#### **NEAL LANGERMAN**

Advanced Chemical Safety San Diego, California, USA neal@chemical-safety.com

- OBJECTIVE:
- Present a tool for easily assessing the RISK associated with a common lab procedure
- GOALS:
- Distinguish HAZARD and RISK
- Understand personal importance of RISK ASSESSMENT
- Understand a LabRat

- **Standard Operating Procedures**
- Part of good science details of how you do the experiment
- Safety must be part of the SOP
  - Reminders to yourself about how you can get hurt
- (M)SDSs report HAZARDS not RISKS
- Protecting yourself must address RISKS not HAZARDS

#### CHEMICAL HAZARD

- INHERENT
- UNCHANGEABLE
- MECHANISM BY WHICH CHEMICAL CAN DO HARM
  - Flammable

Methanol

- Skin/Eye Corrosive
- Specific organ toxic
- HCI/NaOH Benzene, Methanol
- And more ... see GHS

- RISK = TT(frequency, severity)
- Qualitiative Scale
  - HIGH, MODERATE, LOW
    - Making, working with neutral phosphate buffer LOV
    - HPLC CH<sub>3</sub>OH/CH<sub>3</sub>CN/H<sub>2</sub>O
    - Generating vinyl lithium

LOW RISK MODERATE RIS HIGH RISK

- Control banding chemical uses in research laboratories: Hazar are placed into one of several categories, so that general control strategi appropriate for those categories may be implemented.
- Job hazard analysis: A methodical approach to document the work steps and hazards associated with each step.
- What-if analysis: An approach that raises a series of questions to he identify things that might go wrong.
- 4. Checklists: A method that tends to be more operational in that it hel researchers remember all of the precautions they are supposed to take.
- 5. **Structured development of standard operating procedures** (SOPs): A comprehensive method for evaluating various aspects of research work leading to development of SOPs.

Other:

- HAZOP (Hazard & Operability) Study
- Failure Mode and Effect Analysis (FMEA)
- Fault Tree Analysis
  - And more visit <u>www.aiche.org</u>
- Objective is a comprehensive list of hazards

### hemical Lab Safety

- **American Chemical Society** 
  - Identifying and Evaluating Hazards in Research Laboratories
  - <u>http://www.acs.org/content/acs/en/about/governance/</u> committees/chemicalsafety.html

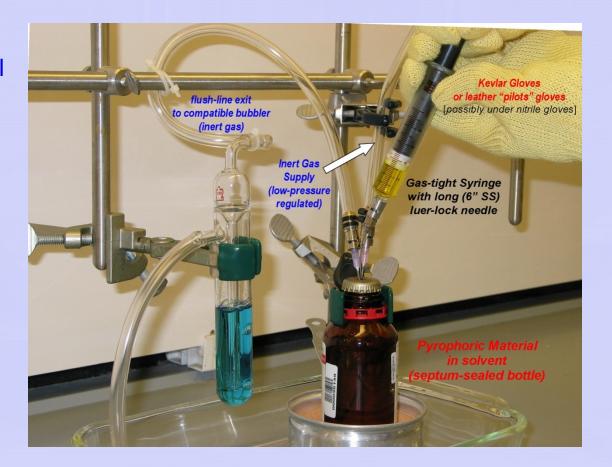




- Using a "simple" Lab Risk Assessment Tool
- LabRAT
- t-Butyl Lithium generation of Vinyl Lithium



See also Aldrich Technical Bulletin "Handling and Storage of Air-Sensitive Reagents" AL-134



#### RISK ASSESSMENT TOOL for LABORATORY PROCEDURES 1 mL transfer t-BuLi via 2 mL syringe, using S-A AL-134

Hazard RecognitionNoneRoutineExtremeFlammable01235Corrosive01235Toxic01235Cryog01235Personnel Preparedness &Pully Trained & PreparedRoutineUnder DeveProcedureDetailed & WrittenRoutineUnder DeveTraining123421245Shielding NeededHood UsedGeneral Lab OnlyNot Used02345Process ConditionsSub-ambient (P < 1 atm; T Ambient (P = 1 atm; T >Extreme	ro 0.5 Normal 2 L Large 5 L > 2 L	
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Corrosive01235Toxic Cryog enic0 $\frac{1}{2}$ 35PESPUSE UPRENT0 $\frac{3}{2}$ bub Atmospheric $\frac{4}{1}$ mospheric2 $\frac{1}{3}$ ligh PressRadiation Hazard005 $\frac{1}{2}$ $\frac{3}{4}$ $\frac{4}{5}$ Radiation Hazard:0013 $\frac{4}{5}$ $\frac{5}{2}$ Pyrophoric $\frac{1}{re}$ MinimalNormalHit012 $\frac{3}{4}$ $\frac{4}{5}$ Special Hazards:Inhalation Toxicity 05Reactive0Training12 $\frac{4}{5}$ Ventilation NeededHood UsedGeneral Lab OnlyNot Used02 $\frac{3}{4}$ $\frac{5}{5}$ Shielding NeededUsedNot UsedNot Used02 $\frac{3}{4}$ $\frac{5}{5}$ Process ConditionsSub-ambient (P < 1 atm; T	e Routine Extreme	
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Radiation Hazard       0       0       5         Minimal       Normal       Hi         Other Hazard: Specify & Sco       0       1       3       4       5         Pyrophoric $re$ Minimal       Normal       Hi         0       1       2       3       4       5         Special Hazards:       Inhalation Toxicity 0       5       Reactive       0         Procedure       Detailed & Written       Routine       Under Deve         1       2       4       5         Personnel Preparedness &       Fully Trained & Prepared       Routine       Untrained         1       2       4       5         Ventilation Needed       Hood Used       General Lab Only       Not Used         2       3       4       5         Shielding Needed       Used       5       Not Used         0       2       3       4       5         Shielding Needed       Used       5       Not Used       5         Process Conditions       Sub-ambient (P < 1 atm; T        Ambient (P = 1 atm; T >       Extreme	Atmospheric 2 High Press	ure <u>:</u>
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Pyrophoric       2       Normal       Hi         0       1       2       3       4       5         Special Hazards:       Inhalation Toxicity 0       5       Reactive       0         Special Hazards:       Inhalation Toxicity 0       5       Reactive       0         Procedure       Detailed & Written       Routine       Under Devo         1       2       4       5         Personnel Preparedness &       Fully Trained & Prepared       Routine       Untrained         Training       1       2       4       5         Ventilation Needed       Hood Used       General Lab Only       Not Used         2       3       4       5         Shielding Needed       Used       5       Not Used         0       2       5       Streme       5	Minimal Normal High	1
re     Minimal     Normal     Hi       0     1     2     3     4     5       Special Hazards:     Inhalation Toxicity 0     5     Reactive     0       Special Hazards:     Inhalation Toxicity 0     5     Reactive     0       Procedure     Detailed & Written     Routine     Under Devo       1     2     4     5       Personnel Preparedness &     Fully Trained & Prepared     Routine     Untrained       1     2     4     5       Ventilation Needed     Hood Used     General Lab Only     Not Used       2     3     4     5       Shielding Needed     Used     3     4     5       Process Conditions     Sub-ambient (P < 1 atm; T      Ambient (P = 1 atm; T >     Extreme	3 4 5	
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Procedure     Detailed & Written     Routine     Under Development       1     2     4     5       Personnel Preparedness &     Fully Trained & Prepared     Routine     Untrained       Training     1     2     4     5       Ventilation Needed     Hood Used     General Lab Only     Not Used       2     3     4     5       Shielding Needed     Used     3     4     5       Process Conditions     Sub-ambient (P < 1 atm; T		
1     2     5       Personnel Preparedness &     Fully Trained & Prepared     Routine     Untrained       Training     2     4     5       Ventilation Needed     Hood Used     General Lab Only     Not Used       2     3     4     5       Shielding Needed     Used     3     4     5       Process Conditions     Sub-ambient (P < 1 atm; T      Ambient (P = 1 atm; T >     Extreme		
I     4       Personnel Preparedness &     Fully Trained & Prepared     Routine     Untrained       Training     1     2     4     5       Ventilation Needed     Hood Used     General Lab Only     Not Used       2     3     4     5       Shielding Needed     Used     Not Used     5       0     2     5	iled & Written Routine Under Develo	pmen
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Process Conditions Sub-ambient (P < 1 atm; T < Ambient (P = 1 atm; T > Extreme	d Not Used	
	5	
$10^{\circ}$ C $10 \& < 40^{\circ}$ C)		
2  or  3 <b>2</b> 4 5	3 1 4 5	

Initial Score:

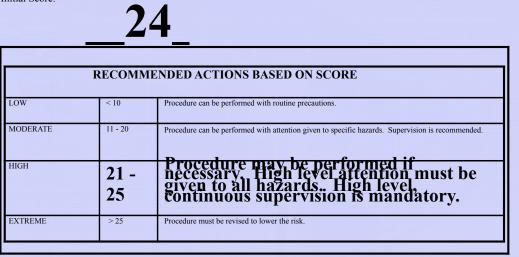


RECOMMENDED ACTIONS BASED ON SCORE					
LOW	< 10	Procedure can be performed with routine precautions.			
MODER	11 -	Procedure can be performed with attention given to specific hazards. Supervision is recommended.			
ATE	20				
HIGH	21 - 25	Procedure may be performed if necessary. High level attention must be given to all hazards. High level, continuous supervision is mandatory.			
	-	Procedure must be revised to lower the risk.			
EXTRE	> 25	riocedure must be revised to lower me fisk.			
ME					

#### **RISK ASSESSMENT TOOL for LABORATORY PROCEDURES** 53 mL transfer t-RuLi via cannula using S-A AL-134

Chemical Volume(s)	BuLi via cannula, Micro	0.5 Normal	2 L	Large
	< 0.5 L			> 2 L
	1	2 3	4	5
Hazard Recognition	None	Routine		Extreme
Flammable	0	1 2	3	5
Corrosive	0	1 2	3	5
Toxic	0	1 2	3	5
Cryog enic	0	1 2	3	5
Pressure Hazard	Sub Atmospheric	Atmospheric		High Pressure
Explosive Hazard	3	1 2		3 5
	No	Yes		
Radiation Hazard	0	5		
	Minimal	Normal		High
Other Hazard: Specify & Sco	1	3	4	5
Pyrophoric	2			
re	Minimal	Normal		High
	0 1 2	3	4	5
Special Hazards:	1     2       Inhalation Toxicity 0     5	5	4	<mark>5</mark>
		5	4	0
Special Hazards:	Inhalation Toxicity 0 5	Reactive	4	0 5
		5	4	0
Special Hazards:	Inhalation Toxicity 0 5 Detailed & Written	Reactive	4	0 5
Special Hazards: Procedure	Inhalation Toxicity 0 5 Detailed & Written 1	Reactive	4	0 5 Under Development
Special Hazards:	Inhalation Toxicity 0 5 Detailed & Written	Reactive Routine	4	0 5 Under Development
Special Hazards: Procedure	Inhalation Toxicity 0 5 Detailed & Written 1	Reactive Routine 2 4 Routine		0 5 Under Development 5 Untrained
Special Hazards: Procedure Personnel Preparedness &	Inhalation Toxicity 0 5 Detailed & Written 1	Reactive Routine	4	0 5 Under Development 5
Special Hazards: Procedure Personnel Preparedness &	Inhalation Toxicity 0 5 Detailed & Written 1 Fully Trained & Prepared	Reactive Routine 2 4 Routine		0 5 Under Development 5 Untrained
Special Hazards: Procedure Personnel Preparedness & Training	Inhalation Toxicity 0 5 Detailed & Written 1 Fully Trained & Prepared 1 Hood Used	Reactive Routine 2 4 Routine 2		0 5 Under Development 5 Untrained 5
Special Hazards: Procedure Personnel Preparedness & Training Ventilation Needed	Inhalation Toxicity 0 5 Detailed & Written 1 Fully Trained & Prepared 1 Hood Used 2	Reactive Routine 2 4 Routine 2 5 6 General Lab Only	4	0 5 Under Development 5 Untrained 5 Not Used 5
Special Hazards: Procedure Personnel Preparedness & Training	Inhalation Toxicity 0 5 Detailed & Written 1 Fully Trained & Prepared 1 Hood Used	Reactive Routine 2 4 Routine 2 5 6 General Lab Only	4	0 5 Under Development 5 Untrained 5 Not Used
Special Hazards: Procedure Personnel Preparedness & Training Ventilation Needed	Inhalation Toxicity 0 5 Detailed & Written 1 Fully Trained & Prepared 1 Hood Used 2 Used	Reactive Routine 2 4 Routine 2 5 6 General Lab Only	4	0 5 Under Development 5 Untrained 5 Not Used 5
Special Hazards: Procedure Personnel Preparedness & Training Ventilation Needed Shielding Needed	Inhalation Toxicity 0 5 Detailed & Written 1 Fully Trained & Prepared 1 Hood Used 2 Used 2 Sub-ambient (P < 1 atm; T <	Reactive Routine 2 4 Routine 2 General Lab Only 3 Ambient (P = 1 atm	4	0 5 Under Development 5 Untrained 5 Not Used 5 Not Used
Special Hazards: Procedure Personnel Preparedness & Training Ventilation Needed Shielding Needed (	Inhalation Toxicity 0 5 Detailed & Written 1 Fully Trained & Prepared 1 Hood Used 2 Used 2	Reactive Routine 2 4 Routine 2 General Lab Only 3	4	0 5 Under Development 5 Untrained 5 Not Used 5 Not Used 5

Initial Score:



Chemical	Volume or Weight

#### RISK ASSESSMENT TOOL for LABORATORY PROCEDURES 53 mL transfer t-BuLi via 60 mL syringe, per 29 Dec 2008

Chemical Volume(s) 0.5 2 L Micro Normal Large < 0.5 L > 2 L2 5 3 4 1 Hazard Recognition None Routine Extreme 5 Flammable 0 2 3 1 5 Corrosive 2 3 0 Toxic 0 2 3 5 Cryog 2 3 5 1 0 enic Pressure Hazard Sub Atmospheric Atmospheric High Pressure 0 3 2 3 5 1 Explosive Hazard No Yes 0 0 5 Radiation Hazard Minimal Normal High 0 1 2 4 5 3 Other Hazard: Specify & Score Minimal Normal High 5 Pyrophoric 0 1 2 3 4 Special Hazards: Inhalation Toxicity 0 5 Reactive 5 Procedure Development Detailed & Written Routine Under 2 4 5 Personnel Preparedness & Fully Trained & Prepared Routine Untrained Training 2 4 5 Ventilation Needed Hood Used General Lab Only Not Used 3 4 5 2 Shielding Needed Used Not Used 0 2 5 Process Conditions Sub-ambient (P < 1 atm; T < Ambient (P = 1 atm; T >Extreme 10°C  $10 \& < 40^{\circ}C$ 4 2 or 3 5 2

Initial Score:



RECOMMENDED ACTIONS BASED ON SCORE				
LOW	< 10	Procedure can be performed with routine precautions.		
MODERATE	11 - 20	Procedure can be performed with attention given to specific hazards. Supervision is recommended.		
HIGH If score is > 25, risk reduction	21 - 25 actions should be id	Procedure may be performed if necessary. High level attention must be given to all hazards. High level, continuous supervision is mandatory. entitled and implemented.		
EXTREME	> 25	Procedure must be revised to lower the risk		

ist Chemicals Used	
Chemical	Volume or Weight

- LabRAT is effective
- LabRAT is easy to learn and to teach
- LabRAT is available at
- http://chemical-safety.com/documents/pdf/LABRAT-all.pdf
- Or email neal@chemical-safety.com

Safe Research enhances excellent research

