Standardization of measurement methods – a Europe-wide instrument for the prevention of chemical hazards

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Legislative background to standardization

European standardization has an important function in supporting the European legislative framework. Product standards in the traditional sense, which place strict requirements upon the safety of products, are of relevance to occupational health and safety in this context. Product standards may for example have as their objective the reducing of hazardous substance emissions from machines, or the design of low-pollution products.

In addition to standardization of OH&S-related product requirements, standards are important for the definition of a comparable level of health and safety at the workplace. They provide a common body of terminology. They standardize measurement, analysis and sampling methods, and thus permit the assessment of chemical hazards on a uniform basis. They form the basis for the evaluation of prevention measures, and for the specification of limit values applicable throughout Europe. They allow for comparison of existing standards of occupational health and safety and of practical measures for reducing exposure, for example in the various countries of the European Union.

The second area of standardization, that governing the measurement of exposure to chemical agents at the workplace, will be considered in closer detail. The objectives of protection and protective measures set forth in Community Directive 80/1107/EEC[1] represent the principal statutory basis for

[1] Community Directive 80/1107/EEC on the protection of workers from risks related to exposure to chemical, physical and biological agents at work has been incorporated into Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical

this standardization activity. This directive requires that the exposure of employees to agents be avoided and/or reduced. To this end, specific provisions must be set out governing sampling and measurement, and the assessment of results.
The 1988 directive[2] makes explicit reference to European standards governing measurement methods and apparatus.[3] EC Directive 98/24/EC, currently in force, also requires standardized measurement methods; the employer's duties include assessment at regular intervals of the risk posed by hazardous chemical substances. The nature, scale and duration of exposure are for example to be determined.

In order for these statutory provisions to be fulfilled uniformly throughout Europe, a standardization of measurement, analysis and sampling methods is essential for assessment of the exposure of employees to chemical agents.

European standardization

The task of supporting the directives mentioned above by way of standards has been assumed in particular by European standards committee CEN/TC 137, "Assessment of workplace exposure". This committee standardizes the framework conditions for measurement of workplace exposure to hazardous substances. Rather than specifying dedicated measurement methods for the large number of hazardous substances, European standards set forth basic requirements for the measurement of hazardous chemical and biological substances at the workplace. Measurement strategies and performance criteria for apparatus are standardized, as are general aspects for certain substance groups. These generic provisions are intended to preserve scope for ongoing technical development.

Measurement strategy

EN 689 provides support in formulation of the measurement strategy. It defines various measurement tasks such as surveys, comparisons with limit values and surveillance measurements.

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agents at work (fourteenth individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC); Official Journal L 131 of 5 May 1998, pp. 0011 - 0023.
[2] Council Directive 88/642/EEC amending Directive 80/1107/EEC of 16 December 1988
[3] "Annex IIa, B.3 h) If the European Committee for Standardization (CEN) publishes general requirements for the performance of measuring procedures and devices for workplace measurements together with provisions on testing, they should be referred to when selecting appropriate measuring procedures."

In addition, instructions are provided concerning reporting, statistical processing of measurement results, and example procedures.

Basic requirements for measurement methods

Essential and fundamental requirements for measurement methods are formulated in the EN 482 generic standard. These requirements are applicable to all methods for the measurement of specific hazardous substances. They address, for example, the unambiguity of the measurement result and the selectivity of the method. Permissible values for the measurement uncertainty are defined for surveys and for direct comparison with exposure limit values. Requirements for the range of measurement, the averaging duration and the measurement uncertainty of the result, and for compound measurement methods and the accuracy under different ambient conditions, are also defined.

Specific measurement methods and apparatus

Dedicated standards are developed on the basis of this "umbrella" standard for particular measurement methods and apparatus: for diffusive samplers (EN 838), for pumped sorbent tubes for determination of gases and vapours (EN 1076), and for short-term detector tube measurement systems and the associated pumps (EN 1231).
As the pumps substantially influence measurement when pumped sorbent tubes are employed, pump characteristics such as the duration of operation and mechanical robustness have been defined in dedicated standards for pumps for personal sampling with a volume flow rate of up to 5 l/min (EN 1232) and for pumps for sampling with a volume flow rate of over 5 l/min (EN 12919).

Practical experience has shown that not all apparatus available on the market meets the requirements of EN 482 or those of the dedicated standards. Nonconformances are attributable in part to the substances to be sampled. They also indicate a need for revision of the dedicated apparatus standards, however. An example is the current EN 1231 standard governing short-term detector tube measurement systems, which is not geared adequately to comparison measurements with limit values, and requires revision.

Electrical apparatus for the measurement of gases and vapours

A four-part series of standards, EN 45544, exists for electrical apparatus used for direct detection and direct concentration measurement of gases and vapours. These standards deal with general requirements and test methods for the measurement apparatus which they describe. They place requirements upon the operating behaviour for concentration measurements within the range of limit values, and for concentrations substantially above such values. Part 4 is a guide to the selection, installation, use and maintenance of the apparatus.

Further specific aspects

EN 481 defines, as a basis for the measurement of airborne particles, three relevant airborne particle fractions (inhalable, thoracal, respirable). These definitions give rise to a need in practice to measure all three particle fractions simultaneously during sampling.
EN 13205 provides guidance on the evaluation of apparatus employed for the measurement of airborne particles. EN 1540 lays down uniform terminology for use throughout Europe. A dedicated standard, prEN 13890, deals with the measurement of metals and metalloids in airborne particles. ENV 13936 governs the measurement of mixtures of airborne particles and vapours.
CR 13841 describes the influence of the time factor (long-term or short-term measurement) upon evaluation of the exposure data.

Biological agents

In addition to chemical agents, CEN/TC 137 also deals with biological agents. EN 13098 and prEN 14031 are standards relevant to the measurement of micro-organisms and endotoxins in the atmosphere. EN 14042 sets forth requirements concerning the application and use of methods and apparatus for the assessment of chemical and biological agents.

Current projects

A standard specifying the requirements and test methods for volumetric bioaerosol sampling devices (prEN 14583) is currently under development. prEN 14530 is being developed for the measurement of diesel particulate emissions. A further standard is being prepared for measurement of dust-raising characteristics.

CEN/TC 137 plans to address a further area in future by establishing a new working group which, following definition of the term "dermal exposure", will begin by formulating technical specifications for strategies and methods for measurement of dermal exposure.

International standardization

Like European standardization, international standardization is also addressing the subject of measurement of air quality at the workplace. EN ISO 16017 is a joint project by ISO/TC 146 and CEN/TC 264, "Air quality" and CEN/TC 137. This standard describes the requirements for sampling and analysis of volatile organic compounds by means of pumped sampling involving detector tubes and by diffusive sampling.

In addition, requirements concerning the measurement of specific hazardous substances are described in ISO/TC 146, in particular in the "Workplace atmospheres" working group. Such substances include carbon monoxide (ISO 8760), nitrogen dioxide (ISO 8761), vinyl chloride (ISO 8762), acrylonitrile (ISO 9977), and arsenic and its compounds (ISO 11041). These standards specify a particular measurement method and the apparatus to be used. In this respect, the international and European standardization concepts differ, as the latter does not involve dedicated methods and apparatus for the measurement of specific substances.
The reasons for the European approach to basic requirements are as follows:

- Development of equipment and market forces should not be constrained by the specification of particular methods.
- The content of standards should not rapidly become obsolete as a result of ongoing technical development.

Standards governing the measurement of chemical agents in the atmosphere of workplaces are already well developed at European and international level. Interested parties are nonetheless able to influence standardization activity through their national standards committees. At intervals of no more than five years, standards are reviewed for their possible need for revision. Standards may however be revised if necessary before the interval has elapsed; in this case, the responsible national standardization institute must be contacted. General information on European standards can be found at www.cenorm.be. The web pages of the national standards institutes and the individual technical committees can also be reached from this site.

Experience in OH&S-related standardization, such as the measurement of hazardous substances, can be shared in EUROSHNET, the network of European OH&S experts active in standardization, testing, certification, and applied research (www.euroshnet.org).

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