous in nature that exists, or could exist, such that bodily injury could result. Hazards include, but are not limited to, falling, pinching, crushing, cutting, impaction, burning, concussion, suffocation, occupational disease, asphyxiation and/or electrocution.

3.2.45 *hazard point, n*—closest point within the hazard zone at which physical contact occurs between machine elements or materials or both.

3.2.46 *hazard zone, n*—that area where a hazard exists and bodily injury could result upon direct exposure or contact with that hazard.

3.2.47 *heat, n*—stated weight of metal obtained from a period of melting in a cupola or furnace or the time required to melt and process this material.

3.2.48 *hopper, n*—bulk container in which materials are stored.

3.2.49 *hostage control, n*—type of control in which the physical act of operating the initiator prevents operator exposure to the motion or response produced by the initiator.

3.2.49.1 *Discussion*—

An initiator located a sufficient distance from the hazard zone that the operator cannot reach the point of operation during the hazardous portion of the cycle, after operating the initiator, is an example.

3.2.50 *hostage protection, n*—means of minimizing personnel exposure to hazards by making it easier to perform an operation in a prescribed manner through work piece or machine design or both.

3.2.51 *inch control, n*—hostage control, which causes machine motion in single or repeated small increments only when controlled by manual pressure.

3.2.51.1 *Discussion*—

It is intended for use in setup or maintenance, but not in normal operation.

3.2.52 *indirect arc furnace, n*—furnace in which heat is produced by an electric arc between electrodes.

3.2.53 *induction furnace*—see *channel furnace and coreless furnace*

3.2.54 *initiator, n*—device that causes an action of control(s) or power.

3.2.54.1 *Discussion*—

Typical operator initiators are pushbuttons, foot switches, manual starters, hand valves, and other valves with manual overrides. Typical non-operator initiators are limit switches, pressure switches, temperature-actuated switches, flow switches, and cam-actuated valves.

3.2.55 *inspections, frequency of, n*—frequent—daily to monthly intervals and periodic—from one- to twelve-month intervals.

3.2.56 *interlock, n*—device in a system which, when actuated, permits or prevents the operation of one or more components in the system.

3.2.57 *interlocked barrier guard, n*—barrier interlocked with the machine power or control so that the machine cycle will stop and cannot be initiated with the operating controls unless the guard, or the hinged or movable sections, effectively encloses the hazard zone.

3.2.58 *isolation switch*—see *disconnect switch*

3.2.59 *jamming (hooking), v*—jamming (hooking) occurs when the work rest becomes improperly adjusted to such an extent that the work piece is pulled between the abrasive wheel and the leading edge of the work rest by the grinding action of the wheel resulting in possible injury to personnel.

3.2.59.1 *Discussion*—

Jamming (hooking) should not be confused with the use of work rest mounted tooling, pins, or pressure bars.

3.2.60 *ladle handler, n*—mechanism used to suspend, transport, raise and/or lower a ladle.

3.2.61 *ladle pouring stand, n*—structural device for supporting or tilting a ladle or both.

3.2.62 *lance, oxygen, n*—device consisting of steel pipe, tubing, oxygen source, and controls.

3.2.62.1 *Discussion*—

Frequently used to open frozen tap or slag holes; also occasionally to oxidize impurities in molten metal bath.

3.2.63 *lip, n*—formed “U” or “V” depression in a molten metal outlet to confine the stream.

3.2.64 *main burner, n*—primary combustion device commonly ignited by a secondary source.

3.2.65 *mandatory safety standards, n*—those safety standards that are legally enforceable by agencies of federal, state, or local government.

3.2.66 *manual, adj*—each machine function in the machine cycle and load cycle is manually initiated and controlled in the sequence or out of the sequence of the normal machine cycle.

3.2.67 *manually powered machines, n*—machine in which the operator provides the motive power to operate the machine.

3.2.68 *manual mode, n*—method of operation that requires manual initiation of each function in the equipment cycle.

3.2.69 *mold, n*—form that contains the cavity into which molten metal is poured to produce a casting of definite shape and outline.

3.2.70 *molding machine, n*—machine for compacting molding media (usually sand) about the pattern(s), thus forming the mold.

3.2.71 *moving frame, n*—that part of a molding machine that supports the flask and imparts the motions necessary to the mold making process.

3.2.72 *muller, n*—machine that blends, coats, kneads, or mechanically combines various sand(s) or other media used for foundry purposes with binders and other additive agents. Typically, it consists of a circular container in which rotating plows or mill wheels (mullers) or both are mounted.

3.2.73 *nip point, n*—point or zone in which a part of the body could be caught and squeezed between two surfaces, edges, or points.

3.2.74 *operator's work zone(s), n*—operator's work zone(s) of equipment is that area in which the operator's presence is required while operating in the intended manner.

3.2.74.1 *Discussion*—

An employee's presence applies to the entrance into the operator's work zone of the employee's body or any part thereof.

3.2.75 *pattern, n*—form of wood, metal, or other material against which molding material is compacted to make a mold for casting metals.

3.2.76 *pilot (flame or spark), n*—auxiliary source that ignites the main burner.

3.2.77 *pinch point, n*—zone in which a portion of the body could be caught and injured between surfaces, edges, or points.

3.2.78 *point of operation, n*—that point or zone in which the principal operation is being performed.

3.2.79 *pouring, n*—final transfer of molten metal before its solidification into its intended form.

3.2.80 *pouring area, n*—location in a foundry where molten metal is poured into molds or transferred from a ladle to a furnace.

3.2.81 *power locked off, n*—state in which the device that turns power off is locked in the off position with the padlock of every individual who is working on the machine. Locks are affixed directly to the power disconnect, to a group lockout device, group lockbox, or comparable mechanism.

3.2.82 *power off or out, n*—state in which power cannot flow to the equipment from the source (see 4.4).

3.2.83 *presence-sensing device, n*—device designed, constructed, and arranged to create a sensing field or area that will detect either the presence or absence of personnel.

3.2.84 *protection from unexpected machine movement, n*—see *protection, primary* and *protection, secondary*.

3.2.84.1 *Discussion*—

There are hazards other than unexpected movement, and the OSHA machine lockout/tagout standard 29 CFR 1910.147 includes protection against such other hazards.

3.2.85 *protection, primary, n*—state in which the primary source(s) of power has been isolated by being locked out (off) and in which stored energy in the machine has been dissipated, constrained, or controlled. The state in which OSHA lockout/tagout has been established.

3.2.85.1 *Discussion*—

Locking out the power to an electric drive motor by means of the main disconnect switch is an example of primary protection against hazards related to the running of the motor.

3.2.86 *protection, secondary, n*—limited protection by control devices.

3.2.86.1 *Discussion*—

It is possible for control devices, like limit switches, to malfunction mechanically or electrically, and interlocks intended for safety purposes are sometimes bypassed or wedged or tied in actuated states. Secondary protection is only justifiable when there is no practical alternative, that is, when primary protection is not practical and when regular disciplined maintenance is present. The operator, whose constant attitude should be one of caution, should understand the fact that operator protection devices such as

interlocked guards are secondary protection. Frequent inspections of such protective devices should be made. Locking a STOP push button in the actuated position instead of using OSHA lockout/tagout is an example of a dangerous attempt to use secondary protection against machine movement.

3.2.87 *protective device, n*—means whereby personnel access to a hazard zone or area is denied by other than a physical guard.

3.2.87.1 *Discussion—*

Protective devices include, but are not limited to, two-hand controls, two-hand trips, and hostage controls.

3.2.88 *puncture point, n*—zone in which a part of the body could be punctured or perforated.

3.2.89 *qualified engineer, n*—qualified engineer is one who possesses an engineering degree from an accredited institution of higher learning or a certificate of professional standing and has engineering experience with the kind of work and equipment involved.

3.2.90 *qualified person, n*—person determined by the employer to have the training or experience or both to operate or maintain or both the equipment involved.

3.2.91 *reactive metal, n*—any metal that is readily oxidized with the release of large quantities of heat.

3.2.92 *runout pit, n*—pit placed below or in front of a furnace or both to receive molten material in an emergency.

3.2.93 *safety, n*—state of being reasonably free or reasonably protected from injury or risk. Never to be construed as absolute or perfect protection from harm, injury, or risk.

3.2.94 *sand mixer, n*—machine for conditioning mold and core sand by controlled mixing with additives.

3.2.95 *sand muller, n*—machine for conditioning mold and core sand by controlled mixing with additives.

3.2.96 *sand system, n*—that part of a foundry installation that processes and transports sand or other media in bulk form.

3.2.97 *screen (sand), n*—sieve or riddle with openings of definite size used to separate one grain size from another or to remove lumps and foreign objects from sand.

3.2.98 *semiutomatic, adj*—at least one machine function in the cycle is automatically performed and sequenced, but which requires the operator to initiate at least one function manually.

3.2.99 *semiautomatic mode, n*—method of operation in which at least one function in an equipment cycle requires manual initiation and at least one function is automatically sequenced.

3.2.100 *shear pin, n*—pin built into a mechanism designed to fail under specified loading and act as an overload disconnect.

3.2.101 *shear point, n*—point or zone in which body parts could be caught by one machine member moving past another.

3.2.102 *shutdown, n*—planned steps required to take machine or process out of operation.

3.2.103 *skimming, n*—removing slag or dross from the surface of the molten metal.

3.2.104 *skip hoist, n*—basket, bucket, or other container that is drawn or elevated on rails by a pulling or pushing action.

3.2.105 *slag, n*—nonmetallic byproducts and contaminants generated during the melting, transferring, and holding of molten metal.

3.2.106 *slagging, v*—see *skimming*.

3.2.107 *slag hole or door, n*—opening in the furnace through which slag is removed.

3.2.108 *slinger, n*—machine that throws sand or other media into a flask, corebox, or other container.

3.2.109 *start up, n*—planned steps required to place a machine or process into operation.

3.2.110 *stop block, n*—rigid restraining device that will prevent hazardous movement of a machine or equipment member(s). A stop block shall be designed and constructed to withstand the forces to which it will be subjected.

3.2.111 *tapping, v*—removing molten material from the furnace by opening a tap hole.

3.2.112 *transfer car, n*—vehicle used for transporting vessels or material(s), usually in a fixed path.

3.2.113 *trunnions, n*—shafts used to support, turn, or tilt a vessel.

3.2.114 *tumbling barrel, n*—power-driven rotating drum or barrel in which castings are cleaned or polished or both. The castings act as abrasives for each other or are tumbled in an abrasive media.

3.2.115 *tuyere, n*—nozzle opening through which the blast enters a cupola.

3.2.116 *two-hand control, n*—type of control in which the operator causes a motion by manually operating an initiator concurrently with each hand, the motion stopping or reversing upon deactuation of either or both initiators.

3.2.117 *two-hand trip device, n*—type of control in which the operator causes a motion by manually operating an initiator concurrently with each hand, the motion continuing to completion whether the initiators continue to be held actuated or not.

3.2.118 *work zone and work station, n*—see *operator's work zone(s)*

~~3.3 *arc furnace, n*—see *direct arc furnace and indirect arc furnace*~~

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~~3.12 *charge, n*—material introduced into a melting furnace for the production of molten metal.~~

~~3.13 *charging, v*—process of adding a charge to a furnace.~~

~~3.14 *control circuit (electrical), n*—circuit of a control apparatus or system that carries the electric signals directing the performance of the controller, but does not carry the main power current.~~

~~3.15 *controller, n*—device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.~~

~~3.16 *core, n*—preformed aggregate or collapsible insert placed in a mold to shape the interior or that part of a casting that cannot be shaped by the pattern.~~

~~3.17 *core- or mold-blowing or shooting machine, n*—machine for injecting sand or other media into the core or mold cavity by means of compressed air or other gas.~~

~~3.18 *core binder(s), n*—any material, liquid or solid, which is used to bond core aggregates.~~

~~3.19 *corebox, n*—a (wood, metal, or plastic) structure, the cavity of which has the shape of the desired core that is to be made therein.~~

~~3.20 *coreless furnace, n*—electric induction furnace consisting of an induction coil surrounding a crucible or refractory lining in which metal is melted or molten metal is retained.~~

~~3.21 *counterweight, n*—weight that corrects a state of unbalance and establishes static equilibrium.~~

~~3.22 *crane ladle, n*—ladle handled by an overhead crane.~~

~~3.23 *crucible, n*—container used for the melting, holding, and pouring of metal.~~

~~3.24 *cupola, n*—vertical shaft-type furnace for melting and/or producing molten metal by combusting coke or other fuels using a blast, and possibly additional pure oxygen, that is introduced through the cupola tuyeres.~~

~~3.25 *cupola drop, n*—materials dropped from the cupola at the end of a heat.~~

~~3.26 *direct arc furnace, n*—furnace in which heat is produced by an electric arc between electrodes and the charge.~~

~~3.27 *disconnecting means (electrical), n*—device, or group of devices, or other means by which it is possible to disconnect the conductors of the circuit from their source of supply.~~

~~3.28 *disconnect switch (electrical), n*—switching device used primarily for isolating a circuit or equipment from a source of power.~~

~~3.29 *drop area, n*—the area directly under the cupola that receives the hot bed coke or other hot materials from the inside of the furnace when the bottom doors or side access door are opened.~~

~~3.30 *drop zone, n*—the zone adjacent to the drop area that is exposed to drop hazards during the dropping process.~~

~~3.31 *dross, n*—metal oxides or foreign matter or both that accumulates on the surface of nonferrous molten metal.~~

~~3.32 *dust collector, n*—air-cleaning device to remove particulate matter from exhaust systems before discharge to the atmosphere.~~

~~3.33 *exhaust system, n*—system of air-moving equipment and ducts used to remove airborne contaminants from affected areas.~~

~~3.34 *explosion vent, n*—a device that is engineered as part of an enclosure, container, or vessel that is designed to release pressure rapidly.~~

~~3.35 *finishing, v*—attainment of a desired surface finish or finish characteristics by such means as abrasive impingement, grinding, or polishing.~~

3.36 *fixed barrier guard, n*—securely attached physical barrier, not readily removable, that prevents entry of any part of the body into the hazard zone by reaching through, over, under, or around the barrier.

3.37 *flame detector, n*—device, which senses the absence or presence of flame, for the purpose of controlling fuel line valves.

3.38 *flask, n*—container, without top or bottom, used to contain the sand or other media while it is being formed. It is made in two or more parts, the lower part called the drag and the upper part called the cope. Intermediate sections, if any, are called cheeks.

3.39 *flask lifting device, n*—chains, rods, bails, cables, slings and other materials used to support a load such as a flask for turning, inverting, or transporting.

3.40 *fuel-fired equipment (enclosed), n*—specially heated chamber such as core oven, drying oven, thermal sand reclamation, sand heater, or annealing oven.

3.41 *gas handling system, n*—the collective group of equipment that draws cupola gas from the furnace.

3.42 *guarded, adj*—shielded, fenced, enclosed, or otherwise protected by means of suitable enclosure, covers, casing, shield guards, trough guards, barrier guard, railing guards, or guarded by location, or other protective devices, so as to reduce the possible risk of personnel injury from accidental contact or approach, or in the case of spill guards, so as to reduce possibility of personnel injury from material being spilled into the area protected. Where it is not feasible to guard against the hazard, or where the guard itself creates a hazard, the potential hazard shall be marked prominently to warn of its existence.

3.43 *guarded by location, adv*—to be guarded by location or position in accordance with the height above a walkway, platform, or workspace, any moving part shall be at least 8 ft (2.46 m) above same. However, pinch points of all descriptions and moving projections shall not be guarded by location unless they are a minimum of 9 ft (2.74 m) above the pertinent floor. When moving parts are remote from floors, platforms, walkways, other working levels, or by their location with reference to frames, foundations, or structures that minimize the probability of accidental contact by personnel, they shall be considered to be guarded by position or location. Remoteness from regular or frequent presence of public or employed personnel, in reasonable circumstances, constitutes guarding by location.

3.44 *hazard, n*—a condition or series of conditions, either continuous, intermittent or instantaneous in nature that exists, or could exist, such that bodily injury could result. Hazards include, but are not limited to, falling, pinching, crushing, cutting, impaction, burning, concussion, suffocation, occupational disease, asphyxiation and/or electrocution.

3.45 *hazard point, n*—closest point within the hazard zone at which physical contact occurs between machine elements or materials or both.

3.46 *hazard zone, n*—that area where a hazard exists and bodily injury could result upon direct exposure or contact with that hazard.

3.47 *heat, n*—stated weight of metal obtained from a period of melting in a cupola or furnace or the time required to melt and process this material.

3.48 *hopper, n*—bulk container in which materials are stored.

3.49 *hostage control, n*—type of control in which the physical act of operating the initiator prevents operator exposure to the motion or response produced by the initiator.

3.49.1 *Discussion*—

An initiator located a sufficient distance from the hazard zone that the operator cannot reach the point of operation during the hazardous portion of the cycle, after operating the initiator, is an example.

3.50 *hostage protection, n*—means of minimizing personnel exposure to hazards by making it easier to perform an operation in a prescribed manner through work piece or machine design or both.

3.51 *inch control, n*—hostage control, which causes machine motion in single or repeated small increments only when controlled by manual pressure.

3.51.1 *Discussion*—

It is intended for use in setup or maintenance, but not in normal operation.

3.52 *indirect arc furnace, n*—furnace in which heat is produced by an electric arc between electrodes.

3.53 *induction furnace*—see *channel furnace and coreless furnace*

3.54 *initiator, n*—device that causes an action of control(s) or power.

3.54.1 *Discussion*—

Typical operator initiators are pushbuttons, foot switches, manual starters, hand valves, and other valves with manual overrides. Typical non-operator initiators are limit switches, pressure switches, temperature-actuated switches, flow switches, and cam-actuated valves.

3.55 *inspections, frequency of, n*—frequent—daily to monthly intervals and periodic—from one- to twelve-month intervals.

3.56 *interlock, n*—device in a system which, when actuated, permits or prevents the operation of one or more components in the system.

3.57 *interlocked barrier guard, n*—barrier interlocked with the machine power or control so that the machine cycle will stop and cannot be initiated with the operating controls unless the guard, or the hinged or movable sections, effectively encloses the hazard zone.

3.58 *isolation switch*—see *disconnect switch*

3.59 *jamming (hooking), v*—jamming (hooking) occurs when the work rest becomes improperly adjusted to such an extent that the work piece is pulled between the abrasive wheel and the leading edge of the work rest by the grinding action of the wheel resulting in possible injury to personnel.

3.59.1 *Discussion*—

Jamming (hooking) should not be confused with the use of work rest mounted tooling, pins, or pressure bars.

3.60 *ladle handler, n*—mechanism used to suspend, transport, raise and/or lower a ladle.

3.61 *ladle pouring stand, n*—structural device for supporting or tilting a ladle or both.

3.62 *lance, oxygen, n*—device consisting of steel pipe, tubing, oxygen source, and controls.

3.62.1 *Discussion*—

Frequently used to open frozen tap or slag holes; also occasionally to oxidize impurities in molten metal bath.

3.63 *lip, n*—formed "U" or "V" depression in a molten metal outlet to confine the stream.

3.64 *main burner, n*—primary combustion device commonly ignited by a secondary source.

3.65 *mandatory safety standards, n*—those safety standards that are legally enforceable by agencies of federal, state, or local government.

3.66 *manual, adj*—each machine function in the machine cycle and load cycle is manually initiated and controlled in the sequence or out of the sequence of the normal machine cycle.

3.67 *manual mode, n*—method of operation that requires manual initiation of each function in the equipment cycle.

3.68 *manually powered machines, n*—machine in which the operator provides the motive power to operate the machine.

3.69 *mold, n*—form that contains the cavity into which molten metal is poured to produce a casting of definite shape and outline.

3.70 *molding machine, n*—machine for compacting molding media (usually sand) about the pattern(s), thus forming the mold.

3.71 *moving frame, n*—that part of a molding machine that supports the flask and imparts the motions necessary to the mold making process.

3.72 *muller, n*—machine that blends, coats, kneads, or mechanically combines various sand(s) or other media used for foundry purposes with binders and other additive agents. Typically, it consists of a circular container in which rotating plows or mill wheels (mullers) or both are mounted.

3.73 *nip point, n*—point or zone in which a part of the body could be caught and squeezed between two surfaces, edges, or points.

3.74 *operator's work zone(s), n*—operator's work zone(s) of equipment is that area in which the operator's presence is required while operating in the intended manner.

3.74.1 *Discussion*—

An employee's presence applies to the entrance into the operator's work zone of the employee's body or any part thereof.

3.75 *pattern, n*—form of wood, metal, or other material against which molding material is compacted to make a mold for casting metals.

3.76 *pilot (flame or spark), n*—auxiliary source that ignites the main burner.

3.77 *pinch point, n*—zone in which a portion of the body could be caught and injured between surfaces, edges, or points.

3.78 *point of operation, n*—that point or zone in which the principal operation is being performed.

3.79 *pouring, n*—final transfer of molten metal before its solidification into its intended form.

3.80 *pouring area, n*—location in a foundry where molten metal is poured into molds or transferred from a ladle to a furnace.

3.81 *power off or out, n*—state in which power cannot flow to the equipment from the source (see 4.4).

3.82 *power locked off, n*—state in which the device that turns power off is locked in the off position with the padlock of every individual who is working on the machine. Locks are affixed directly to the power disconnect, to a group lockout device, group lockbox, or comparable mechanism.

3.83 *presence-sensing device, n*—device designed, constructed, and arranged to create a sensing field or area that will detect either the presence or absence of personnel.

3.84 *protection from unexpected machine movement, n*—see *protection, primary and protection, secondary*.

3.84.1 *Discussion*—

There are hazards other than unexpected movement, and the OSHA machine lockout/tagout standard 29 CFR 1910.147 includes protection against such other hazards.

3.85 *protection, primary, n*—state in which the primary source(s) of power has been isolated by being locked out (off) and in which stored energy in the machine has been dissipated, constrained, or controlled. The state in which OSHA lockout/tagout has been established.

3.85.1 *Discussion*—

Locking out the power to an electric drive motor by means of the main disconnect switch is an example of primary protection against hazards related to the running of the motor.

3.86 *protection, secondary, n*—limited protection by control devices.

3.86.1 *Discussion*—

It is possible for control devices, like limit switches, to malfunction mechanically or electrically, and interlocks intended for safety purposes are sometimes bypassed or wedged or tied in actuated states. Secondary protection is only justifiable when there is no practical alternative, that is, when primary protection is not practical and when regular disciplined maintenance is present. The operator, whose constant attitude should be one of caution, should understand the fact that operator protection devices such as interlocked guards are secondary protection. Frequent inspections of such protective devices should be made. Locking a STOP push button in the actuated position instead of using OSHA lockout/tagout is an example of a dangerous attempt to use secondary protection against machine movement.

3.87 *protective device, n*—means whereby personnel access to a hazard zone or area is denied by other than a physical guard.

3.87.1 *Discussion*—

Protective devices include, but are not limited to, two-hand controls, two-hand trips, and hostage controls.

3.88 *puncture point, n*—zone in which a part of the body could be punctured or perforated.

3.89 *qualified engineer, n*—qualified engineer is one who possesses an engineering degree from an accredited institution of higher learning or a certificate of professional standing and has engineering experience with the kind of work and equipment involved.

3.90 *qualified person, n*—person determined by the employer to have the training or experience or both to operate or maintain or both the equipment involved.

3.91 *reactive metal, n*—any metal that is readily oxidized with the release of large quantities of heat.

3.92 *runout pit, n*—pit placed below or in front of a furnace or both to receive molten material in an emergency.

3.93 *safety, n*—state of being reasonably free or reasonably protected from injury or risk. Never to be construed as absolute or perfect protection from harm, injury, or risk.

3.94 *sand mixer, n*—machine for conditioning mold and core sand by controlled mixing with additives.

3.95 *sand muller, n*—machine for conditioning mold and core sand by controlled mixing with additives.

3.96 *sand system, n*—that part of a foundry installation that processes and transports sand or other media in bulk form.