Arc Welding and Cutting Noise
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SUMMARY

Measurements of the noise produced by four arc welding processes and one arc cutting process were evaluated under standardized measurement conditions now incorporated in AWS F6.1-78, Method for Sound Level Measurement of Manual Arc Welding and Cutting Processes. Several important areas were surveyed or reviewed:

(1) Measurement equipment and calibration procedures
(2) Qualification of the measurement space acoustically
(3) Evaluation of the sound measurement procedures in the qualified space

The conclusions regarding these items are as follows:

(1) Equipment. Manufacturer’s procedures and recommendations must be followed with regard to calibration of sound measuring instruments, microphone placement (relative to observer and reflecting surfaces), microphone orientation (angular orientation of microphone axis in relation to sound source), and wind screen corrections. Using the recommended procedures, repeatable measurements within stated limits can be obtained.

(2) Measurement space. Qualification of the measurement space was found to be less difficult than anticipated. The major criteria are background sound levels due to other sources in the space, reflection of sound from room surfaces, and physical size of the space. The background sound levels should be a minimum of 10 dB below the levels to be measured from the welding process. Acoustically reflecting surfaces, particularly walls, must be covered temporarily during measurements. This can be easily achieved by using 4 ft x 8 ft x 2 in. (1.22 x 2.44 x 0.05 m) high-density glass fiber panels to completely surround the measurement location. These panels need not be permanently attached to walls. The room within which the acoustic measurements are to be taken must be large enough to allow microphone positioning at specified locations that will not be close to room surfaces: that is, walls or ceiling. It is recommended that at least 8 ft (2.44 m) of clear space be available on all sides and above the welding table.

(3) Measurement procedure. The measurement procedure described in the proposed standard was found to be acceptable for determination of noise levels from welding processes. It is important to maintain the welding process as nearly as possible in a stationary location while making noise measurements. A stationary source and a moving workpiece are recommended.

Recommendations are made for future investigation of the procedure sensitivity to small variations in location of microphones, and to variations in spectra of the process noise and the ambient sound. Conducting a round robin test of this method is also recommended.
INTRODUCTION

As part of an overall program to investigate the influence of welding operations on the environment of the workplace, Battelle-Columbus Laboratories carried out a series of noise measurements designed to quantify the noise generated by arc welding and cutting processes. The measurement procedure was selected by the American Welding Society's Safety and Health Project Committee VI on Noise. The processes to be measured were selected by Project Committee VIII on Research.

In addition to obtaining data on process noise, one of Battelle's objectives, as specified by AWS, was to evaluate the effectiveness of the proposed AWS F6.1-78, Method for Sound Level Measurement of Manual Arc Welding and Cutting Processes, at that time not yet approved for publication.

Over half of the Battelle effort consisted of participation in the deliberations of the Committee on the draft procedure and in preliminary evaluation of the room qualification requirements of the procedure. The ad hoc task group charged with drafting the procedure released the procedure to Battelle on July 19, 1977, and the list of processes to be measured was received from the Research Committee approximately one week later. Measurements were started on August 9, 1977, and completed August 16, 1977.

TECHNICAL DISCUSSION

The proposed Method for Sound Level Measurement of Manual Arc Welding and Cutting Processes was followed as closely as possible in order to evaluate the effectiveness of the document. In some cases additional measurement locations and process settings were used to provide insight into the sensitivity of the results to these variables. No attempt was made to analyze the results obtained since this was not included in the scope of the research program. However, comments on the results are included, where appropriate.

The format for the following discussion of the standard and its application consists of statements of each section, alternating with descriptions of the manner in which Battelle used each section in carrying out the measurements.

AWS Method for Sound Level Measurement of Manual Arc Welding and Cutting Processes

The draft standard, as finally presented to Battelle, was essentially the same as the standard now published. The experimental conditions to be tested were chosen by the AWS Committee on Noise and were those listed in the standard, plus readings with the microphone at the position occupied by the welder or welding operator.

Following are sections of the draft procedure used by Battelle in performing the noise measurements. The approved standard procedure appears as Appendix A.

6. Equipment

6.1 Sound level measurements shall be made using a sound level meter configuration conforming with the requirements of ANSI S1.4 (paragraph 2.1) for type I meters.

6.2 Equipment shall be located in accordance with Fig. Al in Appendix A, p. 18.

6.3 The equipment shall be used in a test site that meets the requirements of 9.1 (for outdoor locations), or 9.2 (for semianechoic test rooms), or 9.3 (for in-plant locations).

6.4 Octave band filter sets, if used, shall meet the requirements of ANSI S1.11—1966 for Class II filters. The octave band frequencies shall be those tabulated in ANSI S1.4—1971.

Note: The octave band filter set is required only for the evaluation of the acoustic environment occurring at the test site.

Comments on Section 6

6.1 The sound level meter used by Battelle was the GenRad Model 1933 Precision Sound Level Meter with Octave Band Analyzer. A one inch (25.4 mm) electret microphone with a foam wind screen recommended by GenRad was used for the measurements. The wind screen introduces less than ~0.5 dB error at frequencies up to 5 kHz, and approximately 2 dB in the range 5 kHz to 12 kHz. The effect of the wind screen on A-weighted broad band sound cannot be predicted unless the spectral content of the sound is known; however, the error should not exceed 2 dB.

6.2 Figure 1, p. 3, shows the layout of the measurement area used. The sound level measurements of manual arc welding and cutting processes were conducted in a simulated in-plant location. The test site was a laboratory space in a steel frame building with corrugated steel panel walls. The acoustical absorption of the thermal insulation on the inside of the walls was augmented by placing 4 ft by 2 in. (1.22 x 2.44 x 0.05 m) high-density acoustical glass fiber panels around the perimeter of the measurement space. The dimensions of the building, consisting of a single open area, are 18 ft by 60 ft (5.49 by 18.29 m) long, by 14 ft (4.27 m) high. The measurement space, as defined by the acoustically absorbent panels, was 24-1/2 ft by 17-1/4 ft (7.47 x 5.26 m). The test site had a concrete floor extending the width of the room. The glass fiber panels were at a distance of no less than 5 ft (1.52 m) from any measurement point.

1. The panels used have a density of 0.375 lb/ft (1.83 kg/m).