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Standard Guide for Managing Heat Stress and Heat Strain in Foundries¹

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1. Scope

1.1 This guide is intended to establish best practices for recognizing and managing occupational heat stress and heat strain in foundry environments.

1.2 Objectives of the foundry heat stress and heat strain management guide are as follows:

1.2.1 Provide an objective framework for recognizing heat stress and heat strain, and

1.2.2 Facilitate use of best practices to manage heat exposures to minimize heat strain and prevent heat-related illness.

1.3 In this guide, procedures necessary to manage heat stress and heat strain in foundries are described.

1.4 Key elements of this guide include definitions of heat stress and heat strain, plus techniques for recognizing, communicating, managing, and controlling heat stress and heat strain to prevent heat-related illnesses.

1.5 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only.

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, health, and environmental practices and 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.*

¹ This guide is under the jurisdiction of ASTM Committee E34 on Occupational Health and Safety and is the direct responsibility of Subcommittee E34.80 on Industrial Health.

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2. Referenced Documents

2.1 ASTM Standards:²

E1542 Terminology Relating to Occupational Health and Safety

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this standard, refer to Terminology E1542.

3.1.2 *acclimatization, n*—the beneficial physiological adaptations that occur during repeated exposure to a hot environment.

3.1.3 *dew point, n*—the temperature to which air is cooled (at a specific humidity) where the air can hold no more moisture.

3.1.3.1 *Discussion*—When air in contact with the skin reaches the dew point, evaporation of sweat ceases.

3.1.4 *heat cramps, n*—a heat-related illness characterized by spastic contractions of the voluntary muscles (mainly arms, hands, legs, and feet), usually associated with restricted salt intake and profuse sweating without significant body dehydration.

3.1.5 *heat exhaustion, n*—a heat-related illness characterized by elevation of core body temperature above 38 °C (100.4 °F) and abnormal performance of one or more organ systems, without injury to the central nervous system.

3.1.5.1 *Discussion*—Heat exhaustion may signal impending heat stroke.

3.1.6 *heat rash, n*—also known as prickly heat and miliaria, develops when blocked pores (sweat ducts) trap perspiration under your skin. Symptoms range from superficial blisters to deep, red lumps.

3.1.7 *heat strain, n*—the body's physiological response to heat stress (for example, sweating).

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.

3.1.7.1 *Discussion*—The body’s natural way to keep the core body temperature from rising to unhealthy levels is through an increase in heart rate and sweating. This physiological response to the heat load (internal and external) is how the body attempts to increase heat loss to the environment in order to maintain a stable body temperature.

3.1.8 *heat stress, n*—the net heat load to which a worker is exposed.

3.1.8.1 *Discussion*—The net heat load to which a worker is exposed is from the combined contributions of metabolic heat (workload), environmental factors, and clothing worn which results in an increase in heat storage in the body. Environmental factors include radiant heat, air temperature, relative humidity, and air velocity.

3.1.9 *heat stroke, n*—an acute medical emergency caused by exposure to heat from an excessive rise in body temperature (above 41.1 °C (106 °F)) and failure of the temperature-regulating mechanism.

3.1.9.1 *Discussion*—Injury occurs to the central nervous system characterized by a sudden and sustained loss of consciousness preceded by vertigo, nausea, headache, cerebral dysfunction, bizarre behavior, and excessive body temperature.

4. Significance and Use

4.1 This guide is intended to describe heat management program elements that foundries use to prevent or manage heat strain and heat-related illness. Specifically, the guide:

4.1.1 Provides an objective framework for recognizing heat stress and heat strain, and

4.1.2 Facilitates use of best practices to manage heat exposures to minimize heat strain and prevent heat-related illness.

5. Heat Exposure Control Program Responsibilities

5.1 Foundry management shall be responsible for the following:

5.1.1 With supervisors, evaluate indoor and outdoor temperatures.

5.1.2 Issue heat alerts that initiate actions.

5.1.3 Ensure heat exposure provisions and controls are in place and functional and that prescribed PPE is employed.

5.1.4 Review heat exposure incident reports and approve corrective actions recommended as a follow-up to reports of excessive heat strain.

5.2 Human Resources, a program manager, or safety staff (or combinations thereof) shall be responsible for the following:

5.2.1 Establish procedures and conduct training for employees working under heat conditions and for people associated with the program, such as supervisors and first responders.

5.2.2 Work with engineering to employ measures to reduce heat exposure.

5.2.3 Evaluate areas with significant heat sources as part of job safety assessments.

5.2.4 Oversee the actions taken in the program in response to a report of excessive heat strain by a worker or their supervisor to the point of clearance to return to work or to reassignment.

5.2.5 Participate in individual worker orientation and training before assignment.

5.2.6 Choose PPE for specific situations.

5.2.7 Medical services as described in 5.7 shall be arranged.

5.3 Engineering shall be responsible for the following:

5.3.1 With safety staff, regularly review heat exposures associated with foundry processes and seek ways to reduce heat exposure.

5.3.2 Provide feasible engineering control of process heat sources and ventilation of work areas.

NOTE 1—Portable cooling methods may be used, but could affect exhaust and other ventilation systems.

5.3.3 Research and implement feasible corrective actions recommended in investigative reports.

5.3.4 Provide ready access to cool-off areas and hydration stations.

5.4 Workers shall be responsible for:

5.4.1 Following their training,

5.4.2 Preparing themselves for work under heat stress conditions, and

5.4.3 Following established procedures for recognizing and reporting warning signs of the onset of excessive heat strain in themselves and in their coworkers.

5.5 Supervisors shall be responsible for the following:

5.5.1 Evaluate work conditions and worker heat exposure status, and take actions based on heat exposure levels.

5.5.2 Provide input to the worker training process and to employee evaluation before assignment.

5.5.3 Remove workers from their job assignments who experience signs of excessive heat strain and interface with response personnel.

5.5.4 Ensure employees have break periods to cool off and hydrate.

5.6 First aid responders shall be responsible for the following:

5.6.1 Respond promptly to situations where workers experience signs of excessive heat strain.

5.7 Medical services shall be responsible for the following:

5.7.1 Evaluate potential employees with respect to their capability to perform assigned work tasks without risk of heat-related illness.

NOTE 2—Workers at greater risk of heat stress include those who are 65 years of age or older, are overweight, have heart disease or high blood pressure, or take medications that may be affected by extreme heat.³

5.7.2 Be prepared to treat workers with signs of heat illness.

5.7.3 Participate in the process of clearing workers for return to work.

³ “Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments,” DHHS (NIOSH) Publication 2016-106, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 2016, pp. 33–40.