

PROGRAM DIRECTIVE

Program Directive A-113
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SUBJECT: PPE: Foundries

AFFECTED CODES/

DIRECTIVES: OAR 437-02-1910.132(a); 437-02-123; 437-02-137(1); and
437-02-137(2), Personal Protective Equipment

PURPOSE: Provide guidelines for the interpretation, application and compliance evaluation of 1910.132(a); 437-02-123; 437-02-137(1); and 437-02-137(2).

BACKGROUND: Conditions encountered within foundry operation preclude the establishment of rules which are all inclusive or which can be equally applied to all circumstances as they relate to the requirements for high-temperature protective clothing.

Radiant heat is unaffected by air circulation from fans, blowers, exhausts or other mechanical devices, thus the only protection against radiant heat is the reflective clothing or protective equipment used.

The frequency of heat stroke and heat stress accidents in a particular individual is directly related to the degree of radiant heat in the foundry operation. The application of one rule, such as OAR 1910.132(a), for all conditions and circumstances can and does result in time loss incidents which might not have occurred had the rules been interpreted and applied in a more flexible manner based on employers knowledge of the individual operations. Unneeded protective clothing subjects the employer to possible injury or illness from the additional temperature rise created by the clothing and convective heat.

Conversely, the lack of protective clothing for radiant heat can result in severe heat stress and heat stroke accidents which can occur before the employees are aware of the problem.

Protective clothing used where radiant heat is a factor must be of the highly reflective type such as aluminized cloth. Clothing used where "convective" heat or hot air is a factor can be of cotton or wool or absorptive type cloth.

Foot Protection:

Employers feel that the interpretation and application of OAR 437-02-137(1), as written, is a matter of individual judgment and there is always room for dissension or dispute in judgmental decisions. Employees feel that the interpretations can sometimes be arbitrarily safety oriented with no regard for the comfort or personal preference of the user, when specific styles or designs of equipment are required with no equally effective options permitted.

Clothing:

Types of protective clothing and equipment needed and used in foundry operations is governed, to a large extent, by numerous variables such as:

- a. the type of metal being processed;
- b. the processing method being used;
- c. the melting point of the metal being processed;
- d. the type of foundry;
- e. the rate of production;
- f. the size of the units being cast;
- g. age, size and design of the plant;
- h. location of the plant (i.e., north-south); and
- i. climatic conditions (hot-cold).

Other factors to be considered are the reactions of various metals when a spill or splash occurs.

Metals such as steel or iron tend to roll off common clothing and will not stick or adhere to the smooth cloth surface. Metals such as magnesium and aluminum will stick to clothing and tend to "pop" or blow and shower sparks over large areas. Bronze does not stick to clean clothing while it does adhere to dirty or dusty clothing.

Other metals have certain characteristics which are individually associated with that specific metal while in the molten stages.

Use of the following table will aid in the selection of fabrics used in protective clothing. Numbers in the table represent a degree of protection as based on the molten metal splash test as follows:

- 1 = No damage to skin
- 2 = < 1 cm² area of skin showing 1° burn
- 3 = > 1 cm² area showing 1° burn
- 4 = < 1 cm² area showing 2° burn
- 5 = > 1 cm² area showing 2° burn
- 6 = < 1 cm² area showing SEVERE DAMAGE; possible 3° burn
- 7 = > 1 cm² area showing SEVERE DAMAGE; possible 3° burns

Table

Fabric	Fabric Wt. in g/m ²	Flammability (Brit. Std. 3120)	Thermal Protective Index (Radiation) (Brit. Std. 3791)	Grade for Molten Metal Splash Tests (Direct Pour for Iron Slag)									
				Iron 1540°C		Aluminum 680°C		Magnesium 710°C		Low Carbon Steel	Iron Slag (Splash)	Iron Slag Direct Pour	
				1kg	3kg	0.64kg	2kg	0.4kg	1.4kg	1kg 1650°C	1kg		
1. Wool Melton	680	Pass	32	1	1	1	1	1	1	1	1	1	1
2. Wool Melton	530	Fail	22	1	6	1	1	1	2	2	2	3	2
3. Wool Melton--Zirpro Treated	400	Pass	17	2	7	1	6	2	3	3	3	-	-
4. Wool/Modacrylic	400	Fail	14	4	7	4	7	4	6	5	5	-	-
5. Asbestos	1000	Pass	20	-	7	-	7	-	7	-	-	-	-
6. Novaloid	365	Pass	15	6	7	3	7	6	7	-	-	-	-
7. Aramid	305	Pass	10	7	7	7	7	7	7	-	-	-	-
8. Modacrylic/glass-coated	360	Pass	13	6	7	4	7	5	6	-	-	-	-
9. Wool worsted-Zirpro Treated	345	Pass	14	3	7	1	6	1	6	3	-	-	-
10. Wool worsted-Zirpro Treated	270	Pass	9	6	7	2	7	4	7	-	-	-	-
11. Cotton-Proban Treated	340	Pass	16	3	7	6	7	5	7	3	-	-	-
12. Cotton-Pyrovatex Treated	275	Pass	7	6	7	7	7	7	7	-	-	-	-
13. Wool pile (knitted)	1000	Pass	36	1	1	1	1	1	1	-	-	-	-
14. Wool/PVC/Glass	445	Pass	14	6	7	6	7	6	7	-	-	-	-
15. Wool/Nylon	640	Fail	18	3	7	1	4	1	4	3	3	3	2
16. Wool-Neoprene Coated	909	Pass	36	-	2	-	1	-	1	-	-	-	-
17. Wool-Aluminized	780	Pass	142	-	4	-	6	-	6	-	-	-	-
18. Cotton-Aluminized	424	Pass	97	-	7	-	7	-	7	-	-	-	-
19. Asbestos-Aluminized	1200	Pass	128	-	7	-	7	-	7	-	-	-	-

Note: Table from Mehta, PN and K Willerton "Evaluation of clothing materials for protection against molten metals" Textile Institute and Industry, October 1977.

ACTION:

Foot Protection:

Compliance officers shall use the following information to determine compliance with OAR 437-02-137(1):

- A. "Defective" footwear shall include, but not be limited to, footwear which is excessively worn, damaged, torn, or with other defects which negates the safety features of the footwear, including footwear which might be "effective" if it were not in a damaged condition. Such defective footwear shall not be worn in any working area in foundry operations.

"Ineffective" footwear shall be interpreted to mean footwear of any type or design which would not effectively repel such hazardous materials as molten metal, sparks, hot sand or flames, and/or would prevent their entry into the footwear by any means. Such "ineffective" footwear, depending on the conditions under which they were used, could include, but not be limited to, cowboy type boots, engineers boots with loose open tops, tennis shoes, moccasins, shoes or boots with open type lacing, buckles, or straps not covered with legging or spats, rubber boots or shoes, plastic boots or shoes, or other types of footwear not specifically designed for use in foundry operations or processes.

- B. "Special" types of shoes or footguards, as addressed in the rule, could include, but not be limited to, such footwear as the so called "moulders boot," aluminized boots and shoes, and asbestos boots and shoes.

- C. "Leggings or high boots of leather, rubber, or other suitable material" shall be construed to mean that each article of footwear, constructed of specific materials, shall be used only in the processes or conditions for which they are designed. Such processes or conditions as those encountered in foundries or other molten metal work would require the wearing of boots, shoes, or leggings of leather, asbestos, or aluminized materials when working in molten metal, cutting, burning, or welding of metal, hot sand work, or any other areas where heat or heat associated conditions create a hazardous situation.

The appropriate leggings or high boots shall be worn at all times by all employees engaged in molten metal pouring operations where the pouring level is at a level higher than approximately ankle high of the worker engaged in the pouring operations.

- D. Leggings, high boots, shoes, or any combination thereof worn in foundry molten metal operations, shall present a smooth face of surface, with tight tops, or covered tops, which will effectively repel such hazardous materials as molten metal or sparks, and will prevent any entry of such materials into the tops of the footwear, or from becoming lodged in or on the footwear as in the leggings, straps or buckles, etc. When leggings are worn in combination with any boots or shoes having any surface irregularities such as lacings, buckles, straps, etc., the leggings shall be of a design as to totally enclose the irregularities or additional guards such as spats or metatarsal guards. In foundry areas where "heat" is not a factor, conventional leather footwear may be worn except in areas where heavy objects are being moved or handled which could cause foot injuries, in which case boots or shoes of leather with steel safety toes shall be worn.

Clothing:

1. Variables which must be considered when evaluating protective clothing in foundry operation for the application of 1910.132(a); 437-02-123 and 437-02-137(2) shall be:
 - a. - Radiant Heat - large pours can be expected to produce a higher degree of both radiant and convective heat than small pours.
 - b. - Elapsed Time - large pours require longer elapsed working time than smaller pours.
 - c. - Proximity - the closer to the pour, the higher the heat.
 - d. - Elevation - chest and face-high pours are more hazardous than knee-high pours.
 - e. - Size of Molds - a wide shallow mold will produce more heat than a narrow deep mold.
 - f. - Quantity of Molten Metal - large pours present more hazards in cases of splash or spill than small pours.
 - g. - Specific Characteristics - some metals are prone to "pop" or "blow" while other metals are relatively stable.

2. Clothing

- a. All clothing worn in foundry operations shall be constructed of cotton, wool, aluminized cloth or asbestos type cloth.
- b. All clothing worn in foundry operations shall present a smooth surface facing the pouring operations, i.e., all pockets on shirts or jackets shall have "flap" covering on the open tops.
- c. All clothing shall be in good repair with no rips, tear or other openings in the cloth.
- d. Shirts shall be of the long-sleeve type. No polyester or other synthetic materials permitted.
- e. Pants shall be without "cuffs" or "front pockets" and the legs shall extend below the ankle area of the foot unless spats or leggings are worn.
- f. When existing conditions require the wearing of aluminized or asbestos clothing, then either aluminized legging or spats shall be required.
- g. When existing conditions require the wearing of aluminized or asbestos clothing, i.e., (pants, jackets and legging or spats) then approved face shields shall be considered to be protective clothing and shall be required and worn in all pouring operations.

EFFECTIVE

DATE: This directive is effective immediately and will remain in effect until cancelled or superseded.