

Naar een bibliotheek met specifieke GSD waarden

Theo Scheffers

Sessie A

Wo 11 april 11:00 april Zaal RPS

EU testing compliance

*Testing Compliance with
Occupational Exposure Limits
for Airborne Substances*



British Occupational Hygiene Society
Pride Park Derby
DE24 8LZ, UK
www.bohs.org

September
2011



Nederlandse Vereniging voor
Arbeidshygiëne
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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

FINAL DRAFT
FprEN 689

December 2017

ICS 13.040.30

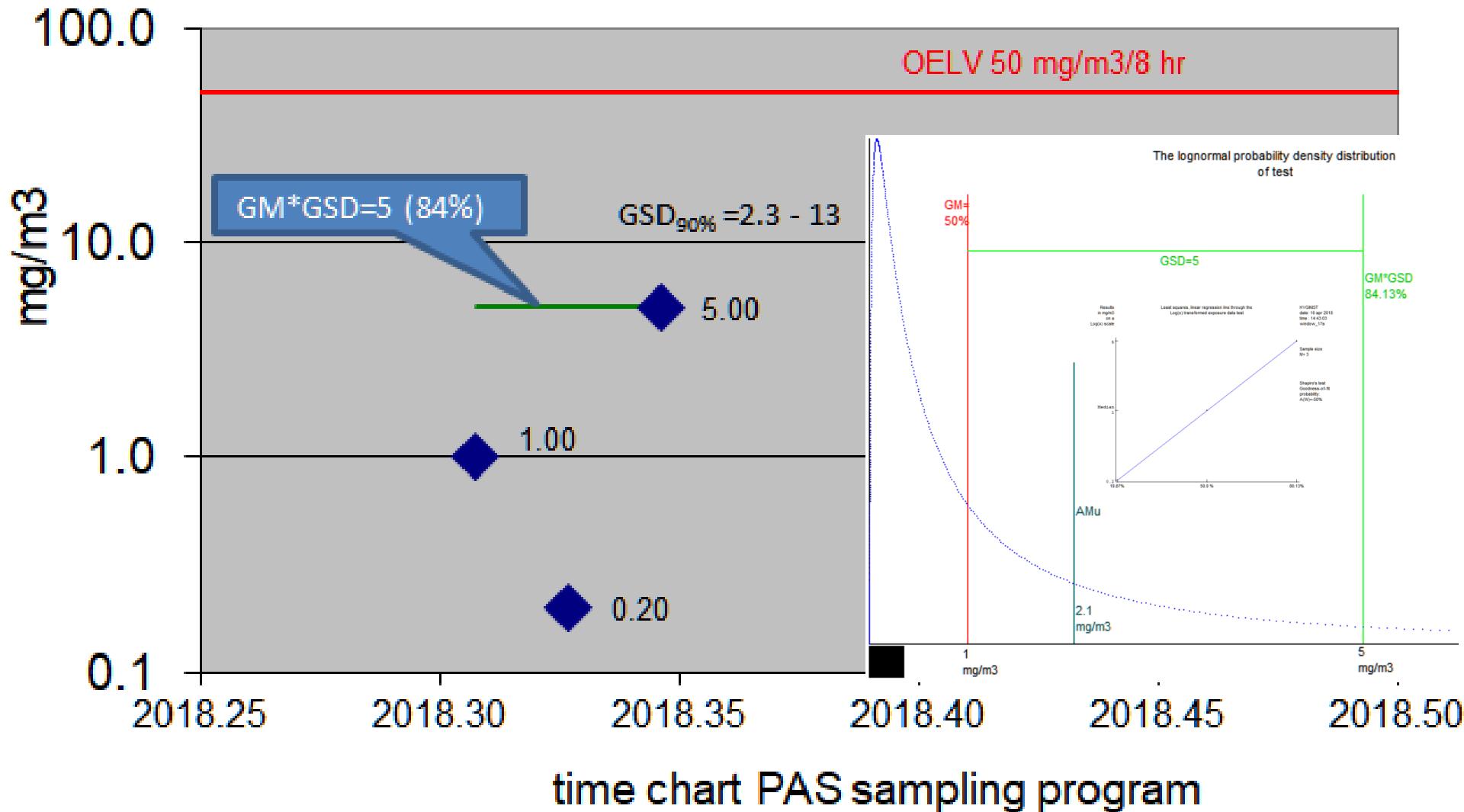
Will supersede EN 689:1995

English Version

Workplace exposure - Measurement of exposure by
inhalation to chemical agents - Strategy for testing
compliance with occupational exposure limit values

C>OELV Test	689 (1995)	NVvA-BOHS (2011)	EN 689 (2018)
preliminary	-	3 samples <0,1 OELV	Clause 5.5.2 3 samples <0,1 OELV 4 samples <0,15 OELV 5 samples <0,2 OELV
statistical	Annex D $C_{95\%} < \text{OELV}$	6+ samples $C_{95\%,70\%} < \text{OELV}$	Clause 5.5.3 6+ samples $C_{95\%,70\%} < \text{OELV}$
target	Homogeneous exposure group	Similar Exposure Group Between & Within worker differences	Similar Exposure Group 5.2.1 Multi-location (REACH) 5.4.3 B&W differences

EN 689 (2018) preliminary compliance (3 measurements)



GSD, the measure for the dispersion

$GSD = EXP(s)$

$$s = \sqrt{\frac{\sum_{i=1}^M (x_i - \bar{x})^2}{M-1}}$$

M sample size, x_i log(concentration)

Validity questions

- 5.5.2 preliminary test is valid for $GSD \leq 4$
 - How often are $GSD \leq 4$?
- 5.2.1 Multi-location SEG (also in REACH)
 - Differences in GM (and GSD ?)
- 5.4.3 Between en within worker variability
 - Differences in GM and GSD (BWStat Online)

Exposure models

Predict location (GM/AM), less dispersion(GSD)



MEASE v.1.02.01, EMKG-EXPO-TOOL and EASE v.2.0.

GSD determinants

- Substance properties en analytical limitations
- Exposure profile (basic characterization)
- assessment bias and limitations

Substance properties & GSD

- saturation concentration (high, low)
- Dustiness (coarse, fine, mist)
- Constant evaporation (paraformaldehyde)

Analytical methods & GSD

Substance & sampling method	Range mg/m ³	GSD
inorganic acid mist	0,5 - 2	1.5
gravimetric	0,5 - 10	2.5
Analytical methods: halogens, metals, Si, P, N, S and solvents	0,16 - 6 0,1 - 10 0,07- 14 0,02 - 50 0,01- 100	3 4.1 5.4 11 17

Operational Conditions (OC)

Low GSD	High GSD
Clean room, well controlled industrial OC, Well defined contributing scenario	Outdoor, Professional OC
Job with single task	Job with multiple tasks
High background level	No background inference

exposure profile (basic characterization)

Contributing Scenario 101

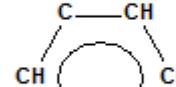
Job/task/



IH SEG



OC/RMM



OC/RMM



Air exposure



Step 1: Identifying contributing scenarios

Step 2: Identifying exposure pathways

CS: A set of conditions of use addressing one task/activity is called a contributing scenario

Assessment bias

Low GSD	High GSD
Short sampling campaign (1 day, one week): autocorrelation, missing tasks	Long-term, mutually independent sampling campaign (months, year)
EM	PAS
Small sample size	Large sample size
Fixed factor or remove undetectables	Include undetectables using lognormal regression

In summary

The GSD is a property of an exposure profile in

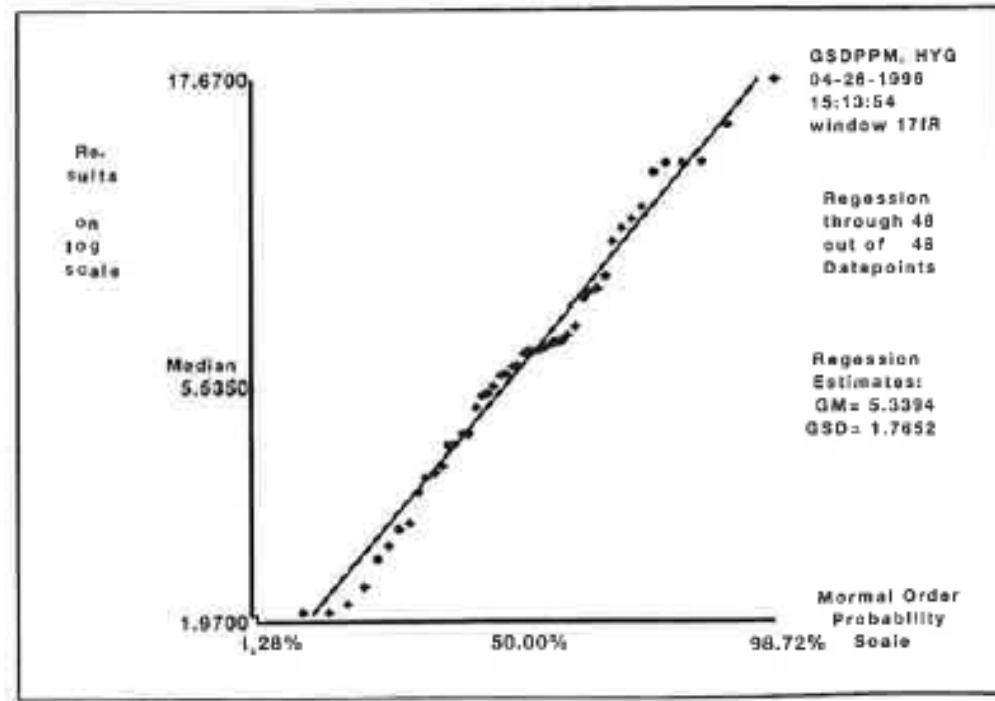
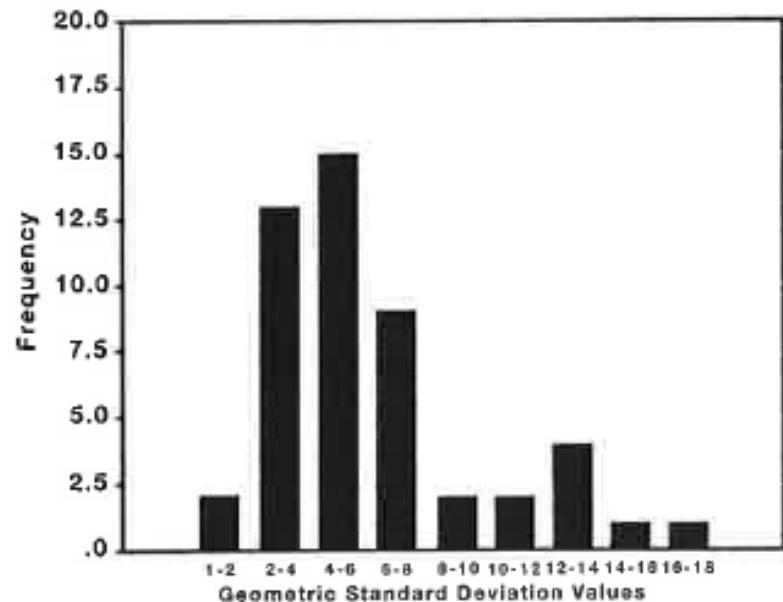
- Similar Exposure Group (EN 689)
- Task/activity Contributing Scenario (REACH)

[if exposure assessment strategy is well performed]

GSDs in literature

GSD	range UTL _{95%} : GSD ^{±1,64}	Orders of magnitude UTL _{95%} :	Comment, reference
<2	0.3 - 3	1	Leidel 1977 (one task, fixed place)
2.7	0.2 - 5	1+	Median, Buringh 1991
≤3	0.15 - 6	2-	Valid SEG, AIHA IHStat
≤4	0.1 - 10	2	Preliminary test EN 689 (2018)
5.3	0.06-16	2+	Median, Scheffers 2000 (single loc)
5.4	0.06 - 16	2+	Solids, Tielemans 2008 (multi loc)
8.2	0.03 - 32	3	Liquids, Tielemans 2008 (multi loc)
17	0.01-100	4	95%, Scheffers 2000 (single loc)

GSD frequency and cumulative distribution



long-term GSD in chemical industry

Tijdschrift voor toegepaste Arbowetenschap 13 (2000) nr 4

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In conclusion

- **Consider the GSD as a property of a SEG/t-CS exposure profile**
- Small (≤ 4) and large GSDs both exists
- Be careful with the EN 689 preliminary test

Problem/solution

Small sample series 1-5 are inaccurate to estimate GSD and will lead to even more inaccurate $C_{95,70}$ (EN 689)

- **Location (GM/AM) is less sensitive for bias and inaccuracy**
- **Location estimation can be supported by models**

If a GSD is a property of a SEG/t-CS exposure profile than a library of GSDs per SEG/t-CS may help compliance testing of small series

- Comparing the GSD_{measured} with the GSD_{lib}
- Using GSD_{lib} as default (in case of $GM_{n=1,2,\dots}$ or modelling)

A library of GSD

How to construct ?

- Large databases (MEGA, SCOLA, COLCHIC, OSHA CEHD)
- Numerous smaller databases (Health services, companies, consultants)
- Kromhout (1993)/Symansky (2006)
- Vast/Stoffenmanager database (Tielemans, 2008)
- exposure measurement sets of REACH PROCs

Examples for a GSD library

description of the exposure profile (SEG/t-CS)	within worker GSD_w	within and between worker GSD_{b+w}	worker and location GSD_{l+b+w}	reference
liquid	?	?	8.2	Tielemans (2008)
solid	?	?	5.4	Tielemans (2008)
Animal feed production Inspirable endotoxin	3.1	4.3	?	Kromhout (1993)

Thanks for contributing

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