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N E M A S T A N D A R D S P U B L I C A T I O N

NEMA EW 5

GUIDELINES FOR THE PREPARATION OF MATERIAL SAFETY DATA SHEETS FOR WELDING CONSUMABLES AND RELATED PRODUCTS

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GUIDELINES FOR THE PREPARATION OF MATERIAL SAFETY DATA SHEETS FOR WELDING CONSUMABLES AND RELATED PRODUCTS

Published by

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FOREWORD

Unless otherwise indicated, this document is approved as Authorized Engineering Information.

The purpose of these Material Safety Data Sheets (MSDS) guidelines is to inform producers, distributors, engineers, code officials, and users about the potentially hazardous physical properties of welding consumables. They also assist in selecting the proper protection needed to protect personnel and property. User needs are a paramount concern in the development of MSDSs.

This publication provides guidelines for the preparation of Material Safety Data Sheets (MSDS) for electrodes, filler metals, and fluxes used in welding and related processes. These guidelines are intended to assist the manufacturers and suppliers of these products in providing accurate and pertinent safety information. This revision has been prepared to conform the guidelines to the requirements of the U.S. Occupational Safety and Health Administration's Standard, 29 CFR 1910.1200 (*Hazard Communication Standard*), which became effective, in part, November 25, 1985.

Modifications to this basic MSDS format are permitted where it serves to more effectively communicate safety information that is peculiar to welding consumables and processes.

The location and wording of safety information on the MSDS, as recommended in these guidelines, may be modified by individual companies to suit their manner of presentation.

These guidelines of the Arc Welding Section of the National Electrical Manufacturers Association are reviewed periodically by the Section for the purpose of updating MSDS to reflect advancing technology. Please address any comments or questions on the text to:

Vice President, Engineering Department
National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, VA 22209

This Standards Publication was developed by the Arc Welding Section. Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Arc Welding section was composed of the following members:

Arc Machines, Inc.—Pacoima, CA
Bohler UTP Welding Materials, Inc.—Houston, TX
ESAB Welding & Cutting Products, Equipment Division—Florence, SC
Hypertherm Incorporated—Hanover, NH
Miller Electric Manufacturing Co.—Appleton, WI
Systematics—West Chester, PA
The Lincoln Electric Company—Cleveland, OH
Thermadyne Industries, Inc.—St Louis, MO

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CAUTION NOTICE

This guideline is organized to present concepts and guidance to a person preparing a material safety data sheet (MSDS) for electrodes, filler metals, and fluxes for use in welding and related processes. The preparer must draw heavily upon the available technical information of experts. This guideline cannot be considered to be a resource for providing all information necessary for full compliance with rules, regulations or laws. Each company and person preparing an MSDS must diligently remain aware of all legal requirements relating to MSDSs, both current and evolving future ones.

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Section 1
GENERAL

1.1 SCOPE

This document sets forth guidelines for the preparation of Material Safety Data Sheets (MSDS) for electrodes, filler metals, and fluxes for use in welding and related processes. These guidelines are intended to assist the manufacturers and suppliers of these products in providing accurate and pertinent safety information. These guidelines are based on U.S. Department of Labor standards, as detailed in Occupational Safety and Health Administration (OSHA) *Hazard Communication Standard* (29 CFR Part 1910.1200). Modifications to this basic MSDS format are recommended where they serve to more effectively communicate safety information that is peculiar to welding consumables and processes.

The location and wording of safety information on the MSDS, as recommended in these guidelines, may be modified by individual companies to suit their manner of presentation.

1.2 REFERENCED STANDARDS

In this publication, reference is made to the standards listed below. Copies are available from the indicated sources.

American Welding Society, Inc.
550 N.W. LeJeune Road
Miami, FL 33126

AWS F1.1-1992	*Methods for Sampling Airborne Particulates Generated by Welding and Allied Processes*
AWS F1.2-1992	*Laboratory Method for Measuring Fume Generation Rates and Total Fume Emission for Welding and Allied Processes*

American National Standards Institute
11 West 42nd Street
New York, NY 10036

ANSI Z49.1-1994	*Safety in Welding, Cutting and Allied Processes*

U.S. Government Printing Office
Superintendent of Documents Administration
Washington, DC 20402

OSHA Standard 29 CFR 1910, Subpart Z 1910.1000	*Toxic and Hazardous Substances Air Contaminants Table Z-2*

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U.S. Department of Labor
Occupational Safety and Health Administration
200 Constitution Avenue
Room N-3101
Washington, DC 20210

OSHA Standard 29 CFR 1910.1200 — *Material Safety Data Sheet* (Non-Mandatory Form)

Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Sections 311, 312, 313 — *Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA)*

American Conference of Governmental Industrial Hygienists
Technical Affairs Office
Kemper Woods Center
1330 Kemper Meadow Drive
Cincinnati, OH 45240

Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)

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Section 2
GUIDELINES

2.1 Section 1—Identification

Date

Manufacturer/Supplier Name

Address

Telephone Number—This should be a source for further information or a contact in the event of an emergency involving this product.

Trade Name—Name under which the product is marketed.

Classification—Applicable classification or specification, if any, to which the product corresponds. (Examples are: AWS E7024, MIL-11018M).

Product Type—General descriptive class of product and intended uses. (Examples are: submerged arc welding flux, flux cored arc welding electrode, shielded metal arc welding electrode). Other information such as size, stock number, etc., may also appear.

If the producer develops a single material safety data sheet to cover more than one product, a group of trade names and classifications may be listed on one MSDS, preferably in Section 2 of these guidelines.

2.2 Section 2—Hazardous Ingredients[1]

The table that makes up this section should list the ingredient's name, chemical abstract service (CAS) registry number and weight percent (optional) of the product, and the OSHA permissible exposure limit, ACGIH threshold limit value (TLV), and any other exposure limit used. It is recommended that materials be included in this table in a manner judged appropriate by the producer, using procedures outlined in the *Hazard Communication Standard.* It is recommended that the TLVs shown be those for the materials as they exist in the product. Ingredients subject to the reporting requirements of Sections 311, 312 and 313 of the *Emergency Planning and Community Right-To-Know Act of 1986* (EPCRA) should also be included as well.

To clarify the nature of this section the following passage should appear either above or below the table: "IMPORTANT! This section covers materials from which this product is manufactured."

2.3 Section 3—Physical and Chemical Characteristics

This section is not applicable for most welding consumables and related products. Where it is determined by the producer that the inclusion of physical data such as appearance information is appropriate for a product, the procedures set down in 29 CFR Part 1910.1200 should be followed.

[1] The term "hazardous" should be interpreted as a term required and defined in 29 CFR Part 1910.1200, Health Hazard Definitions (Mandatory).

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2.4 Section 4—Fire and Explosion Hazard Data

Welding consumables and related products are generally nonflammable. The following text is recommended:

"Nonflammable. Welding arc and sparks can ignite combustibles and flammables. Refer to American National Standard Z49.1 for fire prevention during the use of welding and allied procedures."

Where it is determined by the producer that other information pertaining to this section is appropriate, the procedures set down in 29 CFR Part 1910.1200 should be followed.

2.5 Section 5—Reactivity Data

The only topic in this section that is applicable for most welding consumables and related products is Hazardous Decomposition Products. Where it is determined by the producer that other topics are relevant, the procedures set down in 29 CFR Part 1910.1200 should be followed.

Hazardous Decomposition Products—The following text is recommended to provide information on the Hazardous Decomposition Products that may reasonably be expected to occur during normal use of the welding consumable. The text should include the most likely significant fume constituents for the specific consumable of interest. Special attention should be directed to any fume constituent with a low TLV which may cause the TLV for the overall fume to be below the general welding fume NOC (not otherwise classified) level of 5 mg/m^3. For example, consider hexavalent chromium (CR^{+6}), manganese, copper and nickel.

"Welding fumes and gases cannot be classified simply. The composition and quantity of both are dependent upon the metal being welded, the process, procedure, and electrodes used. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded (such as paint, plating, or galvanizing), the number of welders and the volume of the work area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities)."

When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 2. Fume and gas decomposition products, and not the ingredients in the electrode, are important. The concentration of a given fume or gas component may decrease or increase by many times the original concentration in the electrode. Also, new compounds not in the electrodes may form. Decomposition products of normal operation include those originating from the volatilization, reaction, or oxidation of the materials shown in Section 2, plus those from the base metal and coating, etc., as noted above.

Reasonably expected fume constituents of this product would include:

Example for carbon dioxide shielded flux-cored electrode (AWS 5.20 E70 T-1):

"Reasonably expected fume constituents of this product would include: primarily oxides of iron; secondarily complex oxides of manganese, silicon, titanium, and sodium. The present ACGIH TLV for manganese, 0.2 mg/m^3 will result in a significant reduction from the 5 mg/m^3 general welding fume (NOC) level."

Example for stainless steel covered electrodes (AWS 5.4):

"Reasonably expected fume constituents of this product would include: primarily fluorides and complex oxides of iron and silicon; secondarily complex oxides of manganese, titanium, chromium, nickel, sodium and potassium. The present 1995 OSHA PEL (Permissible Exposure Limit) for hexavalent chromium (Cr^{+6}) is 0.05 mg/m^3 which will result in a significant reduction from the 5 mg/m^3 general welding fume (NOC) level. The limit of 0.05 mg/m^3 for hexavalent chromium from the decomposition products in these electrodes comes from the limit shown at the bottom of OSHA Table Z-2, which is for 0.1 mg of CrO^{3-}

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which calculates to 0.05 mg of Cr^{+6}/m^3. It applies to soluble chromates of the types found in covered stainless electrode fumes."

Reasonably expected gaseous constituents would include carbon monoxide and carbon dioxide. Ozone and nitrogen oxides may be formed by the radiation from the arc.

One recommended way to determine the composition and quantity of fumes and gases to which workers are exposed is to take an air sample from inside the welder's helmet if worn or in the worker's breathing zone. See ANSI/AWS F1.1 and ANSI/AWS F1.2-1992.

2.6 Section 6—Health Hazard Data

Hazard Communication—As required by the OSHA Hazard Communication Standard, a description of health hazards of the hazardous decomposition products, including signs and symptoms of exposure, and any medical conditions which are generally recognized as being aggravated by exposure to the decomposition products, should be shown. It is recommended that statements on acute and chronic exposure be included.

The following paragraph should appear:

"Threshold Limit Value: The ACGIH recommended limit for Welding Fume NOC (Not Otherwise Classified) is 5 mg/m^3. ACGIH-1995 (or latest date) preface states. These values are *not* fine lines between safe and dangerous concentrations and *should not* be used by anyone untrained in the discipline of industrial hygiene. See Section 5 for specific fume constituents which may modify the TLV."

Effects of Overexposure—It is recommended to include here the statements of hazards and consequences from the appropriate ANSI/AWS minimum precautionary label that applies to the product. For an arc welding product the current statements and a recommended preface are as follows:

"WARNING: PROTECT yourself and others. Read and understand this information.

FUMES AND GASES can be hazardous to your health.

ARC RAYS can injure eyes and burn skin.

ELECTRIC SHOCK can kill.

Before use, read and understand the manufacturer's instructions, Material Safety Data Sheets (MSDSs), and your employer's safety practices.

Keep your head out of the fumes.

Use enough ventilation, exhaust at the arc, or both, to keep fumes and gases from your breathing zone and the general area.

Wear correct eye, ear, and body protection.

Do not touch live electrical parts.

See American National Standard Z49.1, *Safety in Welding, Cutting, and Allied Processes*, published by the American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126; and OSHA Safety and Health Standards, available from the U.S. Government Printing Office, Washington, DC 20402.

DO NOT REMOVE THIS INFORMATION"

It is recommended that the following passages also be included for all products immediately following the FUMES AND GASES statement above:

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"Short-term (acute) overexposure to welding fumes may result in discomfort such as: metal fume fever, dizziness, nausea, or dryness or irritation of nose, throat, or eyes and may aggravate pre-existing respiratory conditions, e.g. asthma or emphysema (see Sections 4 and 7)."

"Long-term (chronic) overexposure to welding fumes can lead to siderosis (iron deposits in the lungs) and may affect pulmonary function. Manganese over-exposure can affect the central nervous system resulting in impaired speech and movement. The primary entry route for welding fumes and gases is by inhalation."

Emergency and First Aid Procedures—It is not recommended that specific effects of overexposure, emergency, and first aid procedures be included for all possible decomposition products listed in Section 6. It is recommended that this specific information be included only for decomposition products which in the judgment of the producer require special attention. (Examples may be included).

The following general statement is recommended:

"Call for medical aid. Employ first aid techniques recommended by the American Red Cross."

Carcinogenicity—State whether the hazardous chemical is listed in the National Toxicology Program (NTP) Annual Report of Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) monographs or by OSHA. (If no list is applicable, leave this data off).

2.7 Section 7—Precautions for Safe Handling and Use / Applicable Control Measures

It is recommended that for welding consumables and related products the topics of "Precautions for Safe Handling and Use/Applicable Control Measures" be combined into one section. The combining of these sections add clarity to the overall safety message since the two areas of concern are closely interrelated for welding consumables.

The following general text is recommended for this section:

"Read and understand the manufacturer's instructions and the precautionary label on the product. See American National Standard Z49.1 and OSHA Publication (29 CFR 1910) *Hazard Communication Standard* for more details on many of the following:

Ventilation—Use enough ventilation, local exhaust at the arc, or both, to keep the fumes and gases from the worker's breathing zone and the general area. Train the welder to keep his head out of the fumes. Keep exposures as low as possible.

Respiratory Protection—Use respirable fume respirator or air supplied respirator when welding in confined space or where local exhaust or ventilation does not keep exposure below the recommended exposure limit.

Eye Protection—Wear helmet or use face shield with filter lens. Provide protective screens and flash goggles, if necessary, to shield others. As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go the next lighter shade which gives sufficient view of the weld zone.

Protective Clothing—Wear hand, head and body protection which help to prevent injury from radiation, sparks, and electrical shock. See ANSI Z49.1. At a minimum this includes welder's gloves and a protective face shield, and may include arm protectors, aprons, hats, shoulder protection, as well as dark substantial clothing. Train the welder not to touch live electrical parts and to insulate himself from work and ground."

Procedure for Cleanup of Spills or Leaks—This procedure is not applicable for most welding consumables and related products. Where it is determined by the producer that information pertaining to this topic is appropriate for a product, the procedures set down in the *Hazard Communication Standard* (29 CFR Part 1910.1200) should be followed.

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"STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

Not applicable."

Waste Disposal Method—Prevent waste from contaminating surrounding environment.

Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations.

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Annex
(informative)
MATERIAL SAFETY DATA SHEET

(Welding Consumables and Related Products Conforms to the Requirements of OSHA's 29 CFR 1900.1200)

Section 1—IDENTIFICATION	
Manufacturer/Supplier Name	Telephone No.
Address	Date
Trade Name	
Product Type	

Section 2—HAZARDOUS* INGREDIENTS		
IMPORTANT! This section covers the materials from which this product is manufactured. The fumes and gases produced during welding with (normal use of)** this product are covered by Section 3.		
Ingredient***	Approximate Weight %**	Exposure Limit
		Source (1) OSHA (2) ACGIH TLV (3) Mfr. Recommendation

*The term "hazardous" should be interpreted as a term required and defined in the OSHA *Hazard Communication Standard* (29 CFR Part 1910.1200) and does not necessarily imply the existence of any hazard.

**Optional

***Ingredient means the chemical name or common name, chemical abstract service (CAS) registry number (optional), or any other information that reveals precise chemical designation of the substance.

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Section 3—PHYSICAL AND CHEMICAL CHARACTERISTICS

Not applicable (*appearance information may be included*).

Section 4—FIRE AND EXPLOSION HAZARD DATA

Nonflammable. Welding arc and sparks, however, can ignite combustibles and flammable products. See guideline reference ANSI Z49.1.

Section 5—REACTIVITY DATA

Hazardous Decomposition Products

Welding fumes and gases cannot be classified simply. The composition and quantity of both are dependent upon the metal being welded and electrodes used. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded (such as paint, plating, or galvanizing), the number of welders, the volume of the work area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities).

When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 2. Decomposition products of normal operation include those originating from the volatilization, reaction, or oxidation of the materials shown in Section 2, plus those from the base metal, coatings, etc., as noted above.

Reasonably expected fume constituents of this product would include: (insert fume composition).

Reasonably expected gaseous constituents of this product would include: (insert gas composition). Ozone and nitrogen oxides may be formed by the radiation from the arc.

One recommended way to determine the composition and quantity of fumes and gases to which workers are exposed is to take an air sample inside the welder's helmet if worn or in the worker's breathing zone. See ANSI/AWS F1.1 and ANSI/AWS F1.2.

Section 6—HEALTH HAZARD DATA

Threshold Limit Value:

The ACGIH recommended limit for Welding Fume NOC (Not Otherwise Classified) is 5 mg/m^3. ACGIH-1995 (or latest date) preface states "These values are not fine lines between safe and dangerous concentrations and should not be used by anyone untrained in the discipline of industrial hygiene." See Section 5 for specific fume constituents.

Effects of Overexposure

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Welding may create one or more of the following health hazards:

FUMES AND GASES can be dangerous to your health. Short-term (acute) overexposure to welding fumes may result in discomfort such as: metal fume fever, dizziness, nausea, or dryness or irritation of nose, throat, or eyes and may aggravate pre-existing respiratory conditions, e.g. asthma or emphysema.

Long-term (chronic) overexposure to welding fumes can lead to siderosis (iron deposits in the lungs) and may affect pulmonary function. Manganese over-exposure can affect the central nervous system resulting in impaired speech and movement. The primary entry route for welding fumes and gases is by inhalation.

ARC RAYS can injure eyes and burn skin.

ELECTRIC SHOCK can kill.

Before use, read and understand the manufacturer's instructions, Material Safety Data Sheets (MSDSs), and your employer's safety practices.

Keep your head out of the fumes.

Use enough ventilation, exhaust at the arc, or both, to keep fumes and gases from your breathing zone and the general area.

Wear correct eye, ear, and body protection.

Do not touch live electrical parts.

Emergency and First Aid Procedures

Call for medical aid. Employ first aid techniques recommended by the American Red Cross.

Carcinogenicity: NTP? IARC Monographs? OSHA Regulated?

Section 7—PRECAUTIONS FOR SAFE HANDLING AND USE / APPLICABLE CONTROL MEASURES

Read and understand the manufacturer's instructions and the precautionary label on the product. See American National Standard Z49.1 (*Safety in Welding, Cutting and Allied Processes)* and OSHA Publication (29 CFR 1910) for more detail on many of the following.

Ventilation

Use enough ventilation, local exhaust at the arc, or both, to keep the fumes and gases from the worker's breathing zone and the general area. Train the welder to keep his head out of the fumes. Keep exposures as low as possible.

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Respiratory Protection

Use respirable fume respirator or air supplied respirator when welding in confined space or where local exhaust or ventilation does not keep exposure below the recommended exposure limit.

Eye Protection

Wear helmet or use face shield with correct shade of filter lens. Provide protective screens and flash goggles, if necessary, to shield others. As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to the next lighter shade which gives sufficient view of the weld zone.

Protective Clothing

Wear hand, head and body protection which help to prevent injury from radiation, sparks, and electrical shock. See ANSI Z49.1. At a minimum this includes welder's gloves and a protective face shield, and may include arm protectors, aprons, hats, shoulder protection, as well as dark substantial clothing. Train the welder not to touch live electrical parts and to insulate himself from work and ground.

Procedure for Cleanup of Spills or Leaks

Waste Disposal Method – Prevent waste from contaminating surrounding environment. Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal, state and local regulations.

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: not applicable.

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