

MEGA evaluations for the preparation of REACH exposure scenarios for mercury and its compounds in lamps (e.g. fluorescent tubes or low-energy light bulbs)

1 Introduction

The measured data for workplace exposure evaluated in the following have been gathered and documented in accordance with the principles of the measurement system of the German social accident insurance institutions for exposure assessment (MGU¹, formerly BGMG). The quality of the MGU is upheld by a quality management system that in essence satisfies the requirements of DIN EN ISO 9001. The test laboratories are operated in accordance with DIN EN ISO 17025 “General requirements for the competence of testing and calibration laboratories”.

To measure mercury exposure at the workplace, a defined volume of air is sucked by a suitable pump through a sorption tube containing two hopcalite phases separated by a quartz fibre filter. Mercury contained in the air is adsorbed, and particulate mercury compounds are intercepted by the filter. After preparation of the sample carriers, qualitative and quantitative analyses are performed by means of atomic fluorescence spectrometry. Calibration curves are used for quantification. The mercury concentration of the reference standards is plotted against the height of the peak for this purpose. The quantification limit is 0.004 mg/m³ for a test air volume of 120 L. Source: Mercury (ref. no. [8530](#)). In: IFA-Arbeitsmappe Messung von Gefahrstoffen. 34. Lfg. IV/2005. Ed.: Deutsche Gesetzliche Unfallversicherung (DGUV), Berlin. Erich Schmidt, Berlin, 2011 – loose-leaf edition. Mercury exposure at the workplace can also be measured with direct reading measuring instruments.

All the surveyed data in the MGU are brought together in the MEGA exposure database (measured data on exposure to hazardous substances at the workplace). If individual values fall below the measurement method’s analytical quantification limit, half the value is adopted in the evaluation. The MEGA^{Pro} software developed by the IFA (formerly BGIA) makes it possible to statistically analyse the data of the MEGA exposure database on the basis of various selection criteria and evaluation strategies.

¹ Gabriel, S.; Koppisch, D.; Range, D.: The MGU – a monitoring system for the collection and documentation of valid workplace exposure data. Gefahrstoffe – Reinhalt. Luft 70 (2010) No. 1/2, pp. 43-49
<http://www.dguv.de/ifa>, Webcode [m200066](#)

2 Data situation and evaluation strategy

2.1 Overview of the measured values collected in the MGU, data period 2000 to 2010

Mercury and its compounds with a workplace limit of 0.1 mg/m³

Information on the sampling systems can be found in the IFA work folder (IFA-Arbeitsmappe, in German).

General description	Number of measured values (%)
Total	488
Type of sampling: Stationary	410 (84%)
Type of sampling: Personal	78 (16%)
Sampling time ≥ 1 h and exposure time ≥ 6 h (comparable to shift measurements)	391 (80.1%)
Sampling time < 1 h <u>or</u> exposure time < 6 h	97 (19.9%)
Number of data < quantification limit (Values < quantification limit were adopted in statistics with half their values)	128 (26.2%)
Number of data > limit value	20 (4.1%)
Number of data ≥ quantification limit and ≤ limit value	340 (69.7%)
Examples: Exposure conditions	
Without mechanical ventilation	149
With mechanical ventilation	270
No details	69
Without local exhaust ventilation	205
With local exhaust ventilation	171
No details	112

General description of mercury measurements in 60 branches of industry and 108 work areas

2.2 Criteria for inclusion of measured data in the evaluation

- Measured workplace values relating to exposure
- Sampling time \geq 1 hour
- Exposure time \geq 6 hours
- Data sets comprising fewer than ten measured data were disregarded
- Standard method(s) as well as direct reading measuring instruments.

2.3 Evaluation strategy

The evaluation was performed on the basis of industry groups (Appendix 1) and work area groups (Appendix 2) and broken down further according to type of sampling (stationary or personal) and presence of a local exhaust ventilation device.

3 Abbreviations and indices

The following abbreviations and indices are used in the evaluation tables:

+ The distribution value is below the largest analytical quantification limit in the data set.

\$ With reference to the given limit value, the percentage of values below the limit value is given.

! The number of measured values below the analytical quantification limit (a. q.) is greater than the number of measured values represented by this cumulative frequency value. No concentration is therefore given for this cumulative frequency value.

* Measured values below the analytical quantification limit of the measuring method concerned are adopted in the evaluation with half the analytical quantification limit value.

Appendix 1

Statistic evaluations for industry groups

Mercury and its compounds, sampling time ≥ 1 h and exposure time ≥ 6 h

Industry groups, general

D.No. = Data set number/ Designation Branch of industry	Number of measured data	Number of firms	Frequency < number of values %	Number of Alls*	Largest quanti- fication limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³			
							50 per- centile *	75 per- centile *	90 per- centile *	95 per- centile *
D.No. 3 Mercury and its compounds Total	391	103	102 26.1	20	0.005	95.4	+ 0.003	0.013	0.0518	0.1
D.No. 5 Mercury and its compounds Manufacture and processing of hollow glass; Manufacture and processing of technical glass	40	8	4 10	1	0.0008	100	0.013	0.032	0.065	0.079
D.No. 6 Mercury and its compounds Manufacture of lamps and lighting equipment	90	15	7 7.8	2	0.005	97.8	+ 0.0026	+ 0.0049	0.013	0.047
D.No. 7 Mercury and its compounds Hazardous waste, Recycling plants, Metal recycling (scrap), Recycling of electronic scrap	44	15	8 18.2	4	0.0005	93.2	0.009	0.021	0.0624	0.109

* All = social accident insurance institution

Industry groups: Stationary measurements

D.No. = Data set number/ Designation Branch of industry	Number of measured data	Number of firms	Frequency < number of values %	Number of AIs*	Largest quantification limit in mg/m ³	≤ limit value %\$	Concentrations in mg/m ³			
							50 percen- tile *	75 percen- tile *	90 percen- tile *	95 percen- tile *
D.No. 16 Mercury and its compounds Total	325	86	80 24.6	18	0.005	96	+ 0.003	0.0127	0.0525	0.083
D.No. 17 Mercury and its compounds Manufacture and processing of hollow glass, Manufacture and processing of technical glass	39	8	4 10.3	1	0.0008	100	0.013	0.034	0.066	0.079
D.No. 18 Mercury and its compounds Manufacture of lamps and lighting equipment	85	13	7 8.2	2	0.005	97.6	+ 0.0025	+ 0.005	0.0185	0.05
D.No. 19 Mercury and its compounds Hazardous waste, Recycling plants Metal recycling (scrap) Recycling of electronic scrap	33	14	6 18.2	4	0.0005	90.9	0.0097	0.0205	0.0682	0.202

* AI = social accident insurance institution

Industry groups: Personal measurements

D.No. = Data set number/ Designation Branch of industry	Number of measured data	Number of firms	Frequency < number of values %	Number of Alls*	Largest quanti- fication limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³			
							50 per- centile +	75 per- centile +	90 per- centile +	95 per- centile +
D.No. 28 Mercury and its compounds Total	66	36	22 33.3	12	0.0038	92.4	+ 0.0013	0.0155	0.044	0.219
D.No. 29 Mercury and its compounds Manufacture and processing of hollow glass, Manufacture and processing of technical glass	1	1	0	1		100				
D.No. 30 Mercury and its compounds Manufacture of lamps and lighting equipment	5	5	0	2		100				
D.No. 31 Mercury and its compounds Hazardous waste, Recycling plants Metal recycling (scrap) Recycling of electronic scrap	11	6	2 18.2	3	0.0004	100	0.0007	0.0147	0.0266	0.0328

* All = social accident insurance institution

Industry groups: Measurements with local exhaust ventilation

D.No. = Data set number/ Designation Branch of industry	Number of measured data	Number of firms	Frequency < number of values %	Number of AIs*	Largest quanti- fication limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³			
							50 per- centile *	75 per- centile *	90 per- centile *	95 percen- tile *
D.No. 52 Mercury and its compounds Total	138	35	15 10.9	7		93.5	0.0054	0.021	0.0602	0.116
D.No. 53 Mercury and its compounds Manufacture and processing of hollow glass, Manufacture and processing of technical glass	2	1	0	1		100				
D.No. 54 Mercury and its compounds Manufacture of lamps and lighting equipment	47	4	0	1		100	0.003	0.00465	0.00724	0.009
D.No. 55 Mercury and its compounds Hazardous waste Recycling plants Metal recycling (scrap) Recycling of electronic scrap	15	8	1 6.7	3	0.0004	100	0.013	0.0215	0.041	0.0563

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Industry groups: Measurements without local exhaust ventilation

D.No. = Data set number/ Designation Branch of industry	Number of measured data	Number of firms	Frequency < number of values %	Number of Alls*	Largest quantification limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³			
							50 percen- tile *	75 percen- tile *	90 percen- tile *	95 percen- tile *
D.No. 40 Mercury and its compounds Total	161	54	52 32.3	14	0.005	94.4	+ 0.00195	0.007	0.0518	0.118
D.No. 41 Mercury and its compounds Manufacture and processing of hollow glass, Manufacture and processing of technical glass	7	4	3 42.9	1	0.00084	100				
D.No. 42 Mercury and its compounds Manufacture of lamps and lighting equipment	39	11	6 15.4	2	0.005	94.9	+ 0.00225	0.00925	0.0533	0.0815
D.No. 43 Mercury and its compounds Hazardous waste Recycling plants Metal recycling (scrap) Recycling of electronic scrap	21	8	2 9.5	3	0.0004	85.7	0.003	0.0257	0.114	0.345

* All = social accident insurance institution

Appendix 2

Statistical evaluations for work area groups

Mercury and its compounds, sampling time ≥ 1 h and exposure time ≥ 6 h

Work area groups: General

D.No. = Data set number/ Designation Work area	Number of measured data	Number of firms	Frequency < number of values %	Number of Allis*	Largest quantification limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³			
							50 percen- tile *	75 percen- tile *	90 percen- tile *	95 percen- tile *
D.No. 8 Mercury and its compounds Processing methods, miscellaneous	22	3	0	1		81.8	0.044	0.0625	0.11	0.164
D.No. 9 Mercury and its compounds Storing, Sorting, Final inspection, checking	19	9	6 31.6	4	0.0042	100	+ 0.002	0.01	0.0311	0.0425
D.No. 10 Mercury and its compounds Conveying, Industrial trucks	12	4	5 41.7	4	0.00024	100	0.00067	0.0026	0.00536	0.0084
D.No. 11 Mercury and its compounds Comminution, dismantling, shredding, separation	36	15	6 16.7	5	0.00045	83.3	0.01	0.027	0.17	0.302
D.No. 12 Mercury and its compounds Filling, Packaging	27	16	5 18.5	5	0.005	96.3	+ 0.00225	0.0055	0.0092	0.0302
D.No. 13 Mercury and its compounds Technical school	69	7	2 2.9	3	0.002	98.6	0.0029	0.0048	0.00792	0.009
D.No. 14 Mercury and its compounds Laboratory	36	16	18 50	7	0.004	94.4	+ 0.00045	+ 0.0027	0.027	0.0708
D.No. 15 Mercury and its compounds Thermometers, laboratory appara- tus, neon lamp manufacture	42	10	6 14.3	1	0.00084	100	0.013	0.0285	0.0634	0.0788

* All = social accident insurance institution

Work area groups: Stationary measurements

D.No. = Data set number/ Designation Work area	Number of measured data	Number of firings	Frequency < number of values %	Number of AIs*	Largest quanti- fication limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³			
							50 percen- tile *	75 percen- tile *	90 percen- tile *	95 per- centile *
D.No. 20 Mercury and its compounds Processing methods, miscellaneous	16	2	0	1		87.5	0.04	0.06	0.0824	0.11
D.No. 21 Mercury and its compounds Storing, Sorting, Final inspection, checking	16	7	4 25	3	0.0042	100	+ 0.0026	0.013	0.0344	0.0468
D.No. 22 Mercury and its compounds Conveying, Industrial trucks	7	4	1 14.3	4	0.00017	100				
D.No. 23 Mercury and its compounds Comminution, dismantling, shred- ding, separation	24	12	4 16.7	5	0.00045	79.2	0.013	0.1	0.19	0.286
D.No. 24 Mercury and its compounds Filling, Packaging	24	14	5 20.8	4	0.005	100	+ 0.002	0.0051	0.00796	0.008
D.No. 25 Mercury and its compounds Technical school	68	7	2 2.9	3	0.002	98.5	0.0028	0.0048	0.00804	0.009
D.No. 26 Mercury and its compounds Laboratory	30	13	16 53.3	7	0.004	93.3	! a. q.	+ 0.003	0.053	0.093
D.No. 27 Mercury and its compounds Thermometers, laboratory appara- tus, neon lamp manufacture	41	10	6 14.6	1	0.00084	100	0.013	0.0302	0.0642	0.0789

* AI = social accident insurance institution

Work area groups: Personal measurements

D.No. = Data set number/ Designation Work area	Number of measured data	Number of firms	Frequency < number of values %	Number of Alls*	≤ limit value % \$	Concentrations in mg/m ³			
						50 percentile +	75 percentile +	90 percentile +	95 percentile +
D.No. 32 Mercury and its compounds 1591/1 Processing methods, miscellaneous	6	2	0	1	66.7				
D.No. 33 Mercury and its compounds Storing, Sorting, Final inspection, checking	3	2	2 66.7	2	100				
D.No. 34 Mercury and its compounds Conveying, Industrial trucks	5	2	4 80	2	100				
D.No. 35 Mercury and its compounds Comminution, dismantling, shredding, separation	12	8	2 16.7	4	91.7	0.00075	0.006	0.0262	0.14
D.No. 36 Mercury and its compounds Filling, Packaging	3	3	0	2	66.7				
D.No. 37 Mercury and its compounds Technical school	1	1	0	1	100				
D.No. 38 Mercury and its compounds Laboratory	6	6	2 33.3	4	100				
D.No. 39 Mercury and its compounds Thermometers, laboratory apparatus, neon lamp manufacture	1	1	0	1	100				

* All = social accident insurance institution

Work area groups: Measurements without local exhaust ventilation

D.No. = Data set number/ Designation Work area	Number of measured data	Number of firms	Frequency < number of values %	Number of AIs*	Largest quanti- fication limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³			
							50 per- centile *	75 percen- tile *	90 per- centile *	95 per- centile *
D.No. 44 Mercury and its compounds Processing methods, miscellaneous	0	0	0	0						
D.No. 45 Mercury and its compounds Storing, Sorting, Final inspection, checking	14	7	4 28.6	3	0.0042	100	+ 0.0021	0.0071	0.0232	0.042
D.No. 46 Mercury and its compounds Conveying, Industrial trucks	3	1	0	1		100				
D.No. 47 Mercury and its compounds Comminution, dismantling, shred- ding, separation	17	7	2 11.8	3	0.00045	70.6	0.006	0.114	0.254	0.321
D.No. 48 Mercury and its compounds Filling, Packaging	16	10	3 18.8	4	0.005	93.8	+ 0.002	+ 0.0034	0.00644	0.0544
D.No. 49 Mercury and its compounds Technical school	12	3	1 8.3	1	0.002	100	+ 0.0013	0.0026	0.00356	0.00508
D.No. 50 Mercury and its compounds Laboratory	8	2	2 25	1	0.0009	75				
D.No. 51 Mercury and its compounds Thermometers, laboratory appara- tus, neon lamp manufacture	11	7	6 54.5	1	0.00084	100	! a. q.	0.00875	0.0227	0.051

* AI = social accident insurance institution

Work area groups: Measurements with local exhaust ventilation

D.No. = Data set number/ Designation Work area	Number of measured data	Number of firms	Frequency < number of values, %	Number of AIs* [*]	Largest quantification limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³			
							50 percentile *	75 percentile *	90 percentile *	95 percentile *
D.No. 56 Mercury and its compounds Processing methods, miscellaneous	22	3	0	1		81.8	0.044	0.0625	0.11	0.164
D.No. 57 Mercury and its compounds Storing, Sorting, Final inspection, checking	1	1	0	1		100				
D.No. 58 Mercury and its compounds Conveying, Industrial trucks	2	1	0	1		100				
D.No. 59 Mercury and its compounds Comminution, dismantling, shredding, separation	14	8	1 7.1	4	0.00042	92.9	0.013	0.022	0.0708	0.16
D.No. 60 Mercury and its compounds Filling Packaging	6	4	0	3		100				
D.No. 61 Mercury and its compounds Technical school	56	5	1 1.8	2	0.002	98.2	0.003	0.005	0.009	0.0092
D.No. 62 Mercury and its compounds Laboratory	11	5	7 63.6	3	0.004	100	! a. q.	+ 0.00217	+ 0.00297	+ 0.00345
D.No. 63 Mercury and its compounds Thermometers, laboratory apparatus, neon lamp manufacture	4	2	0	1		100				

* AI = social accident insurance institution