


**HSE** Health and Safety Executive

### The technical basis for COSHH essentials: Easy steps to control chemicals



Introduction

1. This report summarises the technical basis of the generic risk assessment scheme used in the Health and Safety Executive's (HSE's) guide COSHH essentials: Easy steps to control chemicals.<sup>1</sup> It replaces the prior publication The technical basis for COSHH essentials (ISBN 0 7175 2834 0) and partly replaces publication HSG193.<sup>2</sup> It complements and updates the articles published in the *Annals of Occupational Hygiene*.<sup>3,4</sup>



# Validation of the Hazard Grouping in Control Banding

Finding the best hazard grouping to establish “Kick-off” levels (next presentation)

**IFA**  
Institut für Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung

Das GHS-Spaltenmodell

Theo Scheffers,  
Geert Wieling,  
Caroline Coucke.

**Einfaches Maßnahmenkonzept  
Gefahrstoffe**



Modul



# Control Banding (CB)

a generic technique for assessing and managing workplace exposure risks:

- without the use of an Occupational Exposure Limit Value (OELV)
- with the use of grouped Health Hazard Identifiers like the EU R-phrases or EU/GHS H3##-statements



# Identified Control Banding schemes (1)

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new version of TRGS 600 supersedes

**Einfaches Maßnahmenkonzept Gefahrstoffe**



**Modul**

Substitution	
Hazardous Substances	

**INTERNATIONAL LABOUR OFFICE**

PROGRAMME ON SAFETY AND HEALTH AT WORK AND THE ENVIRONMENT

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**INTERNATIONAL CHEMICAL CONTROL TOOLKIT**

Technical Rules for occupational safety knowledge relating to handling of hazardous substances

**ECHA** EUROPEAN CHEMICALS AGENCY

**GUIDANCE**

## Guidance on information requirements and chemical safety assessment

Part E: Risk Characterisation

reflect the state of the science as well as developments in knowledge relating to the substances being placed on the market (AGS)

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**Das GHS-Spaltenmodell**



# Identified CB Schemes (2)

- 7 R-Phrases based CB schemes,
  - R-phrases will be phased out in 2015
- REACH CSA Part E, limited # H-statements
- ILO Toolbox with GHS classifications
- NIOSH Exposure banding process
- 3 CLP H-Statements based CB schemes are enrolled
  - See next slide

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TRGS 600 Page - 1 -

The new version of TRGS 600 supersedes TRGS 440.

Edition: August 2008

Technical Rules for Hazardous Substances	Substitution	TRGS 600
The Technical Rules for Hazardous Substances (TRGS) reflect the state of technology, occupational safety and health and occupational hygiene as well as other scientific knowledge relating to the requirements concerning the placing on the market and handling of hazardous substances. The		

Committee on Hazardous Substances (AGS)



# H-statement based schemes selected

- COSHH Essentials (HSE: Health and Safety Executive)
- einfaches Maßnahmenkonzept Gefahrstoffe (EMKG) (BAuA: Federal Institute for Occupational Safety and Health). Separated hazard grouping for skin route
- GHS Spaltenmodell; based on TRGS600 (DGUV IFA: Institute for Occupational Safety and Health of the German Social Accident Insurance)



## Validation (1) theoretical base

- H-statements are a qualitative and quantitative mix
  - 2 to 5 dose levels: toxicity for different routes (H 300 thru 332)
  - 1 or 2 Severity levels: irritation, corrosive, sensitization
  - 3 to 5 levels of causality and relevance for human: Carcinogenic, Mutagenic Reprotoxic
  - Special single warnings: lactation
  - Examples : next slide

Grouping of H-statements, resulting in an ranked measure.

What kind of ranking?





## Hazard grouping (simplified)

Hazard group	Health Hazard Identifiers (HHI) like R-phrases, H-statements, (inter)national classifications (IARC, etc.)
5/E	Human Carcinogen R45, 49, H350(i), IARC 1, 2a
4/D	Very toxic, R26, H330, Possible Carc. R40, H351 , IARC 2b.
3/C	Toxic R23,H331, Corrosive 34, 35, H314, EUH071
2/B	Harmful R20, H332
1/A	Irritation R37, H335
0/-	Harmless. R36, 38; non dangerous; REACH Annex IV

Increasing hazard group # is linked to a more structural & stringent control regime



# R-phrases and H-statements don't match !

Acute toxicity: LD50 – oral mg/kg

Dose	R-phrase	hazard group	CLP hazard class & category	H-Statement	Hazard group
<5	28	D	Acute Tox 1	300	D
5-25	28	D	Acute Tox 2	300	D
25-50	25	C	Acute Tox 2	300	D
50-200	25	C	Acute Tox 3	301	C
200-300	22	B	Acute Tox 3	301	C
300-2000	22	B	Acute Tox 4	302	B

The most comprehensive database of OEL's and measurement methods



## Conclusions theoretical base

- There is no theoretical base for an objective allocation in 3 to 5 ordered hazard groups
  - health hazard statements are ordered, dichotomous or qualitative entities. Mutually they are categorical.
- R-phrase and H-statement based hazard grouping differ
- 53 EU health R-phrases and 42 H3##/EUH## health statements result in 85 translation combinations.
  - Most CB schemes do not take the differences between R-phrases to H-statement into account.
  - Substances may end up in a different hazard group when switching from an R-phrase to H-statement based Control Band Scheme

## Validation (2) reproducibility

If H-statements cannot be grouped theoretically what is the reproducibility of different hazard groupings?

*In an experimental setting: repeated, independent trails must result in the same outcome*

- multiple institutions throughout the world have performed hazard grouping (more or less independent)

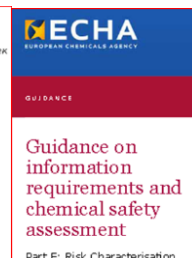
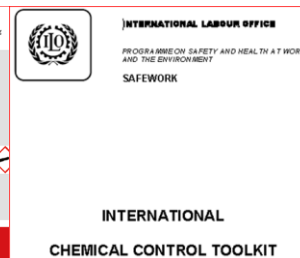
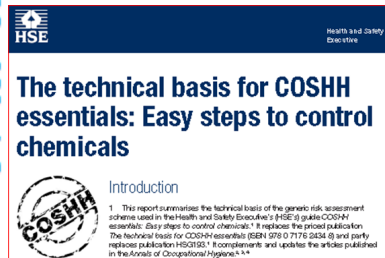
# Reproducibility: different H-statement grouping

Hazard category	DGUV IFA Spaltenmodell (TRGS600)	COSHH Essentials	BAUA EMKG (Einfaches Maßnahmenkonzept) (inhalation)
4/E	H300, H310, H330, EU032 H340 (AGS Mut 1AB) H350, H350i (AGS K1/2 & TRGS 906)	H334, H340, H341, H350, H350i	H340, H350, H350i, H360F (TRGS 905 & 906)
3/D	H301, H311, H331 EUH070, EUH029, EUH031 H370, H317 (Sh), H334 (Sa), H318 H360 <sub>xy</sub> (AGS R <sub>EF</sub> 1/2) H351 (AGS K3), H341 (AGS M3), H372	H300, H310, H330 H351, H360 <sub>xy</sub> , H361, H362, H372	H300, H330, H360D, H372, EUH032
2/C	H302, H312, H332 H314 (pH ≥ 11,5, pH ≤ 2), H371, EUH071 H361 <sub>f/d</sub> , H373, H362 non-toxic gases which may cause asphyxiation	H301, H311, H331, H314, H317, H318, H335, H370, H373, EUH071	H301, H331, H314, H334, H341, H351, H361f/d, H370, H371, H373, EUH031 (TRGS 907)
1/B	H315, H319 damage to the skin during wet work H304, EUH066, H335, H336 Substances chronically harmful in other ways (no H-statement, but still hazardous)	H302, H312, H332 H371	H302, H332, H318
0/A	substances which experience shows to be harmless (e.g. water, sugar, paraffin etc.)	H303, H304, H305, H313, H315, H316, H319, H320, H333, H336, EUH066 and all H-numbers not otherwise listed	H319, H335, H336, H304 No health hazard H-statements



# Reproducibility of CB hazard grouping

- CB hazard grouping is a combination of:
  - Basic toxicological knowledge
  - Professional judgement
  - Risk perception
  - National sentiment
  - ....
- The reproducibility of CB hazard grouping is limited



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## Validation (3): compare with standard

- A “golden” standard does not exist
- OELVs are used to validate hazard grouping
  - OELV is a quantitative measure
  - Substances with both OELV and HHI exists
- Is anybody in the audience aware of a better standard ? (afterwards)

DOHSBase Compare  
[www.dohsbase.com](http://www.dohsbase.com)

172000 substances  
 225000 synonyms  
 40000 PhysChem properties  
 8000 harmonized CLPs  
 3800 OELV  
 2000 Kickoff levels  
**2000 REACH DN/MELs**  
 2500 analytical methods

Name:	Sampling method	Principle of
Isoforondioxyanaal	MDHS 25/3 related method BIA 7670	Active
Isoforondioxyanaal	MDHS 25/3 related method BIA 7670	Active
Hexamethyleendiocxyanaal	MDHS 25/3 related method BIA 7670	Active
Beryllium metaalisch	MDHS 29/2	Active
Cobalt	MDHS 30/2	Active
Dioxychloor(a)	MDHS 32	Active
Dioxykoolstof(a)	MDHS 32	Active
Fluorides, inorganic and soluble	MDHS 35/2	Active
Fluorwaterstof	MDHS 35/2	Active
Fluorwaterstof	MDHS 35/2	Active
Fluorides, inorganic and soluble	MDHS 35/2	Active
Silica, crystalline (Quartz)	MDHS 30 respirabel stof ger. meth. BIA 9522, NIOSH 7602	Active
Platina metaalisch	MDHS 46/2	Active
Platinaoxyden, water oplosbaar	MDHS 46/2	Active
Buadient(1,3)	MDHS 53/2	Active
Fullerenes, tubular	MDHS 59 fibres	Active
Glasvezels, superfin	MDHS 59 fibres	Active







# Database with hazard groups & OELV

NAME	MG_M3	PPM	Reference	SOR	STATE	EMKG_HO	IFA_SPLT_H	COSHH_H	H_PHRASES
Aluminium	4		DFG 2013, Mitteilung 49	301	Solid		1	1	1 H261 H228
Aluminum chloride	0,05		Gr 2009/02OSH	201	Solid		4	3	4 H314
Tetraethylorthosilicaat		1,2	Gr 2000/15OSH131	201	Liquid		2	2	3 H226 H332 H319 H335
Tetraethylsilicaat		5	SCOEL-SUM 064	211	Liquid		2	2	3 H226 H332 H319 H335
Fosfor, wit en geel	0,01		DFG 2013, Mitteilung 49	301	Solid		4	4	4 H250 H330 H300 H314 H400
Fosfortrichloride		0,3	2013 TLVs and BEIs with 7th	311	Liquid		4	4	4 H330 H300 H373** H314
Fosforyltrichloride		0,1	2013 TLVs and BEIs with 7th	311	Liquid		4	4	4 H330 H372** H302 H314
Fosforpentoxide	1		SEG-SUM 014 EUR-15091: 39-4	111	Solid		3	2	3 H314
Tributylfosfaat		0,18	2013 TLVs and BEIs with 7th	201	Solid/Liquid		4	3	4 H351 H302 H315
Tributyl phosphate	5		2013 TLVs and BEIs with 7th	311	Solid/Liquid		4	3	4 H351 H302 H315
Triorthocresylfosfaat	0,1		2013 TLVs and BEIs with 7th	311	Liquid		3	3	3 H370** H411
Dichloorvos		0,11	DFG 2013, Mitteilung 49	301	Solid/Liquid		4	4	4 H330 H311 H301 H317 H400
Mevinfos	0,01		2013 TLVs and BEIs with 7th	311	Solid/Liquid		4	4	4 H310 H300 H400 H410
Mevinfos		0,01	DFG 2013, Mitteilung 49	301	Solid/Liquid		4	4	4 H310 H300 H400 H410
Trichloorfon	1		2013 TLVs and BEIs with 7th	311	Solid		2	3	3 H302 H317 H400 H410
Tetraethylpyrofosfaat		0,005	DFG 2013, Mitteilung 49	301	Solid		4	4	4 H310 H300 H400
Tetraethylthiopyrofosfaat	0,1		SEG-SUM 069	111	Solid/Liquid		4	4	4 H310 H300 H400 H410
Demeton-O		0,01	Gr 2000/15OSH068	201	Liquid		4	4	4 H310 H300 H400
Demeton-S		0,01	Gr 2000/15OSH068	201	Liquid		4	4	4 H310 H300
Demeton-S-methyl	0,01		Gr 2000/15OSH072	201	Solid/Liquid		3	3	3 H311 H301 H411
Demeton-S-methyl	0,05		2013 TLVs and BEIs with 7th	311	Solid/Liquid		3	3	3 H311 H301 H411
Foraat	0,02		Gr 2000/15OSH075	201	Liquid		4	4	4 H310 H300 H400 H410
Foraat	0,05		2013 TLVs and BEIs with 7th	311	Liquid		4	4	4 H310 H300 H400 H410
Parathion	0,1		DFG 2013, Mitteilung 49	301	Liquid		4	4	4 H330 H300 H311 H372** H400 H410
Parathionmethyl	0,02		2013 TLVs and BEIs with 7th	311	Solid		4	4	4 H226 H330 H300 H311 H373** H400 H410
Ethyl-p-nitrofenylthiobenzee	0,5		DFG 2013, Mitteilung 49	301	Solid		4	4	4 H310 H300 H400 H410
Coumaphos	0,05		2013 TLVs and BEIs with 7th	311	Solid		4	4	4 H300 H312 H400 H410
Azinfos-methyl	0,2		DFG 2013, Mitteilung 49	301	Solid		4	4	4 H330 H300 H311 H317 H400 H410
Diazinon	0,1		DFG 2013, Mitteilung 49	301	Solid/Liquid		2	2	2 H302 H400 H410
Malathion	15		DFG 2013, Mitteilung 49	301	Liquid		2	3	3 H302 H317 H400 H410
Ethion	0,05		2013 TLVs and BEIs with 7th	311	Liquid		3	3	3 H301 H312 H400 H410

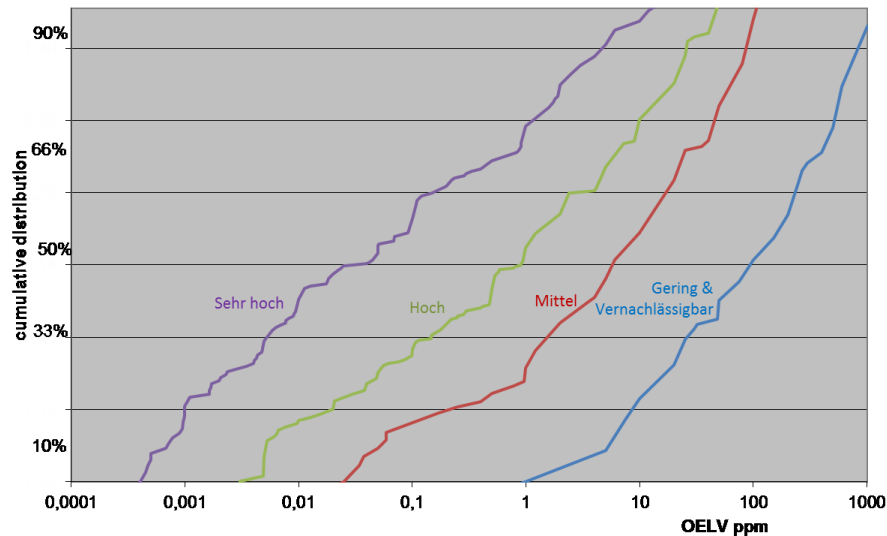
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# Results hazard grouping OELV distributions

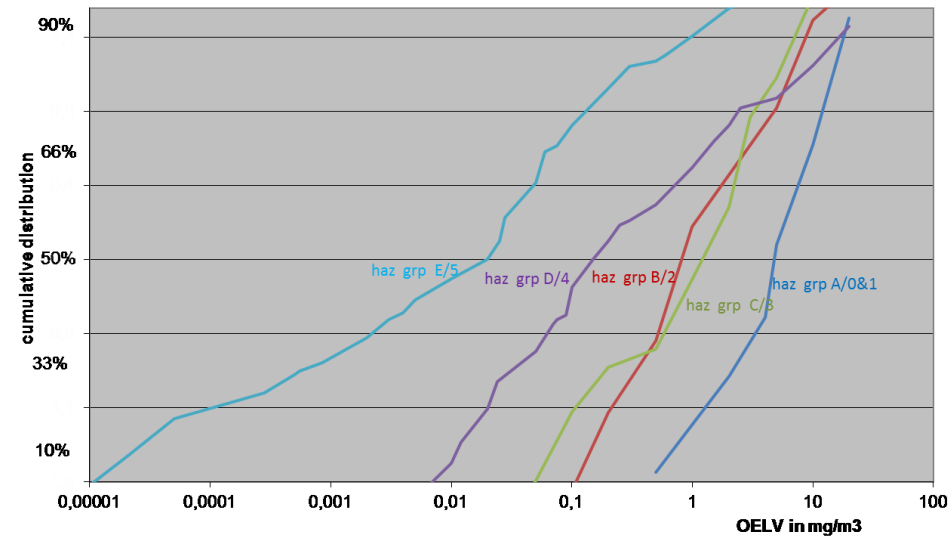
Per hazard group and physical state the OELV distribution is constructed  
 Next slides:

- COSHH Essentials HSE
- EMKG einfaches Maßnahmenkonzept Gefahrstoffe BAuA
- IFA-spaltenmodell/TRG600 DGU

OELV distributions gas/vapour per IFA-TRGS6\_H hazard group

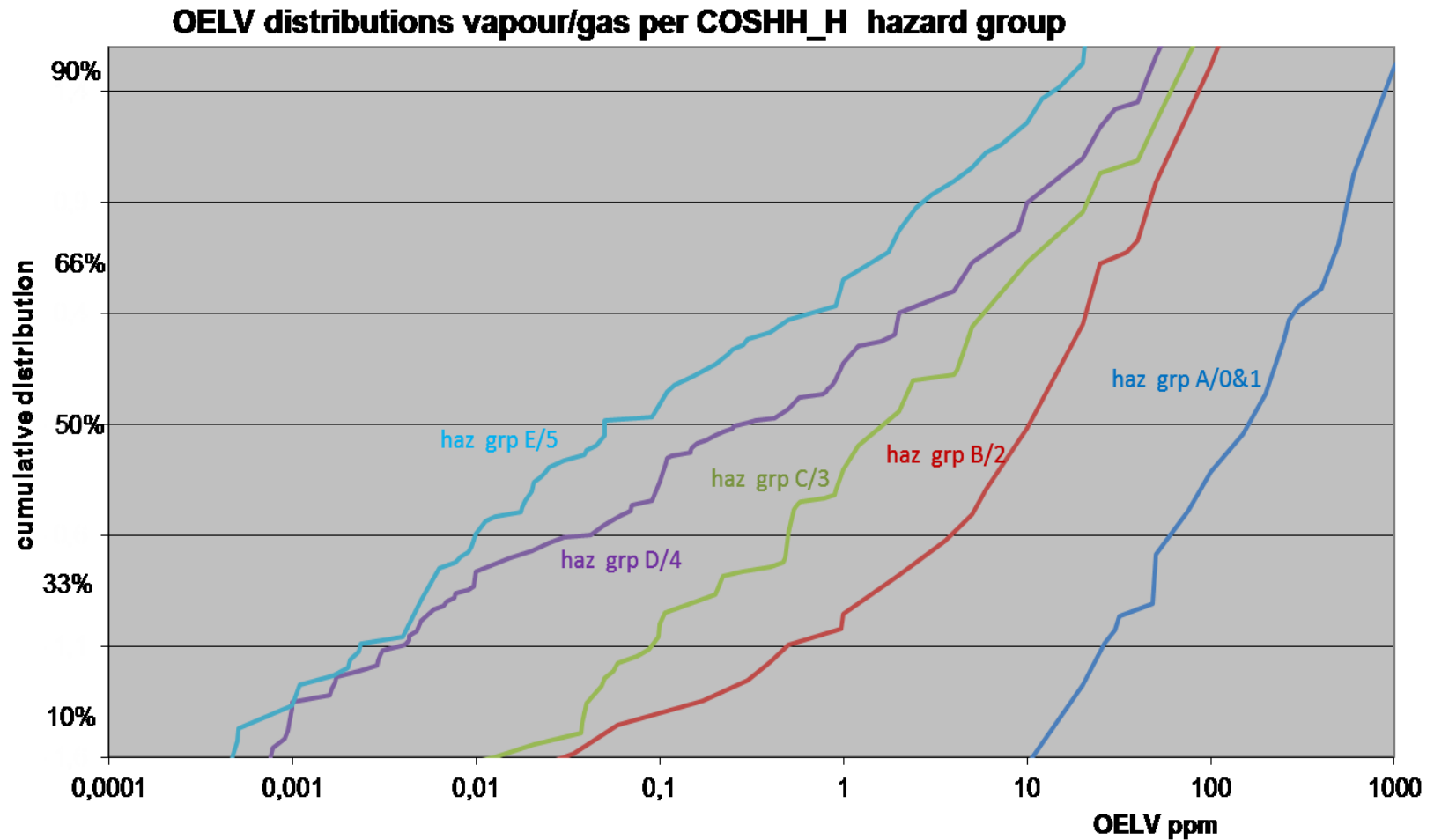


OELV distributions dust/aerosol per COSHH\_H hazard group



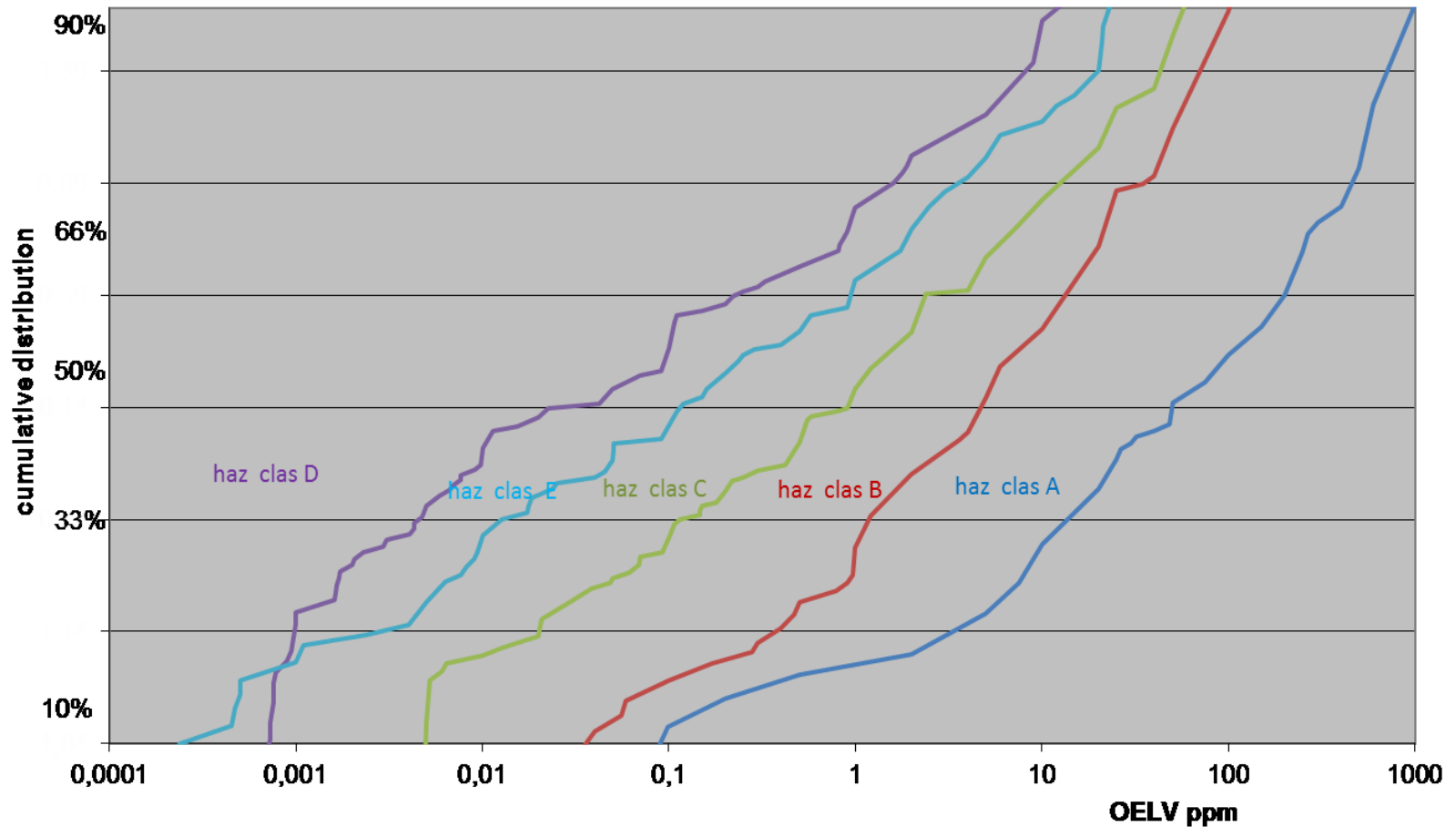
# Results – COSHH vapour/gas

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# Results – EMKG (inhalation) vapour/gas

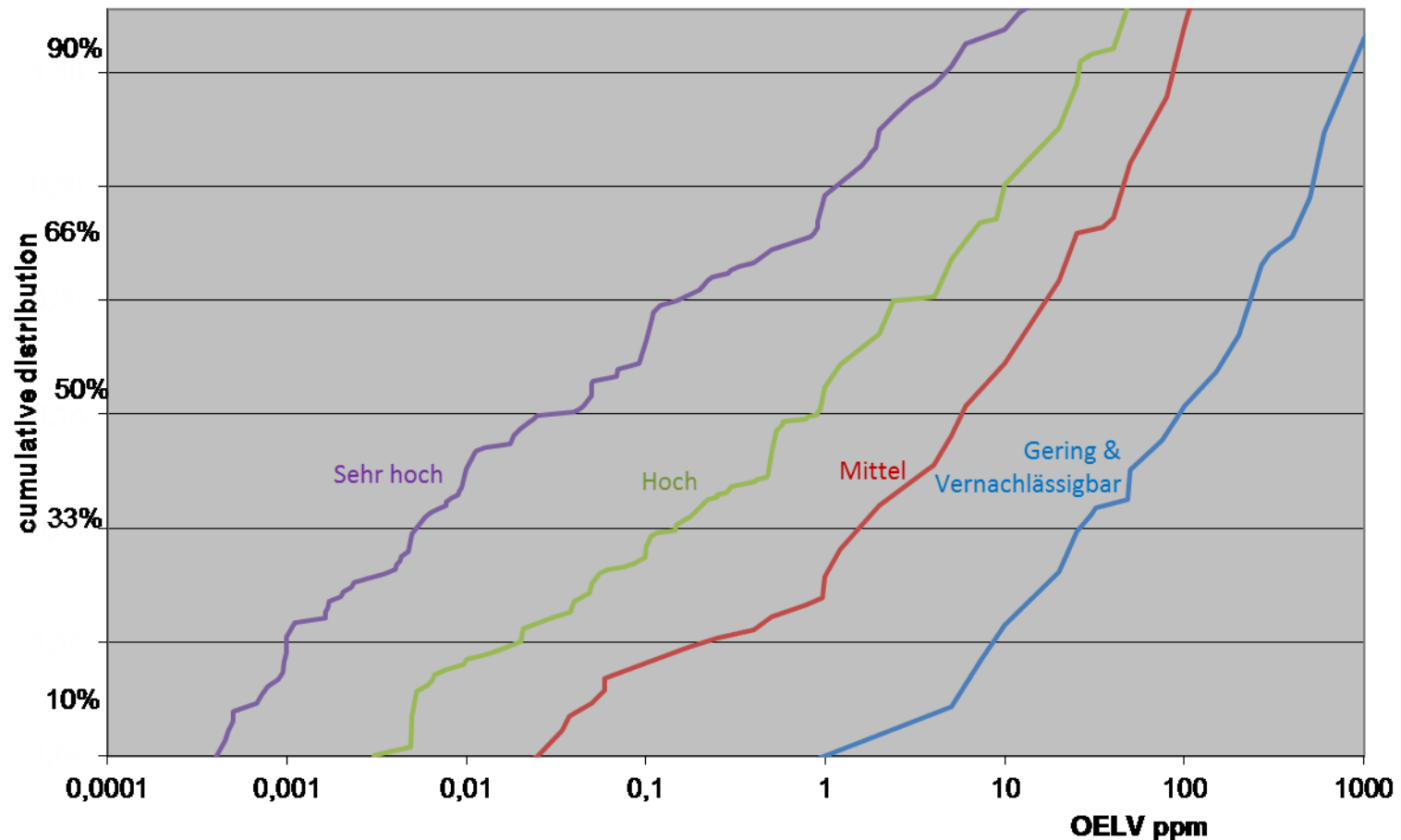
**OELV distributions vapours per EMKG-HOI grouped hazard classification**



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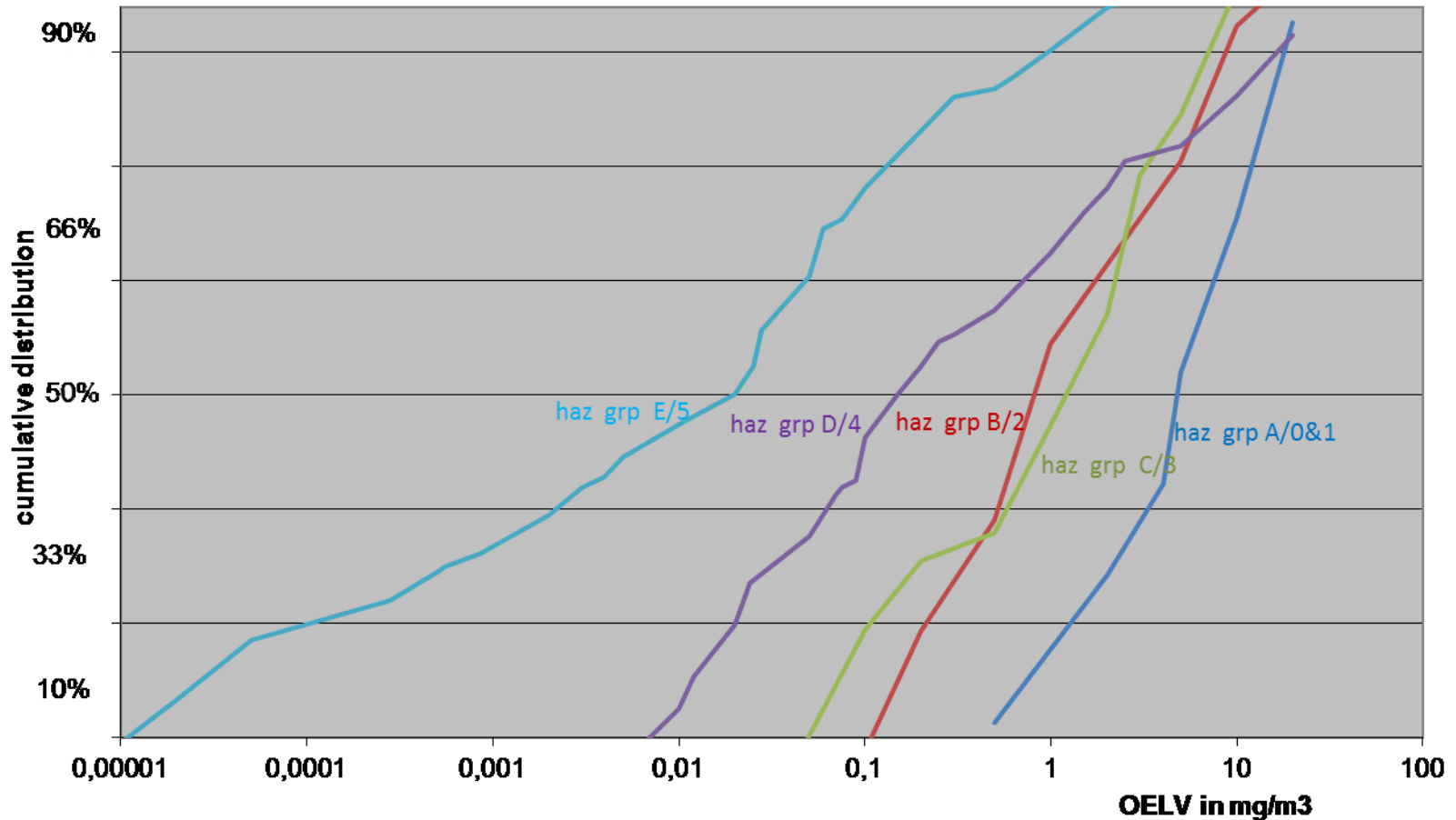
## Results – IFA/TRGS600 vapour/gas

OELV distributions gas/vapour per IFA-TRGS6\_H hazard group



## Results – COSHH dust/aerosol

OELV distributions dust/aerosol per COSHH\_H hazard group

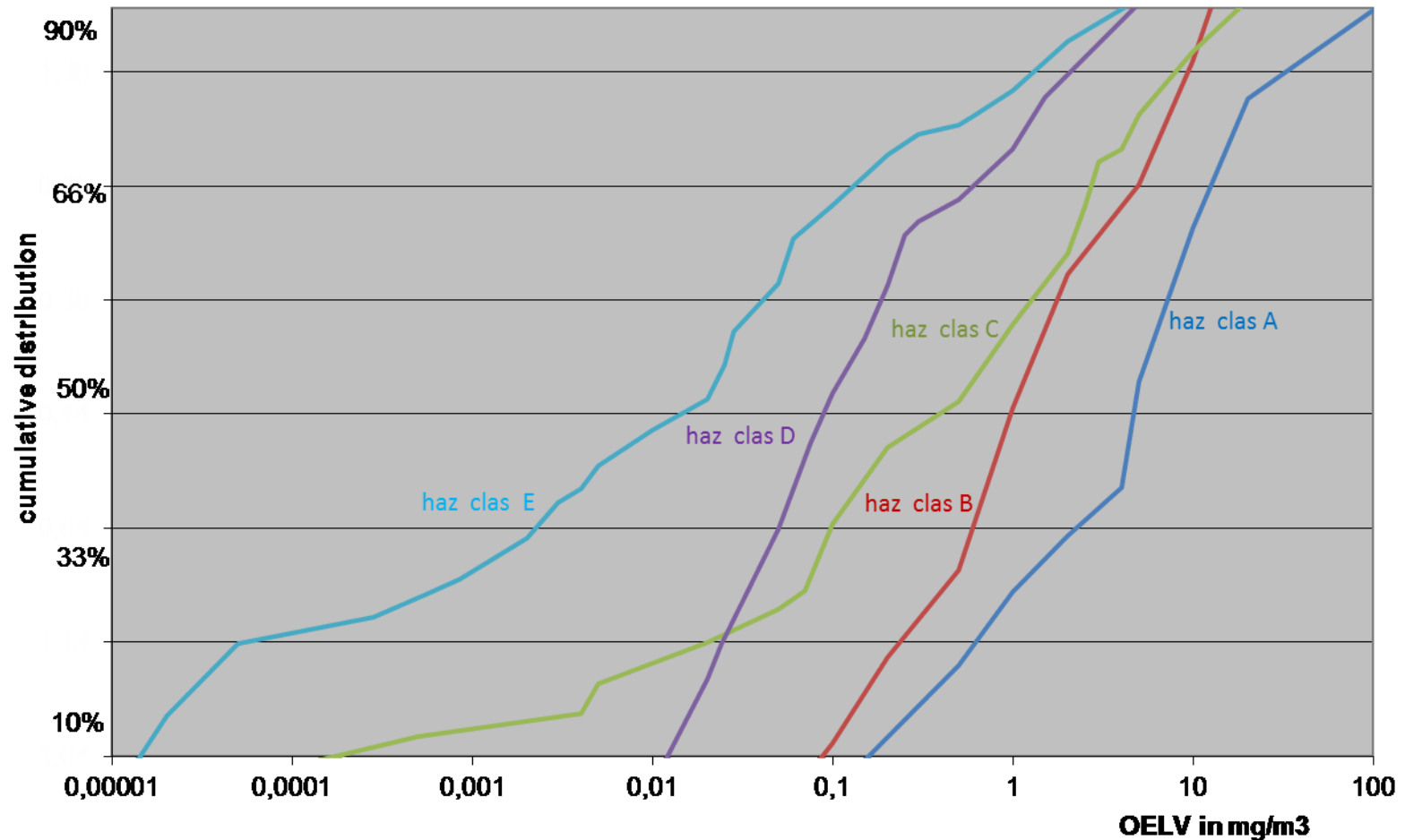


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## Results – EMKG (inhalation) dust/aerosol

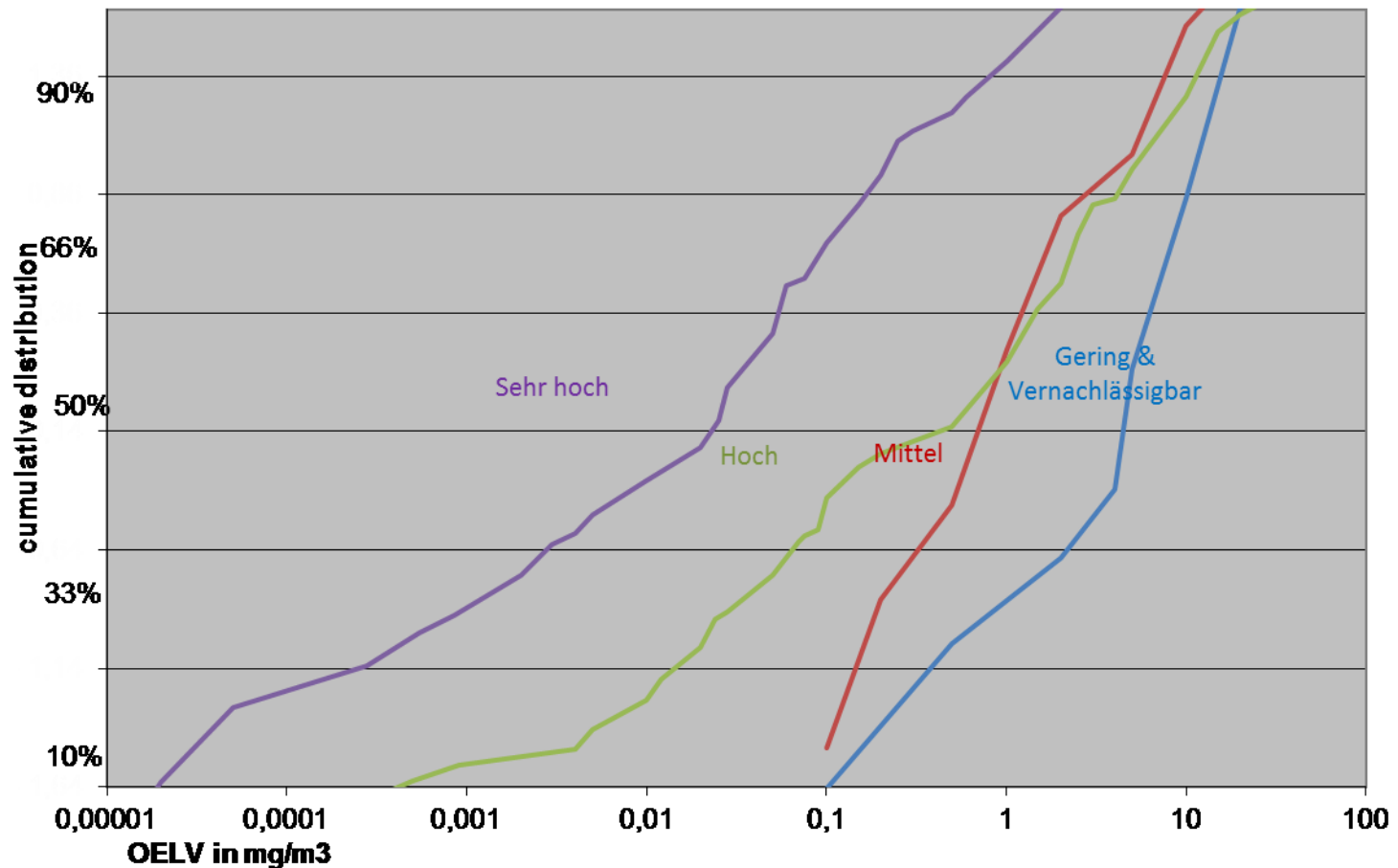
**OELV distributions solids per EMKG-HOI grouped hazard classification**



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## Results – IFA/TRGS600 dust/aerosol

OELV distributions solids per IFA-TRGS6\_H hazard group

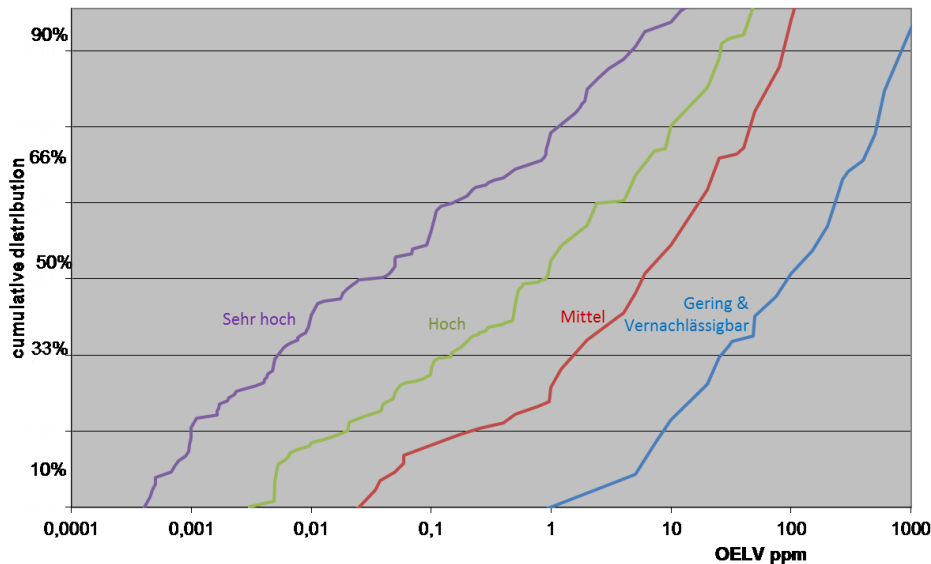


## Results hazard group OELV distributions

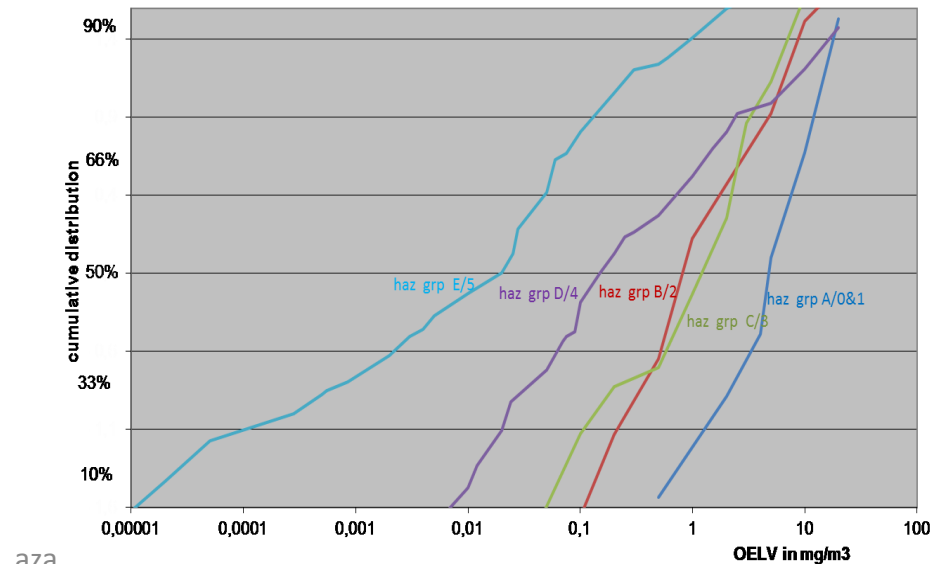
Observationally the OELV distribution strongly indicates that hazard grouping is an ordered measure but that the CB Schemes differ in power

use of OEL's and measurement methods

OELV distributions gas/vapour per IFA-TRGS6\_H hazard group



OELV distributions dust/aerosol per COSHH\_H hazard group



# OELV distribution free and trend

Physical state ->	VAPOUR/GAS			DUST/AEROSOL		
	Institution/parameter	COSHH	EMKG	IFA	COSHH	EMKG
P(Kruskal-Wallis)	8E-47	8E-45	4E-56	3E-27	6E-19	2,1E-22
Fraction variance explained by grouping	0,33	0,29	0,40	0,35	0,27	0,25
P(log, regression coefficient <> 0)	3E-54	1E-47	1E-70	2E-27	4E-24	2,1E-20

The best OELV-hazard group performances:

- IFA-spaltenmodell/TRG600 for vapour/gas
- COSHH Essentials for dust/aerosol

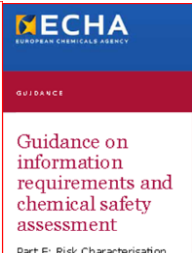


# Conclusions on hazard grouping

Hazard grouping in CB schemes is an ordered measure:

- observationally it explains part of OELV dispersion
- it lacks uniformity between institutions (the whole CB system depends on it !)
- Working condition control depends on it !

Despite the short comings, hazard grouping and OELV are strongly related, **making it suitable to establish kick-off levels (earlier presentation)**



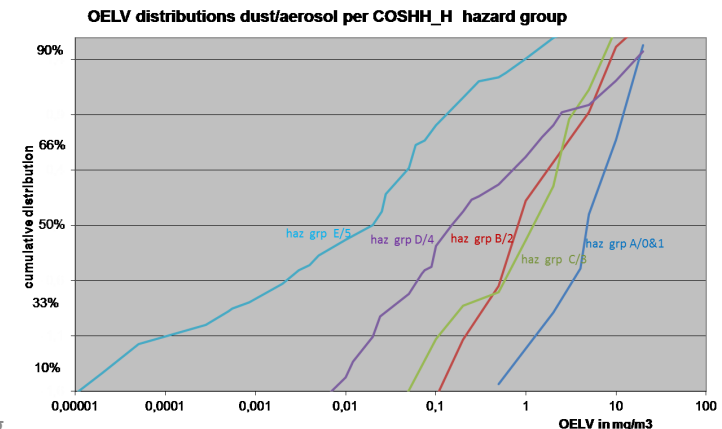
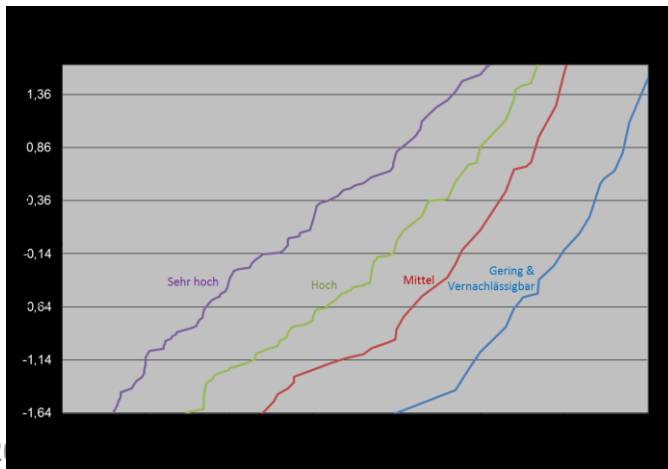
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# Recommendations

To really fulfil the claim of helping SME's with a simple tool:

- Develop and use **one** universal Control Banding scheme
- Optimize hazard grouping of H-statement by minimizing OELV dispersion (GSD), maximizing OELV location (GM) differences and optimizing Lognormal goodness-of-fit

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ation of CB hazard grouping





Vapor/gas



Dust/aerosol

# Thank you!

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