

Both the federal and state governments require that employers provide information to their employees (and students) information about the potential hazards in the work place. This means that employees and students must have access to information about the hazards of any chemicals with which they are working. In Chem 221 or Chem 226, we go beyond the Right to Know and state that all students are **Required to Know** the hazards of all chemicals which they use or synthesize.

All chemical manufactures and suppliers are required to supply a Material Safety Data Sheet (MSDS) with any chemical sold. The content of these sheets contain a bewildering amount of technical information, much more than is needed or useful to a student conducting an experiment. The salient points are described of a MSDS are described on pages 9 & 10 of Pavia.

Efforts to reduce this information to a more useful and readily accessible form have taken several paths. The National Fireman's Protective Association (**NFPA**) has ranked hundreds of chemicals according to their **acute health, fire, and reactivity** hazards. A numerical ranking scheme from 0 (minimal risk) to 4 (extreme risk) is used to evaluate a chemical in each of these areas. This information is contained in a multi-colored diamond that appears near the entrances of this and many other buildings (see attached sheet). This information is also included on the manufacturer's MSDS.

J. T. Baker, a manufacturer and supplier of thousands of chemicals, has extended this ranking scheme to include both **acute and chronic health, fire, reactivity and contact** hazards. It is called the **Saf-T-Data** ranking. Again a numerical ranking from 0 to 4 is given in each category. These Baker hazard ratings are included on the labels of all chemicals sold by J. T. Baker.

Recently, a set of **risk and safety phrases** have been established and required for chemicals sold in Europe and internationally. These Risk Phrases are numbered and are often included with the Manufactures MSDS. A similar list of Safety Phrases is also required. Both of these lists are appended to this handout.

Here is an example of how these various ranking schemes are used.

Diethyl ether (a common organic solvent) has ...

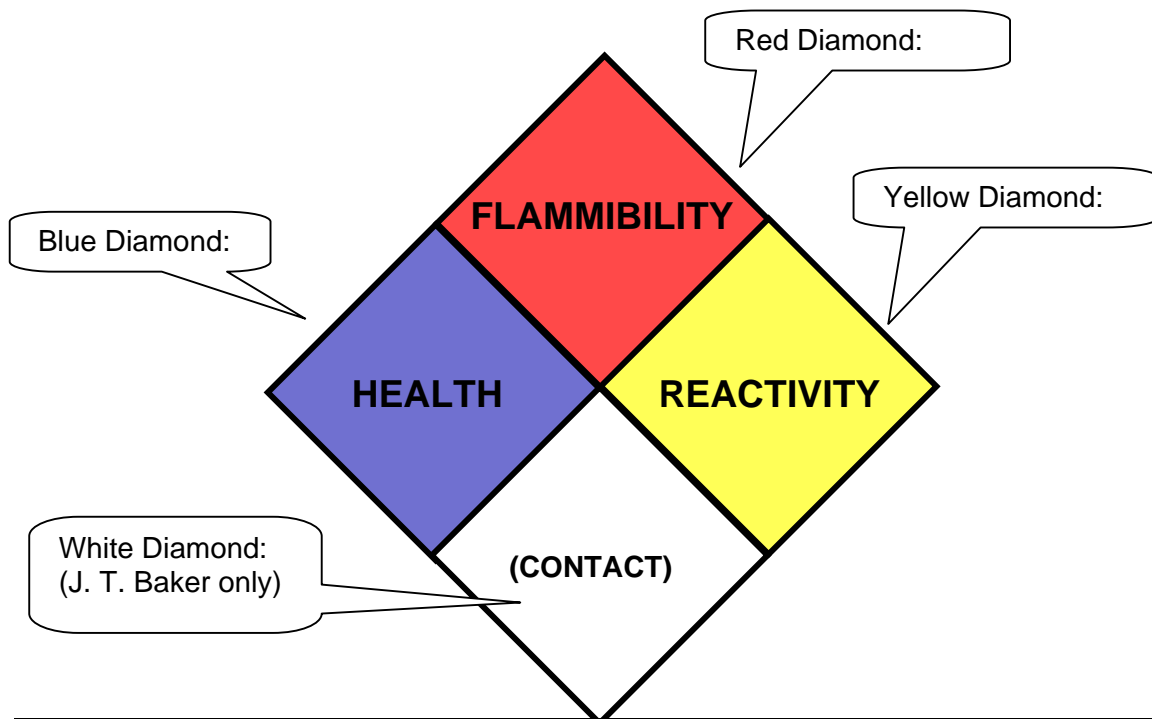
**NFPA Ratings:** Health: **2** Flammability: **4** Reactivity: **1** ;

**Saf-T-Data Ratings:** Health: **2** Flammability: **4** Reactivity **2**: Contact **2**

**International Risk & Safety Phrases:** Risk: **12,19**: Safety: **9,16, 29, 33** (an inspection of the accompanying risk and safety lists show that R12 indicates extremely flammable and that S16 cautions to keep away from ignition sources.

In all of the labs and with all of the chemicals used in our labs, you not only have the **right to know** you also have the **duty to know** information regarding the hazards of these chemicals. In another handout regarding your laboratory record book, you will be instructed on how such information is to be recorded in your record book **prior** to starting the lab.

One last point to be made. You do not need all of the ratings made by all of the methods mentioned. Any one set of NFPA ratings, Saf-T-Data Ratings, or the Risk phrases will be sufficient. While some chemicals may be ranked by all three of these methods, others may be ranked by only one of these, and still others may not be ranked at all.



NUMBER	HEALTH	FLAMMABILITY	REACTIVITY
4	Short exposure could cause death or major residual injury even with prompt medical attention	Rapid or complete vaporization at 25°C and burns readily. Also included are finely-divided, very flammable solids.	Readily capable of detonation or explosive decomposition at 25°C and 1 atm.
3	Short exposure could cause serious temporary or residual injury even with prompt medical attention.	Liquids or solids that can be ignited under ambient temperature.	Capable of detonation but requires initiating source. Also, reagents that react with water explosively.
2	Intense or chronic exposure could cause temporary incapacitation or residual injury without prompt medical attention.	Requires moderate heat before ignition can occur.	Normally unstable; may react violently, especially with water, but does not detonate.
1	Exposure causes irritation and/ or minor residual injury without treatment.	Requires pre-heating before ignition can occur.	Normally stable; unstable at high temperature; reacts with water but not violently.
0	Not considered a health hazard	Will not burn.	Stable, even in fire; does not react with water.

# Risk Phrases

Chemical data sheets available in many countries now contain codes for certain "risk phrases", shown as R23, R45 etc. These risk phrase codes have the following meanings:

- R1 Explosive when dry.
  - R2 Risk of explosion by shock, friction, fire or other source of ignition.
  - R3 Extreme risk of explosion by shock, friction, fire or other sources of ignition.
  - R4 Forms very sensitive explosive metallic compounds.
  - R5 Heating may cause an explosion.
  - R6 Explosive with or without contact with air.
  - R7 May cause fire.
  - R8 Contact with combustible material may cause fire.
  - R9 Explosive when mixed with combustible material.
  - R10 Flammable.
  - R11 Highly flammable.
  - R12 Extremely flammable.
  - R13 Extremely flammable liquefied gas
  - R14 Reacts violently with water.
  - R15 Contact with water liberates extremely flammable gases.
  - R16 Explosive when mixed with oxidizing substances.
  - R17 Spontaneously flammable in air.
  - R18 In use, may form inflammable/explosive vapour-air mixture.
  - R19 May form explosive peroxides.
  - R20 Harmful by inhalation.
  - R21 Harmful in contact with skin.
  - R22 Harmful if swallowed.
  - R23 Toxic by inhalation.
  - R24 Toxic in contact with skin.
  - R25 Toxic if swallowed.
  - R26 Very toxic by inhalation.
  - R27 Very toxic in contact with skin.
  - R28 Very toxic if swallowed.
  - R29 Contact with water liberates toxic gas.
  - R30 Can become highly flammable in use.
  - R31 Contact with acids liberates toxic gas.
  - R32 Contact with acid liberates very toxic gas.
  - R33 Danger of cumulative effects.
  - R34 Causes burns.
  - R35 Causes severe burns.
  - R36 Irritating to eyes.
  - R37 Irritating to respiratory system.
- Page 1 of 2 Chemical Risk phrases  
6/6/2004 [http://physchem.ox.ac.uk/MSDS/risk\\_phrases.html](http://physchem.ox.ac.uk/MSDS/risk_phrases.html)
- R38 Irritating to skin.
  - R39 Danger of very serious irreversible effects.

- R40 Limited evidence of a carcinogenic effect.
- R41 Risk of serious damage to the eyes.
- R42 May cause sensitization by inhalation.
- R43 May cause sensitization by skin contact.
- R44 Risk of explosion if heated under confinement.
- R45 May cause cancer.
- R46 May cause heritable genetic damage.
- R47 May cause birth defects
- R48 Danger of serious damage to health by prolonged exposure.
- R49 May cause cancer by inhalation.
- R50 Very toxic to aquatic organisms.
- R51 Toxic to aquatic organisms.
- R52 Harmful to aquatic organisms.
- R53 May cause long-term adverse effects in the aquatic environment.
- R54 Toxic to flora.
- R55 Toxic to fauna.
- R56 Toxic to soil organisms.
- R57 Toxic to bees.
- R58 May cause long-term adverse effects in the environment.
- R59 Dangerous to the ozone layer.
- R60 May impair fertility.
- R61 May cause harm to the unborn child.
- R62 Risk of impaired fertility.
- R63 Possible risk of harm to the unborn child.
- R64 May cause harm to breastfed babies.
- R65 Harmful: may cause lung damage if swallowed.
- R66 Repeated exposure may cause skin dryness or cracking.
- R67 Vapours may cause drowsiness and dizziness.
- R68 Possible risk of irreversible effects.

It is current safety policy at Oxford University that a written COSHH assessment **must** be provided when a substance to be used has been assigned any of the risk phrases R42, R43, R45, R46, R48, R49, R60 or R61. Other hazards may also dictate the preparation of a suitable COSHH assessment.

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This information was last updated on October 28, 2003. We have tried to make it as accurate and useful as possible, but can take no responsibility for its use, misuse, or accuracy. We have not verified this information, and cannot guarantee that it is up-to-date.

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6/6/2004 [http://physchem.ox.ac.uk/MSDS/risk\\_phrases.html](http://physchem.ox.ac.uk/MSDS/risk_phrases.html)

| **Safety Phrases** | **References** |

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## **INTERNATIONAL SAFETY PHRASES**

**A2.1 Safety phrases (S-Phrases) provide information on safe storage, handling and personal protection**

**A2.2**

**The most appropriate safety phrases from EEC Council Directive 67/548/EEC 14 and amended Directives to 91/325/EEC 15 should be selected in accordance with the criteria listed in this appendix.**

**Relevant safety directions from the SUSDP 2 may also be used where no appropriate European Communities safety phrase can be identified.**

**Other safety phrases may only be used for risk situations not covered by this appendix or the SUSDP 2.**

**A2.3 S10, S11, S19, S31 and S32 from the European Communities are not recommended for use in Australia.**

**A2.4 The relevant safety phrases which should be used are as follows:**

### **Safety Phrases**

S1 Keep locked up.

S2 Keep out of reach of children.

S3 Keep in a cool place.

S4 Keep away from living quarters.

S5 Keep contents under ... [appropriate material to be specified by the manufacturer].

S6 Keep under ... [inert gas to be specified by the manufacturer].

S7 Keep container tightly closed.

S8 Keep container dry.

S9 Keep container in a well ventilated place.

S12 Do not keep the container sealed.

S13 Keep away from food, drink and animal feeding stuffs.

S14 Keep away from ... [incompatible materials to be specified by the manufacturer].

S15 Keep away from heat.

S16 Keep away from sources of ignition - No smoking.

S17 Keep away from combustible material.

S18 Handle and open container with care.

S20 When using, do not eat or drink.

S21 When using, do not smoke.

S22 Do not breathe dust.

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**6/6/2004 <http://www.minerals.csiro.au/safety/toolkit/IntlSafetyPhrases.htm>**

**S23 Do not breathe gas/fumes/vapour/spray [appropriate wording to be specified by the manufacturer].**

S24 Avoid contact with skin.

S25 Avoid contact with eyes.

S29 Do not empty into drains.

S30 Never add water to this product.

S33 Take precautionary measures against static discharges.

S34 Avoid shock and friction.

S35 This material and its container must be disposed of in a safe way.

S36 Wear suitable protective clothing.

S37 Wear suitable gloves.

S38 In case of insufficient ventilation, wear suitable respiratory equipment.

S39 Wear eye/face protection.

S40 To clean the floor and all objects contaminated by this material, use ... [material to be specified by the manufacturer].

S41 In case of fire and/or explosion, do not breathe fumes.

S42 During fumigation/spraying, wear suitable respiratory equipment [appropriate wording to be specified by the manufacturer].

S43 In case of fire use ... [manufacturer to specify the precise type of firefighting equipment. If water increases the risk, add - Never use water].

S47 Keep at temperature not exceeding ... [to be specified by the manufacturer].

S48 Keep wetted with ... [appropriate material to be specified by the manufacturer].

S 49 Keep only in the original container.

S 50 Do not mix with ... [incompatible materials to be specified by the manufacturer].

S 51 Use only in well ventilated areas.

S 52 Not recommended for interior use on large surface areas.

S 53 Avoid exposure - obtain special instructions before use.

## **References**

2. National Health and Medical Research Council, Standard for the Uniform Scheduling of Drugs and Poisons, Australian Government Publishing Service, Canberra, 1992.

14.

EEC Council Directive 67/548/EEC on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances, Official Journal of the European Communities, No. L 196 (16 August 1967).

15.

EEC Council Directive 91/325/EEC adapting to technical progress for the 13th time EEC Council Directive 67/548/EEC on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances, Official Journal of the European Communities, No.L180 (8 July 1991).