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Standard Guide for Using Documents Related to Metalworking or Metal Removal Fluid Health and Safety¹

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1. Scope

1.1 This guide covers information on how to use documents related to health and safety of metalworking and metal removal fluids. As such, this guide will provide the user with sufficient background information to effectively use the documents listed in Section 2. Documents referenced in this guide are grouped as applicable to producers, to users or to all.

1.2 *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 determine the applicability of regulatory requirements prior to use.*

¹ This guide is under the jurisdiction of ASTM Committee E34 on Occupational Health and Safety and is the direct responsibility of Subcommittee E34.50 on Health and Safety Standards for Metal Working Fluids.

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2. Referenced Documents

2.1 *ASTM Standards:*²

E 1302 Guide for Acute Animal Toxicity Testing of Water-Miscible Metalworking Fluids

E 1497 Practice for Safe Use of Water-Miscible Metal Removal Fluids

E 1687 Test Method for Determining Carcinogenic Potential of Virgin Base Oils in Metalworking Fluids

E 1972 Practice for Minimizing Effects of Aerosols in Wet Metal Removal Environment

E 2144 Practice for Personal Sampling and Analysis of Endotoxin in Metalworking Fluid Aerosols in Workplace Atmospheres

E 2169 Practice for Selecting Antimicrobial Pesticides for Use in Water-Miscible Metalworking Fluids

E 2250 Method for Determination of Endotoxin Concentration in Water Miscible Metalworking Fluids

PS 42 Method for Metal Removal Aerosol in Workplace Atmospheres³

~~PS 94 Practice for Personal Sampling and Analysis of Endotoxin in Metal Removal Fluid Aerosols in Workplace Atmospheres²~~

2.2 *Other Documents:*

Management of the Metal Removal Fluid Environment: A Guide to Safe and Efficient Use of Metal Removal Fluids⁴

Criteria for a Recommended Standard: Occupational Exposure to Metalworking Fluids⁵

Metalworking Fluids: Safety and Health Best Practices Manual⁶

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *endotoxins*, *n*—alipopolysaccharides derived from the outer membranes of Gram-negative bacteria.

3.1.2 *metal removal fluids*, *n*—the subset of metalworking fluids that are used for wet machining or grinding to produce the finished part.

3.1.2.1 *Discussion*—Metal removal fluids addressed by this practice include straight or neat oils, not intended for further dilution with water, and water-miscible soluble oils, semisynthetics, and synthetics, which are intended to be diluted with water before use. Metal removal fluids become contaminated during use in the workplace with a variety of workplace substances including, but not limited to, abrasive particles, tramp oils, cleaners, dirt, metal fines and shavings, dissolved metal and hard water salts, bacteria, fungi, microbiological decay products, and waste. These contaminants can cause changes in the lubricity and cooling ability of the metal removal fluid as well as have the potential to adversely affect the health and welfare of employees in contact with the contaminated metal removal fluid.

3.1.3 *mutagenicity index*, *n*—the slope of the dose response curve for mutagenicity in the modified Ames test described in Test Method E 1687.

4. Significance and Use

4.1 Application of this guide will provide users with information on how to use the various documents listed in Section 2 related to health and safety of metalworking and metal removal fluids.

4.2 Users of the documents listed in Section 2 may fall into several categories, such as producers of metalworking or metal removal fluids, suppliers of raw materials to those producers, users of metalworking or metal removal fluids, and other interested parties, such as non governmental organizations.

4.3 While all parties may wish to be generally familiar with all the documents listed in Section 2, producers and users may each want to focus on certain documents which are directly applicable to them:

4.4 *Documents Applicable to Producers :*

4.4.1 *E 1687 Test Method for Determining Carcinogenic Potential of Virgin Base Oils in Metalworking Fluids*

4.4.1.1 This test method covers a microbiological test procedure based upon the *Salmonella* mutagenesis assay of Ames et. al (see also Maron et al⁷ (see also Maron et al⁸). It can be used as a screening technique to detect the presence of potential dermal carcinogens in virgin base oils used in the formulation of metalworking oils. Persons who use this test should be well-versed in the conduct of the Ames test and conversant with the physical and chemical properties of petroleum products.

4.4.1.2 Producers of metalworking fluids and metal removal fluids should assure themselves that virgin base oils used in the formulation of neat metalworking and metal removal oils and soluble and semi-synthetic metal removal fluids have an acceptable

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, Vol 11.03, volume information, refer to the standard's Document Summary page on the ASTM website.

³ Discontinued, see 1998 Annual Book of ASTM Standards, Vol 11.03.

⁴ Withdrawn.

⁵ Available from Organization Resources Counselors, Inc., 1910 Sunderland Place, NW, Washington DC 20036 or at <http://www.orc-dc.com>

⁶ Available from U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Cincinnati, OH 45226.

⁷ Ames, B.N. et al., *Mutation Research*, Vol. 31, 1975, pp. 347-363.

⁸ Available from US Occupational Health and Safety Administration, 200 Constitution Avenue NW, Washington, DC 20210 or at http://www.osha.gov/SLTC/metalworkingfluids/metalworkingfluids_manual.html

⁹ Maron, D.

¹⁰ Ames, B.N. et al., *Mutation Research*, Vol. 113, 1983, pp. 173-215.

¹¹ Maron, D. et al, *Mutation Research*, Vol. 113, 1983, pp. 173-215.

mutagenicity index or mutagenic potency index.

4.4.2 *E 1302 Guide for Acute Animal Toxicity Testing of Water-Miscible Metal Removal Fluids*

4.4.2.1 This guide defines acute animal toxicity tests and sets forth references for procedures to assess the acute toxicity of water-miscible metal removal fluids as manufactured.

4.4.2.2 Application of this guide will provide information on the acute toxicity of water-miscible metal removal fluids and will assist the user in evaluating the potential health hazards of the fluid and developing appropriate work practices.

4.5 *Documents Applicable to Users :*

4.5.1 *E 1497 Practice for Safe Use of Metal Removal Fluids*

4.5.1.1 This practice sets forth guidelines for the safe use of metal removal fluids, additives and biocides. This includes product selection, storage, dispensing, and maintenance.

4.5.1.2 Water-miscible metal removal fluids are typically used at high dilution and dilution rates vary widely. Additionally, there is potential for exposure to undiluted metal removal fluid as manufactured, as well as metal removal fluid additives and biocides.

4.5.1.3 Straight oils generally consist of a severely solvent-refined or hydro-treated petroleum oil, a synthetic oil, or other oils of animal or vegetable origin. Straight oils are not intended to be diluted with water prior to use. Additives are often included in straight oil formulations.

4.5.2 *E 1972 Practice for Minimizing Effects of Aerosols in the Wet Metal Removal Environment*

4.5.2.1 This practice sets forth guidelines for minimizing effects of aerosols in the wet metal removal environment.

4.5.2.2 This practice incorporates all practical means and mechanisms to minimize aerosol generation and to control effects of aerosols in the wet metal removal environment.

4.5.3 *PS 42 Provisional Method for Metal Removal Fluid Aerosol in Workplace Atmospheres*

4.5.3.1 This test method covers a procedure for the determination of both particulate matter and extractable mass metal removal fluid aerosol concentrations in a range from 0.05 mg/m³ to 5 mg/m³ in workplace atmospheres.

4.5.3.2 This test is intended as an interim test method to be used as a standardized means of collecting worker exposure information that can be compared to existing exposure databases, yet a test method that is also more specific to metal removal fluids.

4.5.3.3 It is anticipated that this provisional test method will be superseded by an improved permanent method that will remain correlated with historical databases. Improvements suggested include incorporating a size-selective inlet to sample only that aerosol relevant to the health effects in question, eliminating potential loss to the filter support, increasing the specificity of the test method further, and the addition of a section in the sampler to collect semi-volatile compounds that are underestimated by current methods.

4.5.4 ~~PS 94~~*E 2144 Provisional Practice for Personal Sampling and Analysis of Endotoxin in Metal Removal Metalworking Fluid Aerosols in Workplace Atmospheres*

4.5.4.1 This ~~provisional~~ practice covers quantitative methods for the personal sampling and determination of bacterial endotoxin concentrations in polydisperse metal removal fluid aerosols in workplace atmospheres. Users should have fundamental knowledge of microbial techniques and *Limulus ameobocyte lysate (LAL) assay* testing.

4.5.4.2 Endotoxins in metal removal fluid aerosols present potential respiratory hazards to workers who inhale them.

4.5.4.3 Users of this ~~provisional~~ practice may obtain personal exposure data of endotoxin in metal removal fluid aerosols, either on a short-term or full-shift basis.

4.5.4.4 This ~~provisional~~ practice gives an estimate of the endotoxin concentration of the sampled atmosphere.

4.5.4.5 This practice seeks to minimize interlaboratory variation but does not ensure uniformity of results.

4.5.5 *E 2169 Practice for Selecting Antimicrobial Pesticides for Use in Water-Miscible Metalworking Fluids*

4.5.5.1 This practice provides recommendations for selecting antimicrobial pesticides (microbiocides) for use in water-miscible metalworking fluids (MWF). It presents information regarding regulatory requirements, as well as technical factors including target microbes, efficacy and chemical compatibility.

4.5.5.2 This guide is not an encyclopedic compilation of all the concepts and terminology uses by chemists, microbiologists, toxicologists, formulators, plant engineers and regulatory affairs specialists involved in antimicrobial pesticide selection and application. Instead, it provides a general understanding of the selection process and its supporting considerations.

4.5.6 *E 2250 Method for Determination of Endotoxin Concentration in Water Miscible Metalworking Fluids*

4.5.6.1 This method covers quantitative methods for the sampling and determination of Gram-negative bacterial endotoxin concentrations in water miscible metalworking fluids (MWF).

4.5.6.2 Users of this method should be familiar with the handling of MWF.

4.5.6.3 This method gives an estimate of the endotoxin concentration of the sampled MWF.

(a) Used on site, this method gives an indication of changes in Gram-negative bacterial contamination in the MWF.

(b) This method does not replace Practice E 2144.

4.5.6.4 This method seeks to minimize inter-laboratory variation but does not ensure uniformity of results.

4.5.6.5 This method is intended to relate endotoxin concentration in MWF to health effects of inhaled endotoxin.

4.6 *Documents Applicable to All :*

4.6.1 *Management of the Metal Removal Fluid Environment: A Guide to the Safe and Efficient Use of Metal Removal Fluids*

4.6.1.1 This guide collects best practices in the management of metal removal fluid systems and provides an educational tool to assist users in taking control of the MRF systems in their workplaces.

4.6.1.2 For many industrial organizations, focusing on the systematic management of MRF systems has proven effective in controlling exposures in the wet metal removal/machining environment. The recommendations are distilled from the experiences of Organization Resources Counselors member companies and represent best practice.

4.6.2 *Criteria for a Recommended Standard: Occupational Exposure to Metalworking Fluids*

4.6.2.1 This criteria document reviews available information about the adverse health effects associated with occupational exposure to metalworking fluids and metalworking fluid aerosols.

4.6.2.2 Criteria documents provide the scientific basis for new occupational safety and health standards and contain a critical review of the scientific and technical information available on the prevalence of hazards, the existence of safety and health risks, and the adequacy of control methods.

4.6.3 *Metalworking Fluids: Safety and Health Best Practices Manual*

4.6.3.1 This document provides general information about the metalworking fluid environment and the health hazards of occupational exposure to MWFs.

4.6.3.2 This Manual recommends occupational health guidelines to mitigate the adverse health effects associated with occupational exposure to MWFs and covers major topics such as a systems management approach, exposure assessment, medical surveillance, and training.

(a) Systems management includes a comprehensive programmatic approach including such things as machine enclosure, ventilation, fluid management, and other actions to control exposure and minimize contact with the fluid.

4.6.3.3 The material in this Manual will help safety and health professionals apply their resources to the industrial hygiene problems associated with the metalworking environment. Engineering, work practice, and administrative controls that help reduce workplace exposures are identified and appropriate methods are described that limit exposures.

5. Keywords

5.1 acute toxicity testing; aerosol; base oils; endotoxins; metal removal fluid; metal removal fluid aerosols; metal removal fluid management; metalworking fluids; modified Ames test; workplace atmospheres

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