

**AWS F1.2:2006**  
**An American National Standard**



# **Laboratory Method for Measuring Fume Generation Rates and Total Fume Emission of Welding and Allied Processes**



**American Welding Society**



**AWS F1.2:2006**  
**An American National Standard**

**Approved by the**  
**American National Standards Institute**  
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# **Laboratory Method for Measuring Fume Generation Rates and Total Fume Emission of Welding and Allied Processes**

**Supersedes AWS F1.2:1999**

Prepared by the  
American Welding Society (AWS) Project Committee on Fumes and Gases

Under the Direction of the  
AWS Committee on Safety and Health

Approved by the  
AWS Board of Directors

## **Abstract**

This document outlines a laboratory method for the determination of fume generation rates and total fume emission. A test chamber is used to collect representative fume samples under carefully controlled conditions.



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# Laboratory Method for Measuring Fume Generation Rates and Total Fume Emission of Welding and Allied Processes

## 1. Introduction, Purpose, and Scope

**1.1 Introduction.** This AWS laboratory test method describes the recommended procedures to be followed in collecting samples for determining the composition and quantity of fume generated during welding and allied processes. The directions for performing the test include such details as the following:

1. Amount of sample to be taken;
2. Filter specifications;
3. Care needed to attain a constant weight during sample handling and storage;
4. Calibration procedure for test equipment to assure satisfactory, comparable, and reproducible data; and
5. Sample calculations.

This AWS method is supported by experience and data obtained from cooperative tests. The sampling methods prescribed for breathing zone and general area sampling of fumes for particulate matter are not within the scope of this document. Operator exposure and background sampling methodology are described in detail in AWS F1.1M, *Method for Sampling Airborne Particulates Generated by Welding and Allied Processes*.

Before use of welding equipment or consumables, read and understand manufacturer's instructions, Material Safety Data Sheets (MSDSs), and your employer's safety practices. Fumes and gases can be hazardous to your health. Arc rays can injure eyes and burn skin. Electric shock can kill. Wear correct eye, ear, and body protection. Do not touch live electrical parts. See ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, published by AWS, for further information.

### 1.2 Purpose

**1.2.1** Welding and allied processes produce fumes and gaseous by-products. The amount or rate generated by a particular process and material depends upon the

conditions of use. The laboratory sampling procedure described herein is designed to evaluate the effects of variations in materials, processes, and operating conditions on fume generation rate. Fume generation rates can be useful in prescribing adequate ventilation, making process selections, influencing process variables, and calculating air filtering requirements. In order to provide a safe working environment, it may be necessary to compare the fume generation rate and identify the constituents present in the fumes of various processes.

**1.2.2** The samples obtained using the techniques described herein are representative of the fumes present and, if collected on appropriate filters, may be used for fume constituent analyses.

**1.2.3** This procedure is designed for a short testing time, normally two minutes or less, which yields accurate and reproducible results. The method described in this procedure is suitable for use with the majority of welding and allied processes and allows for variation of selected conditions.

**1.2.4** Fume generation rate data, if collected in accordance with this procedure, can be correlated to and compared with data from different sources.

### 1.3 Scope

**1.3.1** This method describes a laboratory device and procedure for obtaining representative fume samples and determining fume generation rates of welding and allied processes.

**1.3.2** A separate collection procedure for determining fume constituents is described.

**1.3.3** A standard set of fume generation test conditions is specified to calibrate the sampling equipment.

**1.3.4** Methods for obtaining breathing zone and general area welding fume samples are not within the scope of this standard.

**1.3.5** Sampling of gases is not within the scope of this standard.

**1.3.6** This standard will be revised as required in accordance with acknowledged technical advancements in the field.

**1.3.7** This standard makes sole use of U.S. Customary Units except for measures of mass, fume generation rate, and filter pore size. Approximate mathematical equivalents in the International System of Units (SI) are provided for comparison in parentheses or in appropriate columns in tables and figures.

## 2. Referenced Documents

1. AWS F1.1, *Method for Sampling Airborne Particulates Generated by Welding and Allied Processes*<sup>1</sup>
2. ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*<sup>1</sup>
3. ASTM C 800, *Specification for Glass Fiber Blanket Insulation*<sup>2</sup>

## 3. Summary of Methods

**3.1** A chamber using air drawn through a filter pad to collect process fumes is detailed.

**3.2** Total fume samples are collected on specified glass fiber filter pads. The net weight of fumes and process variables are measured. Fume generation rates are calculated.

**3.3** Fume samples for constituent analysis are collected on specified cellulose fiber filters.

## 4. Sampling Equipment

**4.1 General Description of Suggested Chamber.** The conical test chamber (Figure 1) is fabricated with two hand holes to allow access to the chamber. A sighting window with an appropriate removable shaded lens is located in the center of the chamber to provide visibility for setting up and observing tests. Leveling bolts are provided to maintain an air gap of about 1/2 to 3/4 in. (13 to 19 mm) between the base of the chamber and the surface

on which it rests. A filter assembly for collecting the fumes, consisting of the filter and its supports, a pressure drop gauge, and a constant flow rate pump, is mounted at the top of the chamber. This makes the unit accessible for quick and easy filter changes.

### 4.2 Equipment Specification for the Suggested Chamber Shown in Figures 1 and 2

**4.2.1** Filter pad, glass fiber with or without binder, diameter 12 in. (305 mm). Any binder present should be temperature stable to 350°F (177°C). (ASTM C 800, *Specification for Glass Fiber Blanket Insulation*)

**4.2.1.1** Fiber diameter should be the following:

nominal— $0.00005 \pm 0.00001$  in. ( $1.3 \pm 0.3$   $\mu\text{m}$ )

**4.2.1.2** The density should be the following:

nominal— $0.6 \pm 0.05$  lb/ft<sup>3</sup> ( $9.6 \pm 0.8$  kg/m<sup>3</sup>)

**4.2.1.3** Filter pads should have a uniform thickness of the following:

nominal— $0.5 \pm 0.125$  in. ( $13 \pm 3$  mm)

**4.2.1.4** Filter pads shall be uniform in appearance and fiber distribution throughout their thickness. Unstable binders, burnt glass streamers, cuts, tears, holes, and voids are not acceptable.

**4.2.2** The filter shall be of cellulose fiber (sample collection for analysis); approximately 4  $\mu\text{m}$  effective pore size; diameter 12 in. (305 mm), or equivalent.

**4.2.3 Air Pump.** An air pump capable of sampling at a uniform rate of 25 to 35 ft<sup>3</sup>/min (709 to 989 L/min). This flow rate is sufficient to clear the test chamber within 30 seconds.

**4.2.4 Test Chamber.** The design features are detailed in Figures 1 and 2.

**4.2.5 Plate Movement.** Some method of plate movement is needed when an automatic process with a fixed torch is used. This is optional for semiautomatic, hand-held torch operations, but is recommended as it ensures more accurate results. If utilized, the movement apparatus should be capable of maintaining a speed commensurate with the process being used.

**4.2.6 Pressure Drop Gauge.** This gauge is used to measure the pressure drop across the filter and indicates the degree to which the filter is loaded.

**4.2.7 Oven.** An oven at 200° to 225°F (93° to 107°C) shall be used to hold filter samples prior to weighing.

**4.2.8 Balance.** For measuring the fume generation rate, a balance with a sensitivity of 0.01 g or better shall

<sup>1</sup> AWS standards and ANSI Z49.1 are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

<sup>2</sup> ASTM standards are published by ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.