

for Chemical Screening—
Are They All Created Equal?

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Some APPEAR to be

But are they?

Let's find out....

A. During emergency planning...

- DOE Order 151.1C
 - Ch III, 3.b.(2)(b)3, page III-4
 - Specifies use of NFPA 704 Health Hazard Ratings (HHRs) for Chemical Screening
 - "Chemicals without an assigned [NFPA] Health Hazard rating require further analysis in an EPHA ..."
- Draft DOE Guide 151.1-1 (11-1-2006 RevCom)
 - Vol II, Appendix A, A.3.2, page A-11
 - "Human Health Hazard. Materials that have been assigned a NFPA health hazard category rating (or a comparable locally assigned hazard rating)..."
 [emphasis added]

B. During emergency planning...

- If no NFPA HHR for a chemical exists
 - Several other HHR systems exist.....
 - Planner may be tempted to use other systems?
 - Current Order & Draft Guide do NOT allow this.
- IF planner decides to use them anyway...
- What pitfalls might be involved?
- Is the temptation worth the audit risk?
- Let's do some comparisons → → →

Purpose

- Compare HHR Systems Health Criteria
- Determine Similarities & Differences
- Summarize Results

Health Hazard Rating (HHR) Systems

- National Fire Protection Association (NFPA)
- United Nations Economic Commission for Europe (UNECE)
 - Model Regulations: "Transport of Dangerous Goods"
 - Globally Harmonized System (GHS)
- Hazardous Materials Identification System (HMIS)
 - National Paint and Coatings Association
- Sax Hazard Rating (SAX)
 - Part of "Sax's Dangerous Properties of Industrial Materials" database originally published by Irving Sax
- Savannah River Site Hazard Rating System (SRS)
- Only HEALTH Hazard Rating criteria compared

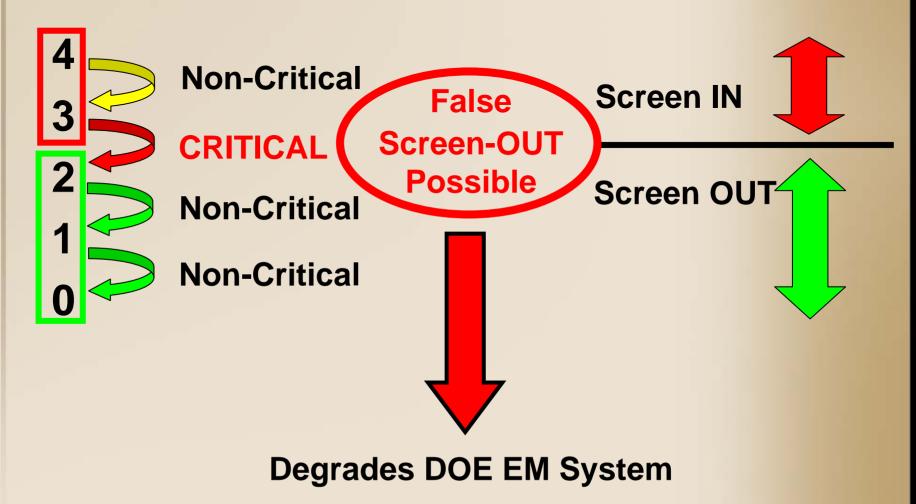
HHR Systems—Intended Use

- NFPA—Emergency response for chemical releases
 - Based in part on UNECE criteria
 - Includes ordinary use + emergency event issues
- UNECE—Safety in transport of dangerous goods
- HMIS—Occupational hazards
 - Ordinary use only, no emergency issues considered
- SAX—Health, Fire, Reactivity COMBINED
 - Single Number—May NOT be specific to Health Hazard
 - May be based on <u>highest</u>...
 - toxic OR fire OR explosive OR reactivity hazard
- SRS—Based on NFPA HHR criteria

NFPA HHR Criteria

- Gas or Vapor—Inhalation
 - LC50 (1-hour Rat)
- Gas or Vapor—Saturated Vapor Conc. (SVC) Index
 - SVC, ppm / LC50, ppm (Unitless index)
- Dust or Mist—Inhalation
 - 10 µm or less, LC50 (1-hour Rat)
- Oral—LD50 (Rat, 14 days or less)
- Dermal—LD50 (Rabbit, 14 days or less)
- HHR Basis—Not Published & Not Available
- Least similar criterion → Vapor Inhalation

NFPA HHR Criteria— Critical vs. Non-Critical Overlaps



UNECE Model Regulations

- Part of basis for NFPA HHR criteria (4, 3, 2)
- Packing Groups I, II, III (High to Low)
 - Transport of Dangerous Goods
 - Notice number REVERSAL
 - I → highest hazard
 - III → lowest hazard

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UN Packing Groups → I, II, III (High to Low)

- Color scheme—red to green categories
 - Colors same as DHS National Threat Advisory
 - Notes similarities & differences in criteria
- > Some minor differences with NFPA

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NON-CRITICAL OVERLAPS:

- ➤ UN Packing Group I & II → NFPA 4 & 3
 - Dust / Mist Inhalation
 - Dermal LD50

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More NON-CRITICAL OVERLAPS:

- ➤ UN Packing Group III (lower cut-offs) → NFPA 2 & 1
 - Dust / Mist Inhalation
 - Oral LD50

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1			G	as / Va	-		ation				Vapor		[Oust / N	lis	t Inhala	ntion				ral					rmal	
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SUMMARY

- > Non-Critical overlaps
- ➤ No Critical NFPA 3 to 2 overlaps
- > No false screen-outs

UNECE Globally Harmonized System (GHS)

- In development since 1990
 - Now in final draft stages
 - Number reversal retained
- EPA, OSHA, DOT
 - Initiated rule making to implement GHS
- DOT
 - Implementation sometime in 2008 (per UNECE)
- NFPA
 - No official statement yet on how to harmonize

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NEPA 704	3		1001		3000	ppm	1	<	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		200	mg/kg
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UNECE	2	>	100	≤	500	ppm					^	0.05	≤	0.5	mg/L	^	5	М	50	mg/kg	۸	50	≤	200	mg/kg
GHS (Proposed)	3	>	500	≤	2500	ppm					^	0.5	≤	1.0	mg/L	۸	50	М	300	mg/kg	^	200	≤	1000	mg/kg
Rev 1, 2005	4	>	2500	≤	5000	ppm					>	1.0	≤	5.0	mg/L	>	300	≤	2000	mg/kg	>	1000	≤	2000	mg/kg
	5															^	2000	≤	5000	mg/kg	>	2000	≤	5000	mg/kg

UN GHS → 1, 2, 3, 4, 5 (High to Low)

- > Intended to replace UN Model Regulations
- > Some significant overlaps with NFPA

NFPA 704 vs. UNECE GHS Gas / Vapor Gas / Vapor Inhalation Dust / Mist Inhalation LC50 Saturated Vapor Conc. Hazard 10 microns or less Rating HHR (SVC. ppm / LC50, ppm) 1-hour Rat LC50 System Range Range Unit-Range Units Units High Hiah Low Low Low High less 0 10 10 0 0.5 ppm ma/L 1 0.512 ma/L 3 1001 3000 ppm 10 NEPA 704 2001 3001 0.2 2 5000 2.01 10 1 ma/L mgg 10000 5001 0 0.2 10.1 200 ma/L 1 ppm 0.2 200 10000 Π ppm ma/L UN GHS Categories n 0 0.05 mg/L 100 ppm 100 500 0.05 0.5 mg/L ppm UNECE GHS mg/L 2500 0.5 1.0 3 500 ppm (Proposed) Rev 1, 2005 mg/L 2500 5000 1.0 5.0 ppm

Major Ca	atego	ry O'	VERL		-Gas								
Major Ca	atego	rv O'	VERL	APS-	-Gas	/ Vap	or & D)U	ist /	Mis	t Ink	nalat	ion

- ➤ UN GHS 3 & 4 overlap NFPA 3 & 2 → CRITICAL
- ➤ Using only GHS cat. numbers → FALSE screen-OUT possible

Oral

LD50

Rat

High

5

50

500

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5

50

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Units

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Hazard Rating	HHR			LC hou	⊃50 ur Rat	ation	aturate VC, pp	ed\ m∌	LC50,		ı	10 mi	cro L(t Inhala ns or b C50				LI F	ral D50 Rat				LI Ra	rmal D50 ıbbit	
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	4		0		1000	ppm	10	>	10			0		0.5	mg/L		0		5	mg/kg		0		40	mg/kg
NFPA 704	3		1001		3000	pm	1	<	10			0.51		2	ng/L		5.01		50	mg/kg		40.1		200	mg/kg
2001	2		3001		5000	ppm	0.2	<	1			2.01		10	mg/L		50.1		500	mg/kg		201		1000	mg/kg
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UNECE	2	>	100	≤	500	ppm					^	0.05	≤	0.5	mg/L	۸	5	М	50	mg/kg	۸	50	<	200	mg/kg
GHS (Proposed)	3	>	500		2500	ppm					^	0.5		1.0	mg/L	^	50	4	300	mg/kg	>	200	<	1000	mg/kg
Rev 1, 2005	4	>	2500		5000	ppm					7	1.0		5.0	mg/L	^	300	4	2000	mg/kg	>	1000	4	2000	mg/kg
	5															>	2000	M	5000	mg/kg	>	2000	×	5000	mg/kg

CRITICAL OVERLAPS—Gas / Vapor Inhalation & Dust / Mist Inhalation

- > UN GHS 3 & 4 → NFPA 3 & 2
- > FALSE Screen-OUT possible

Hazard Rating	HHR		Sas / Va 1-	L	r Inhala 250 ur Rat	ation	Ga aturate VC, pp	d١					cre	t Inhala ons or le C50				L)ral D50 Rat				L	rmal D50 ıbbit	
System			Rar	nge		Units		nge		Unit-		Ra	ng		Units		Ra	ng		Units		Ra			Units
			Low		High	011110	Low		High	less		Low	L	High	011110		Low		High	011110		Low		High	011110
	4		0		1000	ppm	10	>	10			0		0.5	mg/L		0		5	mg/kg		0	7	40	mg/kg
NED 4 704	3		1001		3000	ppm	1	<	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		200	mg/kg
NFPA 704 2001	2		3001		5000	ppm	0.2	<	1			2.01		10	mg/L		50.1		500	mg/kg		201		1000	mg/kg
	1		5001		10000	ppm	0	<	0.2			10.1		200	mg/L		501		2000	mg/kg		1001		2000	mg/kg
	0	>	10000			ppm	0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000			mg/kg
-	LUN G	HS	Categ	oria	26																				
	1		0	S	100	ppm						0	≤	0.05	mg/L		0	<	5	mg/kg		0	Z Z	50	mg/kg
UNECE	2	>	100	S	500	ppm					>	0.05	≤	0.5	mg/L	>	5	≤	50	mg/kg	7	50		200	mg/kg
GHS (Proposed)	3	>	500		2500	ppm					>	0.5	≤	1.0	mg/L	>	50	≤	300	mg/kg	>	200	≤	1000	mg/kg
Rev 1, 2005	4	>	2500	<	5000	ppm					>	1.0	<	5.0	mg/L	>	300	≤	2000	mg/kg	>	1000	<	2000	mg/kg
	5															>	2000	≤	5000	mg/kg	>	2000	≤	5000	mg/kg

NON-CRITICAL OVERLAPS

- ➤ UN GHS 1-2 & 3 → NFPA 4 & 3 (Gas / Vapor Inhalation)
- ➤ UN GHS 1 & 2 → NFPA 4 & 3 (Dermal LD50)

Hazard Rating	HHR		1-	L(ho	r Inhala 250 ur Rat	ation	aturate VC, pp	ed\ m≠	LC50,			10 mi	icro L	t Inhala ons or l C50				L)ral D50 Rat				LI Ra	rmal D50 ıbbit	
System		L	Rai Low		High	Units	Ra Low	nge I	: High	Unit- less	_	Ra Low	ingi	e High	Units		Ra Low	ng:	e High	Units	L	Ra Low	nge	e High	Units
			2011		111911					1000		2011		l light			2017		1.11911			2011		1 11911	
	4		0		1000	ppm	10	>	10			0		0.5	mg/L		0		5	mg/kg		0		40	mg/kg
NFPA 704	3		1001		3000	ppm	1	<	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		200	mg/kg
2001	2		3001		5000	ppm	0.2	<	1			2.01		10	mg/L		50 1		500	mg/kg		201		1000	mg/kg
	1		5001		10000	ppm	0	<	0.2			10.1		200	mg/L		501		2000	mg/kg		1001		2000	mg/kg
	0	>	10000			ppm	0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000			mg/kg
	lun e	HS	Categ	orie	es																				
	1		0	S	100	ppm						0	≤	0.05	mg/L		0	<	5	mg/kg		0	≤	50	mg/kg
UNECE	2	>	100	<	500	ppm					>	0.05	<	0.5	mg/L	>	5	<	50	mg/kg	>	50	<	200	mg/kg
GHS (Proposed)	3	>	500	<	2500	ppm					>	0.5	≤	1.0	mg/L	>	50	3	300	ng/kg	>	200	<	1000	mg/kg
Rev 1, 2005	4	>	2500	<	5000	ppm					>	1.0	≤	5.0	mg/L	>	300	-	2000	mg/kg	>	1000	≤	2000	mg/kg
	5															>	2000	≤	5000	mg/kg	>	2000	≤	5000	mg/kg

Another NON-CRITICAL OVERLAP—Oral LD50

➤ UN GHS 3 & 4 → NFPA 2 & 1

Hazard Rating	HHR		ias / Va 1.l	LC	r Inhala :50 ır Rat	ation		Ga aturate VC, pp	d١					сго	Inhala ns or le 250				LI	ral D50 Rat				L	rmal D50 ibbit	
System			Rar			Units	(0	Ra			Unit-	\vdash	Ra			Units		Rar			Units		Ra			Units
			Low		High	Onits		Low		High	less		Low		High	Onits		Low		High	Onits		Low		High	Offics
					1000			40		40			0		0.5	- 4				-					10	71
	4	Ш	0		1000	ppm		10	>	10			0		0.5	mg/L	Ц	0		5	mg/kg		0		40	mg/kg
NFPA 704	3	4	1001		3000	øpm		1	<	10			0.51		2	ng/L		5.01		50	mg/kg		40.1		200	mg/kg
2001	2		3001		5000	ppm		0.2	<	1			2.01		10	mg/L		50 1		500	mg/kg		201		1000	mg/kg
	1		5001		10000	ppm		0	<	0.2			10.1		200	mg/L		501		2000	mg/kg		1001		2000	mg/kg
	0	>	10000			ppm		0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000			mg/kg
	UN G	HS	Catego	rie	es		_																			
	1		0	≤	100	ppm							0	≤	0.05	mg/L		0	≤	5	mg/kg		0	×	50	mg/kg
UNECE	2	>	10°	_ ≤	500	ppm						>	0.05	≤	0.5	mg/L	>	5	≤	50	mg/kg	7	50		200	mg/kg
GHS (Proposed)	3	> (500	1	2500	ppm						>	0.5	1	1.0	mg/L	>	50	2	300	ng/kg	>	200	≤	1000	mg/kg
Rev 1, 2005	4	>	2500		5000	ppm						K	1.0		5.0	mg/L	>	300	-	2000	mg/kg	>	1000	≤	2000	mg/kg
	5																>	2000	≤	5000	mg/kg	>	2000	≤	5000	mg/kg

SUMMARY

- ➤ Category Overlaps → FALSE Screen-OUT possible
- ➤ CRITICAL Overlaps → FALSE Screen-OUT possible
- > Non-Critical overlaps

HMIS

- Occupational hazards
- Ordinary use only
- No emergency issues considered
- Same category numbers as NFPA

HMIS—Vapor Inhalation Issue

- NFPA: 1-hour LC50 rat vapor inhalation data
- HMIS: 4-hour LC50 rat vapor inhalation data
- NFPA
 - Recommends multiplication factor of 2 to convert
 4-hour vapor inhalation data to 1-hour data
 - NFPA quote from UNECE guidelines
- HMIS—LC50 (4-hour) X 2 ≈ LC50 (1-hour)
- Enables a better apples-to-apples comparison of the two systems.

Hazard Rating	ННЕ		Gas / Va	L	or Inhala C50 ur Rat	ation		aturate	ed '	Vapor Vapor (/ LC50,				cre	t Inhala ons or le C50				LI	ral D50 Rat				L	rmal D50 ıbbit	
System		F	Ra Low	nge	e High	Units		Ra Low	nge	e High	Unit- less		Ra Low	nge	e High	Units		Ran Low		e High	Units		Ra Low		e High	Units
	4		0		1000	ppm		10	>	10			0		0.5	mg/L		0		5	mg/kg		0		40	mg/kg
	3	Τ	1001		3000	ppm		1	<	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		200	mg/kg
NFPA 704 2001	2	Τ	3001		5000	ppm		0.2	<	1			2.01		10	mg/L		50.1		500	mg/kg		201		1000	mg/kg
	1		5001		10000	ppm		0	<	0.2			10.1		200	mg/L		501		2000	mg/kg		1001		2000	mg/kg
	0	>	10000			ppm		0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000			mg/kg
		L																								
		L	4-hour F	₹at	(adj to	1-hr)	L										L		F	Rat		L	Ra	bbi	t or Ra	t
	4	<u> </u>	50			ppm (1)											≤	1			mg/kg	≤	20			mg/kg
HMIS	3	>	50		500	ppm (1)											>	1		50	mg/kg	>	20		200	mg/kg
3rd ed., 2001	2	>	500		2000	ppm (1)											>	50		500	mg/kg	>	200		1000	mg/kg
	1	>	2000		20000	ppm (1)											>	500		5000	mg/kg	>	1000		2000	mg/kg
	0	>	20000			ppm (1)											>	5000			mg/kg	>	2000			mg/kg

HMIS \rightarrow 4, 3, 2, 1, 0 (High to Low)

> Also some significant overlaps with NFPA

Hazard Rating	HHR		Gas / Va 1-l	L	or Inhala C50 ur Rat	ation	G Saturat (SVC, p	ed		Conc.		Dust / M 10 mid	cro	t Inhala ons or le C50				L	ral D50 Rat				L	rmal D50 abbit	
System			Rar Low	nge	High	Units	R Low	ang	e High	Unit- less		Rar Low	nge	e High	Units		Ran Low	ige	e High	Units		Ra Low	ngi	e High	Units
	4		0		1000	ppm	10	>	10			0		0.5	mg/L		0		5	mg/kg		0		40	mg/kg
	3		1001		3000	ppm	1	<	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		200	mg/kg
NFPA 704 2001	2	Г	3001		5000	ppm	0.2	<	1			2.01		10	mg/L		50.1		500	mg/kg		201		1000	mg/kg
	1		5001		10000	ppm	0	<	0.2			10.1		200	mg/L		501		2000	mg/kg		1001		2000	mg/kg
	0	>	10000			ppm	0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000			mg/kg
		L																_							
		4	l-hour R	lat	(adj to			+										-	Rat		L	Ra	bb	it or Ra	t
	4	≤	50			ppm (1)										≤	1			mg/kg	≤	20			mg/kg
HMIS	3	>	50		500	ppm										>	1		50	mg/kg	>	20		200	mg/kg
3rd ed., 2001	2	>	500		2000	ppm 71)										>	50		500	mg/kg	>	200		1000	mg/kg
	1	>	2000		20000	ppm (1)										>	500		5000	mg/kg	>	1000		2000	mg/kg
	0	>	20000			ppm (1)										>	5000			mg/kg	>	2000			mg/kg

Category OVERLAPS—Gas / Vapor Inhalation

- > HMIS 4 & 3 entirely within NFPA 4 → Non-Critical
- ➤ HMIS 2 somewhat similar to NFPA 3 → CRITICAL
- ➤ Using only HMIS 2 cat. number → FALSE screen-OUT possible

Hazard Rating	HHR	Range						ırate	d١	Vapor Vapor (/ LC50,				cro	t Inhala ons or le C50				L)ral D50 Rat				L	rmal D50 ıbbit	
System			Ran Low		High	Units	Lov	Ra	nge		Unit- less		Rai Low		e High	Units		Rar Low	nge	e High	Units	L	Ra Low	nge	e High	Units
			LOW		riigii			**		riigii	iess		LOW		riigii			LOW		riigii			LOW		riigii	
	4		0		1000	ppm		10	>	10			0		0.5	mg/L		0		5	mg/kg		0		40	mg/kg
	3		100		3000	ppm		1	<	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		200	mg/kg
NFPA 704 2001	2		3001		J 000	ppm	C	0.2	<	1			2.01		10	mg/L		50.1		500	mg/kg		201		1000	mg/kg
	1		5001		10000	ppm		0	<	0.2			10.1		200	mg/L		501		2000	mg/kg		1001		2000	mg/kg
	0	>	10000			ppm		0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000			mg/kg
		L	-hour R	- •	(adi ta	1 be)													_	Rat			Do	la la i	t or Ra	
	4		50 S	at	(auj to	ppm	+		Н								,	1		sat		,	20	וממ	t or Ka	
	4	≤	50			(1)											≤	'			mg/kg	≤	20			mg/kg
HMIS	3	>	50		500	ppm (1)											>	1		50	mg/kg	>	20		200	mg/kg
3rd ed., 2001	2	>	50 ₃		2000	ppm (1)											>	50		500	mg/kg	>	200		1000	mg/kg
	1	7	2000		20000	ppm (1)											>	500		5000	mg/kg	>	1000		2000	mg/kg
	0	>	20000			ppm (1)											>	5000			mg/kg	>	2000			mg/kg

CRITICAL OVERLAPS—Gas / Vapor Inhalation

- > HMIS 2 & 1 → NFPA 3 & 2
- > FALSE Screen-OUT possible

Hazard Rating	HHR			L	or Inhala C50 ur Rat	ation		ted	/ Vapor Vapor (/ LC50,	Conc.		Dust / N 10 mi	cro	t Inhala ons or lo C50				L	ral D50 Rat				L	rmal D50 ıbbit	
System			Rai Low	nge	e High	Units	Low	ang	e High	Unit- less		Ra Low	nge	e High	Units	F	Ra Low	nge	e High	Units		Ra Low	nge	e High	Units
														Ţ.											
	4		D		1000	ppm	10	>	10			0		0.5	mg/L		0		5	mg/kg		0		40	mg/kg
	3		1001		3000	ppm	1	<	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		200	mg/kg
NFPA 704 2001	2		3001		5000	ppm	0.2	<	1			2.01		10	mg/L		50.1		500	mg/kg		201		1000	mg/kg
	1		5001		10000	ppm	0	<	0.2			10.1		200	mg/L		501		2000	mg/kg		1001		2000	mg/kg
	0	>	10000			ppm	0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000			mg/kg
<u> </u>		_		L.		4		_								L		L,							
		4		tat	(adj to	_		+										<u> </u>	Rat	<u> </u>			bb	t or Ra	
	4	≤	50			ppm (1)									<u>(</u>	≤	1	N		mg/k j	≤	20	W.		mg/kg
HMIS	3	>	FC,		500	ррт (1)										>	1	7	50	mg/k	>	20		200	mg/kg
3rd ed., 2001	2		500		2000	ppm (1)										>	50		500	mg/kg	>	200		1000	mg/kg
	1	^	2000		20000	ppm (1)										>	500		5000	mg/kg	>	1000		2000	mg/kg
	0	>	20000			ppm (1)										>	5000			mg/kg	>	2000			mg/kg

NON-CRITICAL OVERLAPS

- > HMIS 3 & 2 → NFPA 4 & 3
 - Gas / Vapor Inhalation
- > HMIS 4 & 3 → NFPA 4 & 3
 - Oral LD50, Dermal LD50

Hazard Rating	HHR			L(r Inhala 250 ur Rat	ation	G Satura (SVC, p	tec	dν				Dust / M 10 mie	cro	t Inhala ons or lo C50				L)ral D50 Rat				L	rmal D50 abbit	
System			Ran Low		High	Units	Low	lan	ige H	High	Unit- less		Rar Low		e High	Units	H	Rar Low		e High	Units		Ra Low	ngi	e High	Units
	4		0		1000	ppm	10		>	10			0		0.5	mg/L		0		5	mg/kg		0		40	mg/kg
	3		1001		3000	ppm	1		<	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		200	mg/kg
NFPA 704 2001	2		3001		5000	ppm	0.2		<	1			2.01		10	mg/L		50.1		500	mg/kg		201		1000	mg/kg
	1		5001		10000	r _e m	0		<	0.2			10.1		200	mg/L		5P (2000	ng/kg		1001		2000	mg/kg
	0	×	10000			ppm	0		<	0.2		>	200			mg/L	7	2000			mg/kg	>	2000			mg/kg
		4	-hour Ra	at	(adj to			\perp	\perp								L		-	Rat		L	Ra	bb	it or Ra	t
	4	≤	50			ppm (1)											≤	1			mg/kg	≤	20			mg/kg
HMIS	3	>	50		500	ppm (1)											>	1		50	mg/kg	>	20		200	mg/kg
3rd ed., 2001	2	>	500		2000	ppm (1)											>	50		500	mg/kg	>	200		1000	mg/kg
	1	>	2000		20000	pr n (1)											>	55J		5000	mg/kg	>	1000		2000	mg/kg
	0		20000			ppm (1)											1	5000			mg/kg	>	2000			mg/kg

More NON-CRITICAL OVERLAPS—Gas / Vapor Inhalation, Oral LD50

➤ HMIS 1 & 0 → NFPA 1 & 0

Hazard		Gas / Vapor Inhala LC50	ation	Saturate	ed V		Conc.	ı	Dust / M 10 mic	cro	ns or le					ral 050					rmal D50	
Rating	HHR	1-hour Rat		(SVC, pp	om /	LC50,	ppm)			L	C50				F	lat					ıbbit	
System		Range	Units	Ra	ange		Unit-		Rar			Units		Rar			Units		Ra	nge		Units
		Low High	OIIIIS	Low		High	less		Low		High	Ollits		Low		High	Ollits		Low		High	Offics
	4	0 1000	ppm	10	>	10			0		0.5	mg/L		P		5	mg/kg		0		40	mg/kg
	3	100	ppm	1	<	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		∠00	mg/kg
NFPA 704 2001	2	3001 5000	ppm	0.2	<	1			2.01		10	mg/L		50.1		500	mg/kg		201		1000	mg/kg
	1	5001 10000	rµm	0	<	0.2			10.1		200	mg/L		5P1		2000	ng/kg		1001		2000	mg/kg
	0	> 10000	ppm	0	<	0.2		>	200			mg/L	7	2000			mg/kg	>	2000			mg/kg
													Ľ									
		4-hour Rat (adj to	1-hr)		\perp										F	lat			Ra	bbi	t or Ra	ıt
	4	≤ 50	ppm (1)										_≤	1			mg/k ہ	≤	20	Ĺ		mg/kg
HMIS	3	> FC 500	ppm									\	>			50	mg/k	>	20		200	mg/kg
3rd ed., 2001	2	502 2000	ρ pm 71)										>	50		500	mg/kg	>	200		1000	mg/kg
	1	2000 20000	pr n (1)						_				>	550		5000	mg/kg	>	1000		2000	mg/kg
	0	20000	ppm (1)										1	5000			mg/kg	>	2000			mg/kg

SUMMARY

- ➤ Category Overlaps → FALSE Screen-OUT possible
- ➤ CRITICAL Overlaps → FALSE Screen-OUT possible
- > Non-Critical overlaps

SAX

- Broad Overview of Chemical Hazard
- Only 3 hazard category numbers: 3, 2, 1
- Only ONE number assigned for all hazards
- Highest Hazard
 - -toxic OR fire OR explosive OR reactivity
- SAX HR may NOT be based on Health

Hazard Rating	HHR			LC	r Inhala :50 ır Rat	ation		Ga aturate SVC, pp	d١			[Oust / M 10 mie	cro	Inhala ns or le C50				L)ral D50 Rat				Dermal LD50 Rabbit	
System			Rang			Units		Ra			Unit-		Rai			Units		Rai			Units		Rar		Units
		L,	Low		High	011110		Low		High	less		Low		High	011110		Low		High	011113		Low	High	011110
	4		0		1000	ppm		10	۸	10			0		0.5	mg/L		0		5	mg/kg		0	40	mg/kg
NFPA 704	3		1001		3000	ppm		1	٧	10			0.51		2	mg/L		5.01		50	mg/kg		40.1	200	mg/kg
2001	2		3001		5000	ppm		0.2	٧	1			2.01		10	mg/L		50.1		500	mg/kg		201	1000	mg/kg
	1		5001		10000	ppm		0	٧	0.2			10.1		200	mg/L		501		2000	mg/kg		1001	2000	
	0	>	10000			ppm		0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000		mg/kg
	ONE	Dar	41 111/	21	IFCT -4	TIE AT	<u></u>	L FID		- DEA	*TIV/IT	,													
	4	Ka)	ting: HIC	Эľ	E21 01	HEAL	ın	OFFIR	<u> </u>	I KEAC	, HVII	_	No	+ F	efined										
SAX	3	<	100	П		ppm							NO	1	ennea	<u> </u>	<	400						T	
11 ed., 2004	2	Ì	100	+	500	ppm						\vdash		\dashv			Ì	400		4000					
	1		500	1	5000	ppm												4000		40000					
	0			_									No	t E	efine d								· · · · · ·	'	•

 $SAX \rightarrow 3$, 2, 1 (High to Low)

> Least similar to NFPA of all systems compared

Hazard Rating	HHR			LC		ntion		Ga aturate VC, pp	d١			ſ		ro L(ns or le 250				L	ral D50 Rat)ermal LD50 Rabbit	
System			Rang Low		ligh	Units		Ra Low		e High	Unit- less		Rar Low		High	Units		Ra Low	nge	e High	Units		Rar Low	ige High	Units
				-																					
	4		0		1000	ppm		10	>	10			0		0.5	mg/L		0		5	mg/kg		0	40	mg/kg
NFPA 704	3		1001		3000	ppm		1	٧	10			0.51		2	mg/L		5.01		50	mg/kg		40.1	200	mg/kg
2001	2		3001		5000	ppm		0.2	٧	1			2.01		10	mg/L		50.1		500	mg/kg		201	1000	mg/kg
	1		5001		10000	ppm		0	٧	0.2			10.1		200	mg/L		501		2000	mg/kg		1001	2000	mg/kg
	0	>	10000			ppm		0	٧	0.2		>	200			mg/L	>	2000			mg/kg	>	2000		mg/kg
	ONE	Dat	daa Uli	_ 	ECT of	HEAL	TU	ar FID	E .	- DEAC	TIVIT	,													
	4	Ka)	ting: HIC	аПІ	E31 01	HEAL	111	or FIR	<u> </u>	I KEAC	, HVII	_	No	+ Γ	efined										
SAX	3	7	100	T		maa							110	T	eiiileu		<	400						Т	
11 ed., 2004	2		100	Ť	500	mag			\vdash			\dashv		\dashv			_	400		4000					
	1		500		5000	ppm												4000		40000					
	0		•										No	t D	efined								•	•	

Category OVERLAPS—Gas / Vapor Inhalation

- > SAX 3 entirely within NFPA 4 → Non-Critical
- ➤ SAX 2 entirely within NFPA 4 → CRITICAL
 - Using only SAX 2 number → FALSE screen-OUT possible

Hazard Rating	HHR			or Inha .C50 our Rat	ation		Ga Saturate SVC, pp	d١		Conc.	I		ro L(ns or le C50				L	ral D50 Rat)ermal LD50 Rabbit	
System			Rang Low	je High	Units	F	Ra Low		e High	Unit- less		Rar Low		High	Units		Ra Low	nge	e High	Units		Rar Low	ige High	Units
														_										
	4		0	1000	ppm		10	>	10			0		0.5	mg/L		0		5	mg/kg		0	40	mg/kg
NFPA 704	3		1001	3000	ppm		1	٧	10			0.51		2	mg/L		5.01		50	mg/kg		40.1	200	mg/kg
2001	2		3001	5000	ppm		0.2	٧	1			2.01		10	mg/L		50.1		500	mg/kg		201	1000	mg/kg
	1		5001	10000	ppm		0	<	0.2			10.1		200	mg/L		501		2000	mg/kg		1001	2000	mg/kg
	0	>	10000		ppm	L	0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000		mg/kg
	ONE	Rat	ting: HIG	HEST	f HEAL	TI	H or EIR	Εr	r REAC	TIVIT	,													
	4	l (u	ang. me	, III ST	THEAL				/I INLA		_	No	t E	efined										
SAX	3	<	100		ppm											<	400							
11 ed., 2004	2		100	500	nnm	L							\dashv				400		4000					
	0		500	5000	ppm	H						No	t C	efined			4000		40000					

More Category OVERLAPS—Gas / Vapor Inhalation

- ➤ SAX 1 overlaps NFPA 4, 3, 2 → CRITICAL
 - Using only SAX 1 number → FALSE screen-OUT possible

Hazard Rating	HHR		1-h	LC	:50 ir Rat	ntion		aturate VC, pp	d \ m	Vapor Vapor (/ LC50,	ppm)	ı	10 mi	cro L(Inhala ns or le C50			I	Oral LD50 Rat				F	ermal LD50 Rabbit	
System			Ran Low		High	Units		Ra Low		e High	Unit- less		Rai Low		e High	Units	L	Rang Low	ge Higl	<u> </u>	Units		Ran Low	ge High	Units
					Ŭ										Ŭ				Ţ					Ţ	
	4		0		1000	ppm		10	>	10			0		0.5	mg/L	Г	0	É	5	mg/kg		0	40	mg/kg
NFPA 704	3		1001		3000	ppm		1	<	10			0.51		2	mg/L		5.01	5	0	mg/kg		40.1	200	mg/kg
2001	2		3001		5000	ppm		0.2	٧	1			2.01		10	mg/L	I	50.1	50	00	mg/kg		201	1000	mg/kg
	1		5001		10000	ppm		0	٧	0.2			10.1		200	mg/L		501	20	00	mg/kg		1001	2000	mg/kg
	0	>	10000			ppm		0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000		mg/kg
	ONE	Rat	ting: HI	GE	IEST of	ΗΕΔΙ	TH	or FIR	Εσ	r RFΔ(TIVIT	_													
	4		9. 111	-			•••	31.111	_ `	. neac		_	No	t E	efined										
SAX	3	<	100			ppm											<	400							
11 ed., 2004	2		100 500		5000	ppm												4000	1.400						
	0		200		5000	ppm							No	rt E	efined			4000	400	JUU		_			

Category OVERLAPS—Oral LD50

- ➤ SAX 3 overlaps NFPA 4, 3, 2 → Non-Critical
 - Using only SAX 3 number → FALSE screen-IN possible
- ➤ SAX 2 overlaps NFPA 2, 1, 0 → Non-Critical
- > SAX 1 entirely within NFPA 0 → Non-Critical

Hazard Rating	HHR			or Inha .C50 our Rat			Ga aturate SVC, pp	d١			[Dust / M 10 mie	сго	Inhala ns or le :50				Ora LD50 Rat	0				ermal LD50 Rabbit	
System			Rang Low	je High	Units		Ra Low		e High	Unit- less		Rar Low		High	Units		Ran; Low	ge Hiç	gh	Units		Rang Low	ge High	Units
				14000		1	40		40				+	0.5			0		_				40	
	4	<u>.</u>	U	1 1000	ppm	Н	10	>	10			0	\perp	0.5	mg/L	L	0		5	mg/kg		0	40	mg/kg
NED 1 704	3		1001	3000	ppm	Г	1	<	10			0.51		2	mg/L	L	5.01		50	mg/kg		40.1	200	mg/kg
NFPA 704 2001	2		3001	5000	ppm		0.2	<	1			2.01		10	mg/L		50.1	£	500	mg/kg		201	1000	mg/kg
	1		5001	10000) ppm		0	<	0.2			10.1		200	mg/L	Į	501	21	000	mg/kg		1001	2000	mg/kg
	0	>	10000		ppm		0	<	0.2		>	200	_		mg/L	>	2000			mg/kg	2	2000		mg/kg
	ONE	Rat	ting: HIG	HEST	of HEAL	TH	l or EIR	Εø	r REAC	TIVIT	_													
	4	\C	ang. me	nie 3 i	/I IILAL		31 1 11		/I NEA	v	_	No	t D	efined							_			
SAX	3	<	100		mqq								Ĭ			<	400							
11 ed., 2004	2		100		nnm								\perp				400	4						
	0	Ц	500	5000	ppm	I _						No	t D	efined			4000	40	0000					

SUMMARY

- ➤ ANY SAX HR → could screen IN
 - If based on inhalation criteria but basis is never known
- ➤ Category Overlaps → FALSE Screen-OUT possible
 - Based on HR Category numbers ONLY → SAX 2, 1
- > Non-Critical overlaps

NFPA vs. SRS

Hazard Rating	HHR			LC50 hour R		ition	aturate VC, pp	d \ m .	Vapor Vapor (/ LC50,	ppm)	ı	10 mi	cro L(t Inhala ons or le C50				LI F	ral D50 Rat				LI Ra	rmal D50 ibbit	
System			Rar Low	nge Higl	h	Units	Ra Low		e High	Unit- less		Rar Low		e High	Units		Ran Low		e High	Units		Rai Low		e High	Units
	4		0	10	000	ppm	10	>	10			0		0.5	mg/L		0		5	mg/kg		0		40	mg/kg
	3		1001		000	ppm	1	\ \	10			0.51		2	mg/L		5.01		50	mg/kg		40.1		200	mg/kg
NFPA 704 2001	2		3001	50	000	ppm	0.2	<	1			2.01		10	mg/L		50.1		500	mg/kg		201		1000	mg/kg
	1		5001	100	000	ppm	0	<	0.2			10.1		200	mg/L		501		2000	mg/kg		1001		2000	mg/kg
	0	>	10000			ppm	0	<	0.2		>	200			mg/L	>	2000			mg/kg	>	2000			mg/kg
										"Co	ns	istent v	vit	h NFPA	704"										
SRS	4																								
DRAFT	3																								
9/11/2006	2																								
	0																								

"Consistent with NFPA 704" per SRS Draft 9/11/2006 SUMMARY

- > SRS HHR system uses identical NFPA HHR criteria
- "Comparable" to NFPA

Conclusions

- UNECE Model Regulations
 - Very similar to NFPA 4, 3, 2—no false screen-outs
- UNECE GHS
 - Several differences with NFPA—some false screen-outs
- HMIS
 - Several differences with NFPA—some false screen-outs
- SAX
 - Least similar to NFPA—several false screen-outs
- SRS
 - "Comparable" to NFPA—no false screen-outs

Comparison Summary

		NF	PA 704, 20	01	
	4	3	2	1	0
UNECE Packing Groups 14th rev ed, 2005	₩_	=	₩≡	f	
UNECE GHS 1st rev ed, 2005	1, 2	3	4	↑	5
HMIS 3rd ed, 2001	4, 3	2	-	\	0
SAX 11th ed, 2004	3, 2	1			
SRS Draft, 9/11/2006	4	3	2	1	0

= Possible FALSE Screen-OUT
= Non-critical Overlap

BOTTOM LINE:

- Except for NFPA and SRS
- None of these other systems are either approved or recommended for use in chemical screening at this time.