

COLLECTIVE EXPERT APPRAISAL: SUMMARY AND CONCLUSIONS

**regarding the expert appraisal for recommending occupational exposure limits
for chemical agents**

**concerning the assessment of measurement methods for five substances listed
in the appendix of the European Directive (EU) 2019/130**

**This document summarises the work of the Expert Committee Health Reference Values
(HRV Committee) and the Working Group on Metrology.**

Presentation of the issue

Prior to the transposition of European occupational exposure limits (OELs) into French law, ANSES is mandated by the Ministry of Labour to conduct an assessment of the measurement methods available for the substances listed in the European Directives.

Scientific and legal background

European objectives, intended to protect workers from risks associated with exposure to chemical agents, are set via European directives, in particular in the form of occupational exposure limits (OELs).

Since the European Commission relies on recommendations issued by European scientific expert committees (SCOEL¹ or RAC²) for the establishment of European OELs, ANSES does not reassess the health effects of the substances in question when European directives establishing OELs are published.

However, given that neither SCOEL nor RAC undertakes in-depth assessments of the available measurement methods with regard to the European OELs, ANSES is asked to undertake these assessments so that the French Ministry of Labour can have all of the information necessary to establish the binding or indicative nature of the limit values in national law.

Directive (EU) 2019/130 of the European Parliament and of the Council of 16 January 2019, amending Directive 2004/37/EC, establishes a list of binding occupational exposure limit values for 6 new carcinogens and mutagens.

Of these six substances, trichloroethylene was covered by a previous expert appraisal undertaken by ANSES to establish OELs and recommend measurement methods associated with these OEL proposals (ANSES, 2017a). Thus, the measurement methods for this compound

¹ SCOEL: Scientific Committee on Occupational Exposure Limits

² RAC: Committee for Risk Assessment

were not reassessed as part of this expert appraisal, since these assessments are already available.

As part of the memorandum of understanding on occupational exposure limits and biological limit values (OELs and BLVs) established between the Ministry of Labour and ANSES, the Directorate General for Labour (DGT) mandated ANSES to undertake the metrological expert appraisal for the following substances only:

- 4,4'-methylenedianiline (8h-OEL of 0.08 mg.m⁻³)
- epichlorohydrin (8h-OEL of 1.9 mg.m⁻³)
- ethylene dibromide (8h-OEL of 0.1 ppm, i.e. 0.8 mg.m⁻³)
- ethylene dichloride (8h-OEL of 2 ppm, i.e. 8.2 mg.m⁻³)
- diesel engine exhaust emissions (8h-OEL of 0.05 mg.m⁻³ measured as elemental carbon)

Organisation of the expert appraisal

ANSES entrusted examination of this request to the Expert Committee Health Reference Values (HRV Committee). The Agency also mandated the Working Group on Metrology.

The methodological and scientific aspects of the work of this group were regularly submitted to the Expert Committee on both methodological and scientific aspects.

This report has been prepared from metrology reports developed individually for each substance by the Working Group on Metrology. The Working Group reports take into account the additional observations and information provided by the members of the HRV Committee. In light of the question asked, the HRV Committee did not examine the relevance of the values laid down by the Directive.

This expert appraisal was therefore conducted by a group of experts with complementary skills. It was carried out in accordance with the French Standard NF X 50-110 "Quality in Expertise Activities".

Description of the method

An assessment report of the measurement methods was prepared by the Working Group on Metrology for each substance and submitted to the HRV Committee, for comments and validation.

Each assessment report presents the various protocols for measuring the respective substance in workplace atmospheres grouped together based on the methods they use. These methods were then assessed and classified based on the performance requirements set out particularly in the French Standard NF EN 482: "Workplace atmospheres - General requirements for the performance of procedures for the measurement of chemical agents" and the decision-making criteria listed in the methodology report (Anses, 2017b et 2020). As the methodology for assessing measurement methods was updated in 2020³, two substances were assessed based on the methodological criteria established in 2017 (ANSES, 2017b), i.e. epichlorohydrin and ethylene dibromide, and three substances using the revised methodology, i.e. 4,4'-methylenedianiline, ethylene dichloride, and exhaust emissions from diesel engines.

A list of the main sources consulted is detailed in the methodology report (Anses, 2017b and 2020).

These methods were classified as follows:

- Category 1A: validated methods (all of the performance criteria are met);
- Category 1B: partially validated methods (the essential performance criteria are met);
- Category 2: indicative methods (essential criteria for validation are not clear enough or else the method requires adjustments that need to be validated);
- Category 3: the methods are not recommended. This category encompasses unsuitable methods for which essential validation criteria have not been met, and non-assessable

³ The methodology was essentially supplemented by assessment criteria for substances in aerosol form and substances in mixed phases.

methods (falling in Category 3^(*)) for which essential validation criteria have not been documented.

NB: For the measurement of aerosols and substances in mixed phases, an initial classification is established with regard to the performance criteria for sampling methods. A second classification is then established with regard to the performance criteria for analytical methods. The final classification of the method corresponds to the least favourable of these two classifications.

A detailed comparative study of the methods in Categories 1A, 1B and 2 was conducted with respect to their various validation data and technical feasibility, in order to recommend the most suitable method(s) for measuring concentrations for comparison with OELs.

This overall report was prepared from metrology reports developed individually for each substance. The details concerning the adoption of each measurement method assessment report are given in the following table.

Table 1: Adoption dates of the individual reports by the Working Group on Metrology and by the HRV Committee

Substance		Adoption date	
Name	CAS number	By the WG	By the HRV Committee
4,4'-Methylenedianiline	101-77-9	16/04/2020	14/05/2020
Epichlorohydrin	106-89-8	16/05/2019	17/10/2019
Ethylene dibromide	106-93-4	17/09/2019	17/10/2019
Ethylene dichloride	107-06-2	16/04/2020	14/05/2020
Diesel engine exhaust emissions	-	16/04/2020	14/05/2020

The overall report, as well as the summary and conclusions of the collective expert appraisal, were adopted by the HRV Committee on 14/05/2020.

This collective expert appraisal work and the summary report were submitted to public consultation from 27/07/20 to 30/09/20. The people or organizations that contributed to the public consultation are listed in appendix of the report (only available in French). The comments received were reviewed by the HRV Committee who finally adopted this version on the 22/10/20.

Conclusions and recommendations of the collective expert appraisal

The assessment of the applicable reference methods for the measurement of occupational exposure levels for the five substances, listed in Directive (EU) 2019/130 and to be assessed in light of the values established therein, found that:

- epichlorohydrin and ethylene dichloride have a measurement method classified in Category 1B;
- 4,4'-methylenedianiline, ethylene dibromide and diesel engine exhaust emissions have a measurement method classified in Category 2.

The table below summarises the measurement methods recommended by the HRV Committee for each of the five substances.

Concerning 4,4'-methylenedianiline, the HRV Committee also underlines that there is a measurement method, described in the OSHA ORG 57 protocol, consisting of active sampling on a filter impregnated with sulphuric acid followed by water extraction, derivatisation with

heptafluorobutyric acid anhydride, and GC/ECD analysis. This measurement method is classified in Category 3 for the regulatory technical control of the 8h-OEL because the sampling device is not compliant for the inhalable fraction, but the analytical method is highly sensitive and has been validated over a range of very low concentrations: 0.001 to 0.2 times the 8h-OEL. The HRV Committee therefore also recommends validating a sampling method that would enable the inhalable fraction to be sampled, would be compatible with the analytical technique described in the OSHA ORG-57 protocol, and would be more appropriate with regard to the occupational exposure levels reported in the literature (Weiss *et al.*, 2011).

Table 2: Measurement methods recommended by the HRV Committee

Identification of the substance		Principle of the recommended method	Implementation protocols (References)	Classification for 8h-OEL regulatory technical control	Additional information	
Substance	CAS number					
Epichlorohydrin	106-89-8	Active sampling on an adsorbent tube Solvent desorption GC/FID or ECD analysis	Activated charcoal tube (100/50 mg) CS ₂ desorption GC/FID analysis	NIOSH 1010 (1994)	1B	Users should be aware that the CS ₂ used for desorption is classified as toxic to reproduction, Category 2
			Activated charcoal tube (500 mg) Acetone desorption GC/ECD analysis	DFG1 (1982)		
Ethylene dichloride	107-06-2	Active sampling by pumping through an adsorbent activated charcoal tube. Solvent desorption and GC/FID or ECD analysis	Medium: Activated charcoal tube (100/50 mg) Solvent: Carbon disulphide Analysis: GC/FID	HSE-MDHS 96 (2000) HSE-MDHS 104 (2016) NIOSH 1003 (2003) INSHT MTA/MA-043/A99 (1999) NF ISO 16200-1 (2001)	1B	A flow rate of 0.05 L·min ⁻¹ is necessary to cover the range of 0.1 to 2*8h-OEL Users should be aware that the CS ₂ used for desorption is classified as toxic to reproduction, Category 2
			Medium: Activated charcoal tube (100/50 mg) Solvent: o-Xylene Analysis: GC/ECD	OSHA Org -03 (1979)		
			Medium: Activated charcoal tube (100/50 mg) Solvent: Not specified Analysis: GC/FID	IRSST 173-1 (1995)		
			Medium: Activated charcoal tube (400/200mg) Solvent: Carbon disulphide Analysis: GC/FID	INRS-MétroPol M-395 (2004) IFA 6976 (1991)		

Identification of the substance		Principle of the recommended method		Implementation protocols (References)	Classification for 8h-OEL regulatory technical control	Additional information
Substance	CAS number					
Ethylene dibromide	106-93-4	Active sampling on an activated charcoal tube (100/50) – Solvent desorption (CS ₂) – GC/FID analysis		INRS MétroPol M-403 (2014)	2	<p>The method is classified in Category 2 because the expanded uncertainty associated with the method has not been determined and the only available uncertainty data are repeatability standard deviations. The influence of environmental conditions and interfering compounds is not mentioned.</p> <p>The flow rate needs to be reduced to be able to sample 30L of air for 8h.</p> <p>Users should be aware that the desorption solvent (CS₂) is classified as toxic to reproduction, Category 2</p>
4,4'-methylenedianiline	101-77-9	Active sampling on filter(s) impregnated with sulphuric acid Solvent (water) extraction HPLC/UV analysis	Sampling device for the inhalable fraction: GSP	DGUV ZH 1/120.39 E- GSP 2-HPLC (1994)	2	<p><u>Sampling:</u> The sampling device is indicative of the inhalable fraction and is therefore classified in Category 2 in terms of its compliance with regard to this conventional fraction.</p> <p><u>Analysis:</u> The analytical method is classified in Category 2 due to partial validation data. It is necessary to implement the conditions of the DGUV ZH 1/120.39 E- GSP 2-HPLC protocol and take three successive 2h30 samples using a GSP inhalable fraction sampler with a flow rate of 3.5 L·min⁻¹. This should be followed by water extraction and HPLC/UV analysis.</p>

Identification of the substance		Principle of the recommended method	Implementation protocols (References)	Classification for 8h-OEL regulatory technical control	Additional information
Substance	CAS number				
Exhaust emissions from diesel engines	-	Sampling of the alveolar fraction by a cyclone device on a quartz fibre filter Determination of the elemental carbon (EC) fraction by thermal-optical transmittance analysis-FID detection	NIOSH 5040 (2016) NF EN 16909 (2017)	2	<p><u>Sampling:</u> The performance of cyclones for ultrafine particles and the elimination of potential interferences from other larger carbonaceous particles led these devices to be considered as appropriate for the sampling of diesel particles. Higgins-Dewell (HD) cyclones, which have different geometries and flow rates, should be favoured with the use of 25mm-diameter filters for atmospheres appearing to have low levels of pollution. For atmospheres suspected of having high levels of pollution, Dorr-Oliver cyclones with 37mm-diameter filter should be favoured. The sampling method is therefore classified in Category 1A as part of this expert appraisal.</p> <p><u>Analysis:</u> The validation data are partial, especially in the absence of a traceable primary reference material for the analysis of elemental and organic carbon. No absolute analytical distinction between elemental and organic carbon is possible. Therefore, some of the validation data are based on measurements of total carbon, extrapolating these values to the measurement of elemental carbon, differentiated within total carbon. That is why the analytical method is classified in Category 2.</p>

Validation date of the summary by the Expert Committee: 22 October 2020.

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