Hexavalent Chromium Exposure Testing in Steel Foundries

As a result of new regulatory requirements, steel foundries have conducted tests to determine exposures of certain workers to hexavalent chromium. A paper given by Susan R. Fiore at the 2006 SFSA T&O Conference gave some of the background and requirements of the regulation. The background and requirements of the standard from that paper are given below:

Reducing Exposure to Hexavalent Chromium in Welding Fumes

Susan R. Fiore
Edison Welding Institute

Background

In October of 2004, the Occupational Safety and Health Administration (OSHA) announced a proposal to amend the 8-hour time-weighted average permissible exposure limit (PEL) for hexavalent chromium (Cr(VI)), and for all Cr(VI) compounds. On February 28, 2006, OSHA issued its final rule. The new standard lowers the PEL from 52 to 5 micrograms (g) of hexavalent chromium per cubic meter of air as an 8-hour time-weighted average (TWA). The new action level has been set at 2.5 g/m^3 of air. Although lower limits were considered by OSHA, it was determined that a PEL of 5 $\mu g/m^3$ is the lowest level that is technologically and economically feasible for industries impacted by this standard.

There are three separate standards that cover general industry (29 CFR 1910.1026), shipyards (29 CFR 1915.1026), and construction (29 CFR 1926.1126). Although the proposed standards for the three industry sectors differed in some of the detail (e.g., provisions for exposure determination) in the final standards, the requirements are very similar.

The decision to lower the exposure limit was based on a finding that employees exposed to Cr(VI) face an increased risk of significant health effects. The health effects cited by OSHA which are associated with Cr(VI) include lung cancer, asthma, nasal septum ulcerations and perforations, skin ulcerations (“chrome holes”), and allergic and irritant contact dermatitis. One group cited by OSHA as being at risk is workers who are involved with welding of stainless steels. Specifically, OSHA stated that “In general, the studies found an excess number of lung cancer deaths among stainless steel welders. However, few of the studies found clear trends with Cr(VI) exposure duration or cumulative Cr(VI). In most studies, the reported excess lung cancer mortality among stainless steel welders was no greater than mild steel welders, even though Cr(VI) exposure is much greater during stainless steel welding. This weak association between lung cancer and indices of exposure limits the evidence provided by these studies. Other limitations include the coexposures to other potential lung carcinogens, such as nickel, asbestos, and cigarette smoke, as well as possible healthy worker effects and exposure misclassification in some studies, which may obscure a relationship between Cr(VI) and lung cancer risk.” And “Nevertheless, these studies add some further support to the much stronger link between Cr(VI) and lung cancer found in soluble chromate production workers, chromate pigment production workers, and chrome platers.”

The final rule took effect on May 30, 2006, which was 90 days after the date of publication in the Federal Register, February 28, 2006. Employers have until November 27, 2006, 180 days from the effective date, to comply with the rule (1 year for employers with fewer than 20 employees). The deadline for implementing engineering controls is 4 years after the effective date, or May 31, 2010. Complete details of the standard can be found at www.osha.gov. The following section provides some highlights.

Requirements of the new standard

The first step to complying with the standard is to determine the 8-hour TWA exposure for each employee exposed to Cr(VI). Exposure testing should be done by taking a sufficient number of personal breathing zone samples to characterize full shift exposure on each shift for each job classification, in each work area. Representative sampling can be done instead of sampling all employees in order to meet this requirement. However if representative sampling is performed, the employer must sample the employee(s) expected to have the highest Cr(VI) exposure. As an alternative, the employer can determine the 8-hour TWA exposure for each employee based on any combination of air monitoring data, historical monitoring data, or objective data which is sufficient to accurately characterize employee exposure to Cr(VI).

If the initial monitoring shows that employee exposures are below the action level (2.5 g/m^3), the employer may discontinue monitoring for those employees who are represented by that monitoring. If, on the other hand, exposures are found to exceed the action level, the employer must perform monitoring at a minimum of every 6 months. If the initial monitoring shows that employee exposures are above the PEL, then the employer must perform periodic monitoring at a minimum frequency of every 3 months. It is important to note that there is a specific prohibition in the standard against rotating employees to different jobs in order to comply with the standard.

In order to comply with the standard, employers must implement engineering controls to protect those workers whose exposures exceed the PEL. Respirators may be used as an interim measure while engineering controls are being implemented or in the case where the employer can demonstrate that a process or task does not result in any employee being exposed to Cr(VI) above the PEL for 30 or more days per year. Respirators can also be used in those cases where engineering controls are not feasible, or in those cases in which they have been implemented but are not sufficient to reduce exposures to below the PEL.

SFSA Survey

As a result of the regulatory requirement, SFSA asked member companies to share some of their test results to allow a summary report to be prepared. This shows the results from tests from ten plants. Tests included melting and welding operations predominantly. Tests were conducted by outside laboratories specializing in this type of compliance testing.

Melting

The results of melting trials are shown in Table 1. There are no reported instances of being above either the PEL of 5 or the action limit of 2.5.

Table 1 Results of tests for Hexavalent Chromium in Steel Foundry Melting Operations

Position	Plant Type	Exposure μg/m^3
Melter	Induction melting carbon steel	N.D.
Melter	Induction melting stainless and other steel	<0.012
Melt Crane Operator	Arc Melting Steels	<0.02
Melter	Arc Melting Steels	<0.02
Melter	Induction of stainless and other steel	0.059
Melter	Induction of stainless and other steel	0.061

Melt Furnace	Arc Melting Steels	0.072
Melter	Induction of stainless and other steel	0.073
Melter	Induction melting stainless steel	0.10
Melter	Induction melting stainless steel	0.46
Melter	Induction melting stainless steel	0.49
Melter	Induction of stainless and other steel	0.63
Melter	Induction melting stainless steel	0.54
Melter	Arc melting stainless and other steel	0.64
Melter	Induction melting stainless steel	0.74
Melter	Induction melting stainless steel	0.82
Melter	Induction melting stainless steel	1.3
Melter	Induction melting stainless steel	1.5
Melter	Induction melting stainless steel	1.5
Melter	Induction melting stainless steel	1.5
Melter	Induction melting stainless steel	1.8
Operator	AOD melting stainless	0.49
Operator	AOD melting stainless steel	1.1
Pourer	Pouring stainless and other steel	N.D.
Pourer	Pouring carbon steel	0.085
Pourer	Pouring stainless steel	0.27
Pourer	Pouring stainless and other steel	0.95
Pourer and shotblast	Pouring stainless steel	1.3

The rest of the reported tests are included in Table 2. There the results show some areas with reported levels well above the PEL. The lowest numbers reported are from welders with air-supplied helmets. Surprisingly the highest numbers are from arc-air, grinding and welding.

Table 2 Results for Hexavalent Chromium in Steel Foundry Cleaning and Other Areas

Position	Plant Type	Exposure $\mu g/m^3$
Welder	Stainless and other steel production	<0.015
Welder	Stainless and other steel production	<0.015
Welder	Stainless and other steel production	<0.015
Welder	Stainless and other steel production	<0.017
Welder	Stainless and other steel production	0.04
Welder	Stainless and other steel production	0.04

Welder	Stainless and other steel production	0.06
Welder	Stainless production	0.10
Welder	Stainless production	0.17
Molder	Stainless production	0.18
Welder	Stainless production	0.19
Shakeout	Stainless production	0.21
Welder	Stainless and other steel production	0.26
Welder	Stainless production	0.26
Welder	Steel production	0.29
Welder	Stainless production	0.34
Shakeout	Stainless production	0.34
Welder	Stainless production	0.41
Grinder	Steel production	0.41
Arc-Air	Stainless and other steel production	0.43
Molding	Stainless production	0.47
Arc-Air	Stainless production	0.50
Molding	Stainless production	0.52
Welder	Stainless production	0.6
Welder	Stainless and other steel production	0.61
Shot blast	Stainless production	0.68
Molding	Stainless production	0.8
Welder	Steel production	0.87
Arc-Air	Stainless production	1.1
Welder	Stainless production	1.1
Welder	Steel production	1.2
Shot Blast	Stainless production	1.3
Grinding	Stainless production	1.4
Welder	Steel production	1.5
Molding	Stainless production	1.5
Welder	Steel production	1.6
Grinding	Stainless production	1.7
Welder	Steel production	2.2
Welder	Steel production	2.3
Grinding	Stainless production	2.3
Grinding	Stainless production	2.7
Welder	Steel production	3.3
Welder	Stainless production	3.8
Welder	Stainless production	4.0
Arc-Air	Stainless and other steel production	4.9

Arc-Air	Steel production	5.1
Arc-Air	Stainless production	5.1,1.5
Arc-Air	Stainless and other steel production	5.7
Cutting	Stainless production	6.6
Arc-Air	Stainless and other steel production	6.7
Cutting	Stainless production	6.7
Grinder	Stainless production	6.8
Arc-Air	Stainless production	12
Arc-Air	Stainless and other steel production	12
Welding	Stainless production	20, 0.92
Welding	Stainless production	28
Arc-Air	Stainless production	89,23,2.5
Arc-Air	Stainless production	41,74,106