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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 E34.20 ~~on Foundry Safety and Health.~~

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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 and health practices and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F 1002 Performance Specification for Protective Clothing for Use by Workers Exposed to Specific Molten Substances and Related Thermal Hazards

F 1449 ~~Guide for Care and Maintenance of Flame Resistant and Thermally Protective Clothing~~ Guide for Industrial Laundering of Flame, Thermal, and Arc Resistant Clothing

[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.

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
ANSI ~~B5.35Machine~~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~~ B107.4 Driving & Spindle Ends for Portable Hand, Air and Electric Tools (Percussion Tools Excluded)
ANSI ~~B186.1 Portable~~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

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~~ Mechanical Power Presses

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

2.5 ~~*American Foundry Society (AFS)*~~

~~Recommended Clothing and Personal Protective Equipment (PPE) for Metal Melting and Pouring Operations Managing the Foundry Indoor Air Environment~~ 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] ~~Available from the American National Standards Institute, 25 W. 43 rd St., 4th Floor, New York, NY 10036.~~
[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.
[4] Available from ~~the~~ National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA ~~02269-9101.~~02169-7471, http://www.nfpa.org.
[5] Available from ~~the~~ Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, http://www.osha.gov.
[6] Available from the American Foundry Society. 505 State St., Des Plaines, IL 60016.

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.

3.2 *acoustical treatment*, *n*—means by which the level of sound, noise, or audible vibration may be attenuated (reduced).

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

3.3.1 *Discussion*—This type of guard requires close supervision of use and adjustment or inadequate protection may 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).

3.4 *airless blast cleaning*, *n*—form of abrasive blast in which the abrasive media is propelled by centrifugal force.

3.5 *anti-tie-down*, *n*—requires that the two-hand controls function only when both initiators have been released just before operation. Unauthorized tying down of one initiator to permit one-hand operation by the other initiator prevents operation (see 3.151 and 3.152).

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

3.7 *auger*, *n*—rotating screw used to mix, or transport, or both sand, clay, or other media used in core and mold making.

3.8 *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.

3.9 *automatic mode*, *n*—method of operation in which each function in the equipment cycle is automatically sequenced and repeated.

3.10 *backcharge*, *n*—recharging a furnace to produce the desired heat size.

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

3.12 *barrier guard*—see *adjustable barrier guard, fixed barrier guard, and interlocked barrier guard*

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

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

3.15 *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.

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

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

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

3.19 *charge preheater*, *n*—device for preheating charge materials before they are added to a furnace.

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

3.21 *clamp frame*, *n*—moving frame on a core-blowing machine that moves the corebox and presses it against the blow plate.

3.22 *clearance line*, *n*—line, which marks the distance, required to prevent contact between a guard(s) and moving parts.

3.23 *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.

3.24 *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.

3.25 *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.

3.26 *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.

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

3.28 *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.

3.29 *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.

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

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

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

3.33 *cupola*, *n*~~—vertical shaft-type furnace for melting metal using coke or other fuels in conjunction with combustion air introduced under pressure through openings (tuyeres) near its base.~~ —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.

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

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

3.36 *disconnecting means (electrical)*, *n*—device, or group of devices, or other means by which the conductors of the circuit can be disconnected from their source of supply.

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

3.38 *drain bed*, *n*—a dry clean, dry bed of refractory like material, usually sand, that is below the cupola drain and is intended to receive or collect molten iron and/or slag from the cupola.

3.39 *drain box*, *n*—a large box or vessel that is lined with a dry clean, dry refractory like material, usually green sand or refractory, that is placed below the cupola drain and is intended to receive or collect molten iron, or slag, or both from the cupola.

3.40 *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.

3.41 *drop zone*, *n*—the zone adjacent to the drop area that may be exposed to drop hazards during the dropping process.

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

~~3.39~~

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

~~3.40~~

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

~~3.41~~

3.45 *explosion vent*, *n*—~~part of an enclosure or container designed to release pressure rapidly.~~

~~3.42~~—*a device that is engineered as part of an enclosure, container, or vessel that is designed to release pressure rapidly.*

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

~~3.43~~

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

~~3.44~~3.48 *flame detector*, *n*—device, which senses the absence or presence of flame, for the purpose of controlling fuel line valves.

~~3.45~~

3.49 *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.

~~3.46~~

3.50 *flask clamp*, *n*—device used to lock together two or more flask sections.

~~3.47~~

3.51 *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.

~~3.48~~

3.52 *foot control—initiators*, *n*—type of control in which the operator causes a motion or actuation of the machine by depressing a foot switch or pedal.

~~3.48.1~~

3.52.1 *Discussion*—The use of foot controls requires additional guarding or operator restraint, unless the control satisfies hostage control ~~6.4.7~~ 6.5.7 (3) or ~~6.4.10~~6.5.10.

~~3.49~~

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

~~3.50~~

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

3.55 *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.

~~3.51~~

3.56 *guarded by location or position*, *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 may, in reasonable circumstances, constitute guarding by location.

~~3.52~~3.57 *hand ladle*, *n*—handheld ladle for pouring molten metal.

~~3.53~~

3.58 *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 may include, but are not limited to, falling, pinching, crushing, cutting, impaction, burning, concussion, suffocation, occupational disease, asphyxiation and/or electrocution.

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

~~3.54*hazardous zone*~~

3.60 *hazard zone*, *n*~~—that area within the operator's work zone in which bodily injuries may be encountered.~~

~~3.55~~*—that area where a hazard exists and bodily injury may result upon direct exposure or contact with that hazard.*

3.61 *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.

~~3.56~~

3.62 *hopper*, *n*~~—bulk material container in which materials are temporarily stored and later discharged by tilting or opening bottom doors.~~

~~3.57~~*—bulk container in which materials are stored.*

3.63 *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.

~~3.57.1~~

3.63.1 *Discussion*—An initiator located a sufficient distance from the ~~hazardous~~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.

~~3.58~~3.64 *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.

~~3.59~~

3.65 *hydraulic blasting*, *v*—method of cleaning castings through the abrasive action of liquid alone or liquid-bearing solid particles.

~~3.60~~

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

~~3.60.1~~

3.66.1 *Discussion*—It is intended for use in setup or maintenance, but not in normal operation.

~~3.61~~

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

~~3.62~~

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

~~3.63~~

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

~~3.63.1~~

3.69.1 *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.

~~3.64~~

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

~~3.65~~

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

~~3.66~~

3.72 *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 ~~hazardous~~hazard zone.

~~3.67~~3.73 *investment mold*, *n*—flowable mixture of a graded refractory filler, a binder, and a liquid vehicle which, when applied around the patterns, in conformance with their shape and subsequently sets hard to form the investment mold.

~~3.68~~

3.74 *isolation switch*—see *disconnect switch*

~~3.69~~

3.75 *jamming (hooking)*, *v*—jamming (hooking) occurs when the work rest becomes improperly adjusted to such an extent that

the work piece can be 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.

~~3.69.1~~

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

~~3.70~~

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

~~3.71~~

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

~~3.72~~

3.78 *ladle shank*, *n*—handle(s) attached to the side(s) of a hoop or band into which a crucible or ladle is placed for pouring.

~~3.73~~

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

~~3.73.1~~

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

~~3.74~~

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

~~3.75~~

3.81 *lip pour ladle*, *n*—ladle in which the contents are discharged over a lip(s) at the top.

~~3.76~~

3.82 *lock pin*, *n*—pin, when installed, designed specifically to stop or limit motion of a machine element to attain OSHA lockout/tagout.

~~3.77~~

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

~~3.78~~

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

~~3.79~~

3.85 *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.

~~3.80~~

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

~~3.81~~

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

~~3.82~~

3.88 *minimum guarding line*, *n*—that distance between the point of entry side of the guard and the hazard point.

~~3.83~~

3.89 *mode of operation*, *n*—see *automatic, manual,* and *semiautomatic*.

~~3.84~~

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

~~3.85~~

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

~~3.86~~

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

~~3.87~~

3.93 *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.

~~3.88~~

3.94 *nip zone*, *n*—point or zone in which a portion of the body may be caught hold of and squeezed between two surfaces, edges, or points.

~~3.89~~

3.95 *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.

~~3.89.1~~

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

~~3.90~~

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

~~3.91~~

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

~~3.92~~

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

~~3.93~~

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

~~3.94~~

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

~~3.95~~

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

~~3.96~~

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

~~3.97~~

3.103 *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.

~~3.98~~

3.104 *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.

~~3.99~~

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

~~3.99.1~~

3.105.1 *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.

~~3.100~~

3.106 *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.

~~3.100.1~~

3.106.1 *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.

~~3.101~~

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

~~3.101.1~~

3.107.1 *Discussion*—Control devices, like limit switches, can malfunction mechanically or electrically, can be frustrated by a ground or short circuit in the wiring to them, and interlocks intended for safety purposes are often ~~by-passed~~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.

~~3.102~~3.108 *protective device*, *n*—means whereby personnel access to a ~~hazardous~~hazard zone or area is denied by other than a physical guard.

~~3.102.1~~3.108.1 *Discussion*—Protective devices include, but are not limited to, two-hand controls, two-hand trips, and hostage controls.

~~3.103~~

3.109 *puncture zone*, *n*—zone in which a portion of the body may be punctured or perforated.

~~3.104~~

3.110 *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.

~~3.105~~

3.111 *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.

~~3.106~~

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

~~3.107~~

3.113 *reclaimed sand*, *n*—used foundry sand, which has been reprocessed by thermal, air, or hydraulic methods so that it can be used in place of new sand without substantially changing current foundry sand practice.

~~3.108~~

3.114 *recuperative hot blast operation*, *n*—operation of a cupola in which effluent gases escaping from the cupola are used to preheat the blast.

~~3.109~~

3.115 *reverberatory furnace*, *n*—shallow bath furnace for melting metal in which the bath is heated by the combustion of hot gases over the surface of the metal and by radiation from the roof.

~~3.110~~

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

~~3.111~~

3.117 *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.

~~3.112~~

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

~~3.113~~

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

~~3.114~~

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

~~3.115~~

3.121 *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.

~~3.116~~

3.122 *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.

~~3.117~~

3.123 *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.

~~3.118~~

3.124 *shank ladle*, *n*—ladle with integral support band and handle or handles to support or manually tilt the ladle or both.

~~3.119~~

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

~~3.120~~

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

~~3.121~~

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

~~3.122~~

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

~~3.123~~

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

~~3.124~~

3.130 *slag*, *n*~~—nonmetallic covering on or from the surface of ferrous molten metal.~~

~~3.125~~*—nonmetallic byproducts and contaminants generated during the melting, transferring, and holding of molten metal.*

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

~~3.126~~

3.132 *slagging*, *v*—see *skimming*.

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

~~3.127~~

3.134 *slip clutch*, *n*—shaft-coupling device designed to slip when overloaded.

~~3.128~~

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

~~3.129~~

3.136 *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.

~~3.130~~

3.137 *tap changer*, *n*—switching device on power transformers to change the voltage or reactance.

~~3.131~~

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

~~3.132~~

3.139 *teapot ladle*, *n*—ladle in which molten metal is discharged from below the metal line into an external or internal spout and up over the lip.

~~3.133~~

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

~~3.134~~3.141 *trolley ladle*, *n*—ladle supported by an overhead trolley confined by a track system.

~~3.135~~

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

~~3.136~~

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

~~3.137~~

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

~~3.138~~

3.145 *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.

~~3.139~~

3.146 *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.

~~3.140~~

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

~~3.141~~

3.148 *zero mechanical state (ZMS)*, *n*—now superseded by OSHA lockout/tagout (29 CFR 1910.147).

~~3.141.1~~

3.148.1 *Discussion*—This term was pioneered by the American Foundry Society (AFS) and first appeared in a standard in 1975. This was the first general lockout procedure for machines powered by electric or fluid power or both. ZMS required that potential and kinetic energy be reduced, dissipated, or controlled before servicing to avoid injury from unexpected or inadvertent movement. ANSI Z244.1 Safety Requirements for Lockout/Tagout of Energy Sources was first published in 1982. OSHA Standard 29 CFR 1910.147 Machine Lockout/Tagout, Control of Hazardous Energy Sources, was first published in 1989.

4. Materials and Manufacture

4.1 *Responsibility*—It shall be the responsibility of any person constructing, reconstructing, or modifying any equipment covered by this practice to:

4.1.1 Design, construct, and modify equipment in accordance with the provisions of this practice. (Consider other applicable safety standards.)

4.1.2 Select and include in construction only components that have a working rating equal to or greater than required to meet the maximum recommended operating condition(s).

4.1.3 Furnish printed instructions with each unit of equipment. (To minimize hazards, it is essential that this material be readily available to maintenance, operations, and engineering personnel.) The instructions shall include:

4.1.3.1 Engineering drawings and other materials required to install and place such equipment into operation properly.

4.1.3.2 Operating and maintenance instructions as specified in Section 5.

4.1.3.3 Spare parts lists.

4.1.3.4 Procedures in accordance with 29 CFR 1910.147 OSHA lockout/tagout standard shall be followed.

4.1.4 Hazard alert signs when used shall comply with the following standards: 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.

4.1.5 Apply a legible identification plate to each piece of equipment. This plate shall include as a minimum the manufacturer's name, equipment type or model identification or both, serial number, and rated capacity(s).

4.1.6 Insure that any modification(s) or alteration(s) to a piece of equipment or machinery covered by this practice that result in a change from the manufacturer's original design or intended method of operation or both shall be done under the supervision of a qualified engineer and shall comply with mandatory safety standards for that given category of equipment. An additional legible identification plate shall be attached to the machine or equipment adjacent to the manufacturer's original identification plate (see 4.1 (5)). The new identification plate shall state the date the modification(s) was made and the person or organization

responsible. (Restrictions on modifications or alterations are not intended to bar repair or maintenance including the substitution of substantially equivalent components.)

4.2 *Inherent Hazards*

4.2.1 *Hazards to Personnel Associated with Moving Parts*—Hazards to personnel associated with moving parts (other than point of operation hazards) shall be guarded in accordance with ANSI B15.1 or ANSI B20.1, as appropriate. ~~Note1—Some examples of hazards to personnel associated with moving parts are:~~

~~*(1)* Rotating components, such as flywheels, gears, sheaves, and shafts in proximity to personnel;~~
~~*(2)* Run-in pinch points, such as meshing gears, belts, and chains; and~~
~~*(3)* Pinch points between the moving and stationary components of the machine.~~

4.2.1.1 ~~*Responsibility—manufacturer* —The manufacturer shall endeavor to eliminate the hazards by design or provide protection against them. When hazards cannot be eliminated by design or protection, the manufacturer shall warn against them by using signs in accordance with ANSI Z535.1, 2, 3, 4, 5, as appropriate.~~

~~NOTE2—Together, these five ANSI standards contain information needed to specify formats, colors, and symbols for safety signs used in environmental and facility applications, product applications, and accident prevention signs.~~ Discussion—Some examples of hazards to personnel associated with moving parts are:

(1) Rotating components, such as flywheels, gears, sheaves, and shafts in proximity to personnel;

(2) Run-in pinch points, such as meshing gears, belts, and chains; and

(3) Pinch points between the moving and stationary components of the machine.

4.2.1.2 *Responsibility—Manufacturer* —The manufacturer shall endeavor to eliminate the hazards by design or provide protection against them. When hazards cannot be eliminated by design or protection, the manufacturer shall warn against them by using signs in accordance with ANSI Z535.1, 2, 3, 4, 5, as appropriate.

4.2.1.3 *Discussion*—Together, these five ANSI standards contain information needed to specify formats, colors, and symbols for safety signs used in environmental and facility applications, product applications, and accident prevention signs.

4.2.1.4 *Responsibility—Employer* —Equipment with moving parts that could cause injuries to personnel shall be guarded.

4.2.2 *Hazards to Personnel Associated with the Point of Operation*—Refer to Section 6.

4.2.3 *Hazards to Personnel Associated with Broken, Falling, or Flying Equipment Components*—The manufacturer shall design, secure, or cover machine components to minimize hazards caused by falling or flying components resulting from loosening or breakage.

4.3 *Installation*

4.3.1 *Employer Responsibility*—The employer shall be responsible for safe conditions for installing the equipment covered by this practice.

4.3.2 *Safeguarding During Construction, Reconstruction, or Modification*—Use of barriers, shields, and covers over excavations, pits, or tanks shall be required and used. Means shall be provided to prevent unauthorized persons from entering an area or zone in which construction or repair is in progress. ~~Note3—ANSI A12.64.1~~

4.3.2.1 *Discussion*—ANSI A12.64.1 contains the appropriate requirements and recommendations.

4.3.3 *Workstation*—Each workstation shall have space to permit work without physical interference from equipment or another employee(s) within that workstation. Services, including electric power, air hydraulic, water, steam, or process liquids, shall be delivered in identified conductors with shutoff valves or disconnecting means legibly marked, and shall be visible and accessible.

4.4 *Power Requirements*

4.4.1 *Disconnect Means*—All motors, motor circuits, and controllers shall have disconnecting means as required by Article 430 of the National Electric Code (ANSI/NFPA 70). The disconnecting means shall be capable of being locked in the (OFF) position.

4.4.1.1 *Disconnect Means Identification* —Each disconnect means shall be marked with a legible durable label that identifies the voltage and equipment controlled. Identification shall be verified at time of installation.

4.4.1.2 *Disconnection*

(1) Control circuits shall be so arranged that they will be disconnected from all sources of power when disconnecting means is in the open (OFF) position.

(2) There shall be an interlock, on separate power source feeds, that opens when the main disconnect is opened.

(3) The disconnecting means consists of two or more separate devices, one of which disconnects the motor and the controller from the source(s) of power supply for the motor, and the other disconnects the control circuit(s) from its power source. Where separate devices are used, they shall be located immediately adjacent, one to the other.

4.4.1.3 *Disconnection Hazards*—Where the operation of a disconnecting means could create a hazard, a suitable hazard alerting nameplate shall be provided and located adjacent to the label required in 4.4.1.1

4.4.1.4 *Motor-Starting Equipment*—Motor-starting equipment with the potential to restart a motor automatically after an unplanned power interruption or power outage shall not be used when automatic restarting would potentially result in injury to personnel. It shall be necessary to restart the motor manually.

4.4.2 *Electrical Power Off—Electrical Panels or Electrical Furnaces*

4.4.2.1 *Disconnect Means*—All control and power circuits shall be equipped with disconnecting means that have the capability to be locked in the open (OFF) position for the protection of the operating or maintenance personnel.

4.4.2.2 *Isolation (Disconnect) Switches*—Isolation switches not capable of interrupting load current shall not be opened under load and shall be provided with signs warning against opening under load. ~~Note4—Where possible, these isolation switches shall be key interlocked with the circuit-interrupting device so that the isolation switch cannot be opened under load. Individual consideration shall be given to keep these switches in a locked closed (ON) condition during normal operation.~~

4.4.2.3 *Discussion*—Where possible, these isolation switches shall be key interlocked with the circuit-interrupting device so that the isolation switch cannot be opened under load. Individual consideration shall be given to keep these switches in a locked closed (ON) condition during normal operation.

4.4.2.4 *Door Interlock*—All doors providing access to electrical circuits that operate at over 50 V shall be interlocked to disconnect electrical power when the door is opened. If voltages in excess of 50 V remain after electrical power has been disconnected, hazard alert signs shall be provided. ~~Note5—While~~

4.4.2.5 *Discussion*—While power has been disconnected when the door is opened, electrical power remains at the primary terminals. In addition, in some instances capacitors will remain charged and must be discharged to remove all voltage from the circuits inside the cabinet.

4.4.3 *Fluid Power Off*—Means shall be provided for isolating fluid (air, oil, or other) energy sources from a machine, or group of machines, controlled as a system. These means shall have provisions for being locked in the isolating mode. Pressure buildup on the machine side port of the isolating means shall be eliminated by positive means such as venting to atmosphere or drainage to tank.

4.5 *Electrical Ground Faults*

4.5.1 *Grounded Control Circuit*—When one side of the control circuit is grounded, the control circuit shall be designed so that an accidental ground will not start a motor, energize any component, or cause a machine movement.

~~Note6—Circuits~~

4.5.1.1 *Discussion*—Circuits that have all coils or solenoid(s) common to the grounded side of the control circuit, without intervening contacts, will almost always meet these requirements on a circuit that is grounded. It is possible that circuits that do not have this characteristic are hazardous in that an accidental ground might cause unwarranted energization or machine movement or both.

4.5.2 *Ungrounded Control Circuit*—Ungrounded control circuits shall have operative ground-indicating lights. An indicated ground shall be reported at once by the employee and investigated immediately. If a personnel hazard exists, corrections shall be made before resuming operation of the equipment. ~~Note7—Without~~

4.5.2.1 *Discussion*—Without grounds, each light has only one half voltage and both lights are therefore equally dim—the normal condition. A ground causes one light to glow brightly, the other to dim or go out. Depending upon the location of the accidental ground this indication is usually either constant or intermittent during operations. In an ungrounded system, it is not clear whether the first accidental ground will indicate a personnel hazard possible with the second accidental ground—or with simultaneous double accidental grounding.

(*1*) For instance, a ground on the common coil side of the control circuit will in effect merely convert the ungrounded circuit into a grounded circuit. The remarks in 4.5.1 ~~and Note 6~~ and the Discussion in 4.5.1 are then applicable.

(*2*) However, where the first accidental ground is on the contact side, it could possibly create a personnel hazard. This potential hazard must be resolved by authorized personnel.

4.6 *Fluid Power Off*—Means shall be provided for isolating fluid (air, oil, or other) energy sources from a machine, or group of machines, controlled as a system. These means shall have provisions for being locked in the isolating mode. Pressure buildup on the machine side port of the isolating means shall be eliminated by positive means such as venting to atmosphere or drainage to tank.

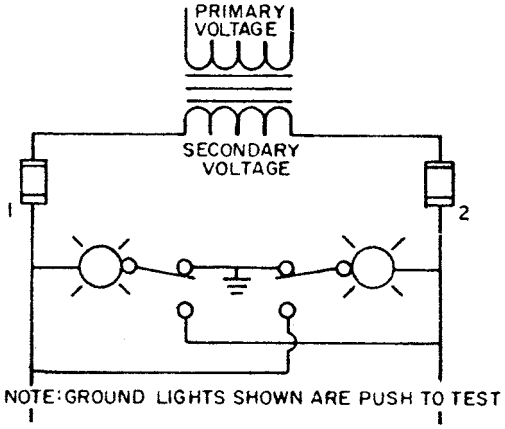

FIG. 1 Ungrounded Control Circuit