

How To Protect Personnel in Melting Operations



The
Schaefer Group, Inc

JEFF ZURFACE

Aluminum Market Specialist
THE SCHAEFER GROUP

ARTICLE TAKEAWAYS:

- Keeping personnel safe when handling molten aluminum
- Selection of proper PPE
- Establishing a safety program

Wearing the proper protective apparel and equipment when working near molten aluminum is extremely important in preventing injury to production workers. It could mean the difference between life and serious injury/or death.

Millions of pounds of aluminum are melted and cast correctly and safely every day in cast shops, foundries, and secondary processing plants across the country. However, there are inherent dangers in handling molten metal that can be minimized...“Failure to employ proper handling practices can be hazardous.”

This excerpt from *Guideline for Handling Molten Aluminum*, published by the Aluminum Association Inc., underscores the important role of special clothing, equipment, and procedures in assuring the safety of people who work with or around molten aluminum.



Acceptable practice in safety is to eliminate or control processes and operations that might present a foreseeable risk of harm to personnel. Operations necessary to the production of aluminum and aluminum castings, however, involve heat sources and there is an ever-present danger that a worker may be splashed by molten metal. Since it is impossible to remove all sources of ignition from the work place, reasonable practices that can significantly reduce the risk of serious burns to workers should be followed.

Where possible, workers should be protected by suitable shields or be positioned far enough from the molten metal or other ignition sources to prevent contact. In instances where this engineering approach is not technologically feasible, the employer should ensure that workers wear clothing that resists ignition and use other personal protective equipment (PPE) suitable for the exposure.

EQUIPMENT SELECTION

The selection of appropriate PPE requires that close attention be paid to several factors.

- An analysis of the type of hazard and the degree of exposure.
- Consideration of any mandatory standards or guidelines issued by regulatory agencies (Federal or State OSHA, MSHA, etc.) or advisory standards groups (ANSI, ASTM, NEPA, ACGIH, etc.).
- Consideration for employee comfort and health.

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- An evaluation of the types of PPE available that will effectively protect the work.

The responsible safety manager or supervisor must weigh a great many factors when advising workers who are exposed to molten metal and other ignition sources about protective clothing. These include flammability, heat transfer, melting point of the fabric material, sticking of substances to the fabric material, durability (life of the garment), retention of the desirable protective properties of the material, ability to withstand laundering or cleaning, toxicity of any treatment, wearability, comfort, worker acceptance, aesthetics, and costs. Even the design and construction of the garment can contribute to the severity of an injury or the degree of protection.

ESTABLISHING A PROGRAM

Several steps should be taken when developing and implementing a PPE program to protect workers against job hazards in the cast shop.

- Define the areas and/or operations where protective equipment must be worn.
- Determine the type of PPE suitable for the various exposures.
- Establish procedures for issuing and replacing damaged or defective equipment.
- Establish procedures for cleaning, maintain an adequate inventory of the proper equipment.
- Amend the program as necessary to accommodate changes in operation, the hazards or the exposure.

Head Protection — For hazards of impact, penetration from falling or flying objects, and electrical shock, suitable safety hats must be worn.



The safety hats must meet the specifications of American National Standard (ANS) Z89.1, *Requirements for Protective Headwear for Industrial Workers*.

All personnel working around molten aluminum should wear a head covering. Industrial safety hats are required where an overhead hazard exists. Where an overhead hazard does not exist, a hat, cap

or other head covering of flame-retardant material should be worn.

Eye/Face Protection — Due to the possibility of splash, personnel working with molten aluminum must wear eye and face protection. Industrial safety glasses with side shields should be considered minimum protection against molten metal splash. During periods of greatest exposure, such as charging,

opening or closing a tap hole, starting or terminating a cast, or skimming molten metal during casting of sows and foundry ingot, it is recommended that workers wear a face shield in addition to the safety glasses.

Additional guidelines may be found in ANS Z87.1, *Practice for Occupational and Educational Eye and Face Protection*.

Foot Protection — Proper protective footwear should be worn at all times. Laceless safety toe boots or smelter/foundry boots are recommended for molten substance exposure. These shoes can be removed easily and rapidly in an emergency because they have no fasteners.

Laced safety toe boots worn around molten substances must be covered with spats to prevent them from capturing the molten metal. As a precaution, laces, if permitted, should be of materials that will burn through quickly.

Where there is a potential for molten metal to enter the top of the shoes, or where lower extremities are exposed to molten metal splash, leggings with spats should be worn.

Safety toe shoes with metatarsal guards should be worn where there is danger of falling objects striking the foot.

Hand Protection — During operations that have a potential for burn injury to the hands, industrial-type, heat resistant and/or flame-retardant gloves should be worn. Cotton hot mill gloves are recommended as a minimum. Under most circumstances, gloves that minimize the opening at the wrist where molten metal might enter should be selected.

Trunk/Extremity Protection — The trunk/ arms, and legs must be

protected against cuts, punctures, abrasions, extreme heat, extreme cold, and harmful chemicals.

Ordinary work clothing, if clean, in good repair, and suited to the job may be considered safe in most exposures. “Ordinary” work clothing does not protect employees from hot molten aluminum.

THE BURNING ISSUE

Burns have been one of the leading causes of work injuries in molten aluminum operations. The most serious injuries, of course, are the disabling burns that involve a major portion of a worker’s body. Such serious burns are generally caused by the use of inadequate or improper protective clothing and equipment. Protective clothing for workers is divided into two categories.

Secondary protective clothing, according to ASTM F1002 (Standard Performance Specification for Protective Clothing for Use by Workers Exposed to Specific Molten Substances and Related Thermal Hazards), is “protective clothing designed for continuous wear for work activities in designated locations in which intermittent exposure to molten substance splash, radiant heat, and flame sources is possible. Secondary protective clothing is designed so that it will not continue to burn after exposure to, and removal of, a source of ignition. Protection against metal splash and radiant heat are secondary in intent.”

While secondary protective clothing replaces “ordinary” work clothing, it does not eliminate all burns. It will, however, significantly reduce the number and severity of burns.

Secondary clothing for molten aluminum casting operations may be made from specially treated cotton (non-phosphorus treatment such as FR-8), specially treated

wool (Zirpro), or a special non-melting, synthetic fabric (Vinex FR-9B). Some workers, with limited exposure, wear outer garments (pants and shirts) made of 100% cotton or wool. Workers should be encouraged to wear natural fiber undergarments (“long johns”) and socks since that will provide additional protection against burns. Most synthetic materials or synthetic blends offer little or no protection against molten metal and should never be used.

Research and development by fabric manufacturers and aluminum producers is continuing. Primary protective clothing, as defined by ASTM F1002, is “protective clothing designed to be worn for work activities during which significant exposure to molten substance splash, radiant heat, and flame is likely to occur. Such work activities include charging, tapping, and pouring, during which work is carried out in close proximity to molten substances and hot surfaces and contact with either is likely.”

Primary clothing consists of jackets, capes, aprons, chaps, leggings, spats, and sleeves designed and fabricated from materials capable of withstanding a major assault from the substance against which it is protecting. It is worn by workers actually working with the metal. Primary protective clothing is worn over secondary protective clothing, providing a layering effect and greater protection to the worker. This clothing may be made from aluminized fabrics (which also reflect radiant heat), “Zipro” treated wool, leather, or some specialized synthetic fabrics.

It is recommended that workers directly exposed to, or working with molten metal in melting, transfer,

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and casting operations wear secondary protective clothing that extends to the wrist and ankle. Each facility must determine the area in which workers are considered exposed. One company has defined “exposed” as being within 25 feet of furnaces, open troughs, casting pits, pigging wheels or conveyors, and similar operations involving molten metal.

During periods of greatest exposure, primary protective clothing and equipment is recommended. Where possible, exposure should be reduced or eliminated by adequately designed shields that protect against frontal, side, and overhead exposures.

PROOF FOR PURCHASE

Employers should take a “show me” attitude with their suppliers when selecting personal protective equipment to protect workers. Many employers have learned too late that there is no universal protective device. Face shields, gloves, hats, jackets, pants, etc., that provide adequate protection against one substance or exposure may not provide that same degree of protection against another substance or exposure. For example, molten aluminum sticks to some

fabrics but not to others; and some types of aluminized fabrics ignite when splashed with molten aluminum but others do not. Simple molten metal splash tests can be conducted to determine the effect of the molten metal on the protective fabrics being considered. Testing many different fabrics will allow the most effective ones to be selected for a specific operation.

A final note on personal protective equipment. Wearing multiple layers of protective clothing, some of it heavy, in the vicinity of heat sources can contribute to the potential for a worker to experience heat stress. Employers and workers must be aware of this potential. Proper evaluation of each exposure, careful selection of protective equipment, and training employees to recognize heat stress can drastically reduce the potential for serious illness.

Sometimes, work practices and procedures can be modified to reduce the length of time a worker is required to wear primary protective equipment. Other possibilities include changes in work schedules, more frequent rest breaks, and providing of cooling rooms. “Safety and protecting your employees are most important as they are a top asset of any operation.”

OTHER PRECAUTIONS

Normally, respiratory protection is not necessary in aluminum cast houses or foundries. Occasionally, however, there may be a leak of chlorine gas used in degassing molten metal. Where the chlorine concentration is less than 5 ppm an air purifying respirator equipped with the appropriate cartridges or canister may be used. In situations where exposures exceed this level, or where repairs are being made and the concentrations are unknown, employees should be provided with a full-face piece, self-contained breathing apparatus operating in the pressure demand mode.

Each employee who would be required to wear a respirator must be trained to understand the proper fit, use, and care of the respirator (see OSHA Standard 29CFR 1910.134). In addition, all emergency use respirators (3.g., SCBAs) must be inspected monthly and adequate records kept of the results.

More generally, all visitors entering the plant work areas should be required to wear personal protective equipment appropriate for the exposure they will experience. The plant should maintain an adequate supply of personal protective equipment for loan to visitors.



Contact:

JEFF ZURFACE

Jeff.Zurface@theschaefergroup.com

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