

Fume from welding and allied processes —

Part 2: Guide to methods for the sampling and analysis of gases

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- British Constructural Steelwork Association Ltd.
- British Occupational Hygiene Society
- British Shipbuilders
- Health and Safety Executive
- Process Plant Association
- Society of Motor Manufacturers and Traders Ltd.
- Welding Institute
- Welding Manufacturers' Association (BEAMA Ltd.)

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Foreword

This British Standard has been prepared under the direction of the Welding Standards Committee. It was developed from DD 54-1:1977 and DD 54-2:1981 which are withdrawn. It is published in two Parts as follows:

- *Part 1: Guide to methods for the sampling and analysis of particulate matter;*
- *Part 2: Guide to methods for the sampling and analysis of gases.*

The prime concern of this Part of BS 6691 is to recommend the procedures to be used for sampling and to suggest methods for analysing gas from the breathing zone of the operative. This may necessitate the wearing of certain apparatus that can obtain samples while the operative is working without interfering with natural breathing or with the performance of the job. It is normally essential to know the general background levels of gases in a workshop, and this Part also covers this form of static sampling which could involve several units located over the work area operating for extended periods.

The gases evolved during welding are so numerous that it would be impracticable to cover them all. It has therefore been decided to limit the scope of this Part to those gases which are most commonly investigated. It is not intended to consider explosive gases in this Part. Although oxygen may be used in welding and allied processes, the hazards associated with it are different from those arising from the other gases and therefore it forms the subject of Appendix A.

Recommended procedures for sampling and suggested methods for analysis are included. It is not the function of this Part to state what level of any particular constituent should be regarded as acceptable, as it is essential that expert occupational health/hygiene advice be sought.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 6691 provides guidance on methods for the sampling and analysis of the following pollutant gases that may be produced or be present during welding and allied processes:

- ozone (O₃)
- carbon monoxide (CO)
- carbon dioxide (CO₂)
- nitric oxide (NO) and nitrogen dioxide (NO₂)

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Summary of analytical techniques

2.1 General

The methods generally used for analysis of gases in welding fume are of two main types as follows:

- detector tubes (short-term or long-term)
- instrumental methods

Detector tubes provide a convenient way of measuring short-term concentrations, but repeated measurements may be necessary in order to assess the exposure of the welder. Their usefulness is being extended with the development of tubes that can be used to sample over periods of up to 8 h.

Instrumental methods will normally be found to be most satisfactory, as they may be accurately calibrated, give immediate results, and can be used to indicate the variation in gas concentration during the sample period.

Chemical methods are seldom appropriate being more cumbersome. They require a higher degree of manipulative skill than other methods. However, their use may be necessary in the absence of instrumental facilities, but considerable analytical expertise will be necessary to ensure accurate results.

Diffusion samplers, both of the direct reading type and those which provide samples for subsequent analysis, are under development but are not yet in general use.

Welding fumes are a complex mixture of particulates and gases, and, whatever method of analysis is selected, it will be necessary to confirm that techniques, which may have been used successfully in other applications, are suitable for the welding situation.

2.2 Detector tubes

Chemical detector tubes consist of sealed glass tubes containing solid reagents which undergo reaction with the specific contaminant when the sample gas is drawn through them by a calibrated pump. The length of reagent filling undergoing a colour change after aspiration of a given volume of gas provides a measure of the concentration of the contaminant. (In a few cases the detector tube works on the principle of a degree of colour change as a basis of measurement.) Tubes that require sampling periods of up to a few minutes are available for the gases included in this guide and long-term tubes which require sampling periods of up to 8 h are available for some of them.

The short-term tubes vary in precision, accuracy and shelf-life from gas to gas and sometimes from batch to batch for the same gas. Their precision is generally less than for other methods but they provide a convenient means for preliminary screening of the gases in welding fume. Where high precision is not essential, they can be used to measure concentrations over the short period required for a single tube, or average concentrations over an extended period by the use of an adequate number of tubes at intervals throughout the period. The tubes selected should comply with BS 5343¹⁾.

2.3 Instrumental methods

The use of instrumental methods usually involves aspiration of an air sample into a vessel for subsequent analysis, e.g. a vacuum tube, or directly into self-contained apparatus in which the contaminant concentration is measured, either directly or after reaction with solids, liquids or gases, by spectrophotometric, electrometric, enthalpimetric, or other appropriate means which produce an electrical signal. This can be applied to an indicating or recording meter calibrated to give a direct measure of the concentration of the relevant contaminant. Instruments are available for the gases included in this guide. Whereas some of these are too large to be worn by the welder, small self-contained personal monitors are available for some gases. The latter are primarily intended for protection of the operator against acute hazards and some incorporate alarms that can be set to operate at predetermined levels, but they are normally less suitable than other means for measuring average concentrations over a period.

¹⁾ Recommended characteristics for detector tubes are also given in: Chemical indicator tubes for the measurement of the concentration of toxic substances in air. *Ann. Occup. Hyg.*, 1973, 16, 51–62.