CSIR - Indian Institute of Petroleum, Dehradun

Laboratory Safety Rules and First Aid Measure

GENERAL RULES

1. Working alone in the laboratory is strictly not allowed.

2. Do work in the laboratory during working hours as per instructions by your supervisor / laboratory in-charge.

3. **No one is allowed to work alone in the laboratory beyond the working hours and during holidays**. However, if needed, permission to work in the laboratory has to taken in advances from Head of Area / Head of Division and copy of same has to be sent to Security for their awareness.

4. Use common sense and do not rush in the laboratory. Never be complacent about chemicals or chemical reactions.

5. **You must wear lab coat and safety goggle at all times in the laboratory. You are responsible for your lab coat and safety goggle.**

6. When you are using gloves and working in the laboratory, don't touch switches, door latches, computer keyboards, even your own laptop and bags. Gloves may contaminate common / public items.

7. **Face shield must be worn, if needed.**

8. **Use mask as per the instruction, when working with toxic and volatile chemicals / reagents.**

9. You must be covered continuously from shoulders to below the knees and must wear shoes that cover your feet. Bare feet, sandals, shorts, sleeveless shirts, short shirts, and short skirts are **UNSAFE** and must not be worn in laboratory. For fire safety, flammable materials, loose clothes and neck ties should not be worn, and long hair should be tied back. Full coverage by (cotton) clothing and leather shoes offers the best protection against chemical spills and fire.

10. **Everyone should know the location and operation of the laboratory safety equipment**. This includes the eye wash, fire extinguishers, deluge shower, and fire blanket.

11. **Keep your work space clean and tidy**. The working space, desk drawers, cabinets, and instruments must be kept neat and clean at all times. If you have any issue related to work place and equipment (minor / major), please discuss with laboratory in-charge / your supervisor.

12. **Please don't entertain any outside person in the laboratory, unless he/she has been allowed / permitted from Head of Area / Head of Division**. **Please make ensure that person from outside will not use any equipment as well not allowed to take any snaps / photographs as per the instruction from the Director, CSIR-IIP.**

13. **Ensure an uninterrupted water supply before you start your experiment**. If needed, please send water supply request to ESD for the same.

14. Do not carry out any non-instructed and / or unauthorized experiment.

15. When lab work is completed, all materials must be returned to their proper places and the working benches, instruments and glassware must be cleaned up.

16. Many chemicals are toxic and/or corrosive. Chemical reagents require careful handling. Therefore, it is mandatory to strictly follow-up handling and safety instructions. Please be aware of symbols, descriptions and codes of safety, risk and hazardousness of

chemicals. **Some of symbols and codes are provided in Annexure I. S- and R- Phrases are provided in Annexure IV.**

17. Be familiar with the following terminologies and their effects.

    FLAMMABLE : They burn.

    IRRITANTS : They irritate eyes, lungs and skin.

    TOXIC : They are poisonous, effective either the short or long term.

    CARCINOGENIC: They cause cancer.

    TERATOGENIC: They cause defects in the unborn fetus.

    MUTAGENIC : They cause genetic mutations.

    EXPLOSIVE : They explode, usually on being mixed with air.

    CORROSIVE : They burn the eyes, lungs and skin.

18. **Read the label twice and understand the meaning of given safety and risk codes on chemical bottle before taking any chemical / reagent.**

19. Take the exact amount of reagent indicated. Larger amounts will not be more effective and may lead to uncontrollable reactions.

20. Never return unused chemicals to stock bottles. Dispose properly.

21. Do not taste or ingest any chemical in the laboratory. Do not keep food or drink items at your laboratory working bench. It may get contaminate with chemicals and be unsafe. For the same reason, you shouldn't bring food or drink items into the laboratory (except in seating room). Laboratory chemicals that may have toxic properties dissolve in foods, or beverages in the laboratory.

22. Do not use laboratory equipment such as electric / microwave oven and refrigerator to keep any eatable and drinkable items.

23. Do not work under any condition that you believe to be unsafe for you or others.

24. Equipment should be performed only for its intended purpose.

25. Bringing any chemicals / glassware / goggles out of the laboratory for personal use will not be tolerated.

26. **Never use laboratory glassware for drinking and eating purpose**.

27. Never heat inflammable solvents, even small amounts, with or near a flame. As for refluxing or distillation, never place solvents in an open beaker. Pouring solvents in the vicinity of a flame is extremely hazardous. Use an oil bath, steam bath, water bath, heating mantle, or hot plate as a heat source whenever is required.

28. If an inflammable solvent is spilled, have all workers at the desk turn off their burners and clean it up immediately using a cloth.

29. Inflammable solvents which you may have contact with are: ether, ligroin (petroleum ether), cyclohexane, toluene, xylene, alcohols, ethyl acetate, carbon disulfide, acetone, dioxane, etc. **If in doubt about the inflammability of a solvent, assume that it is hazardous.**

30. Benzene and chlorinated solvents are toxic. In some cases, the toxic effect is cumulative. Avoid contact with the skin and inhalation of solvent vapors.

31. Corrosive substances which give off noxious fumes (e.g., bromine, acetyl chloride, benzyl chloride, phosphorus trichloride, acetic anhydride, fuming nitric and sulfuric acids, chlorosulfonic acid, benzene sulfonyl chloride, etc.) should be handled in the fume hoods. Use proper gloves. Do not spill these chemicals on yourself or on the working benches. They will cause very painful burns. Bromine is especially bad. Do not put any of these in waste cans / trash-boxes.

32. **Over the last several years a number of organic compounds have been confirmed as carcinogens and the list is steadily growing. It is best to assume that all chemicals are toxic, and possibly carcinogenic.**

33. Sodium and potassium metals react explosively with water. They are rapidly corroded by the atmosphere and should be stored in kerosene or oil. These metals should not be allowed to come into contact with the skin. They may be handled with dry filter paper or tweezers. Unused pieces of metal may be destroyed by dropping into 95% ethyl alcohol. **Avoid contact between chlorinated solvents and sodium or potassium**.

34. Do not work with a chemical above or near your face (For example, holding a beaker up to look at what is in the bottom, or filling a burette which is higher than eye-level, can result in a splash down onto your face).

35. **Never pipette by mouth**. Drawing up a liquid (e.g., into a pipet) should be done only with a rubber bulb or micropipette.

36. Do not inhale reagent fumes. Odor tests are to be made only when specifically directed to do so. Use a waving motion of your hand to bring the vapor near your nose.

37. Fume hoods must be used whenever toxic or corrosive vapors are released during the work you are doing. Work with concentrated hydrochloric, nitric, or acetic acids, or with bromine, chlorine, or hydrogen sulfide should be done only in a fume hood.

38. Alkalis are particularly corrosive. Strong bases must be handled with great caution because they attack tissues so rapidly.

39. Do not add water to a concentrated reagent, especially concentrated sulfuric acid. Keep the mixture as dilute as possible; add the reagent to water. Addition of water to concentrated sulfuric causes much heat formation and may result in splashing of this corrosive reagent.

40. Handle liquid reagent containers with care. When pouring a liquid, grasp each container properly so that drops cannot contact your fingers. When using a flexible polyethylene bottle, think first; do not pour from it or squeeze it in any manner that might result in a stream of liquid getting on you, or someone nearby.

41. Gas cylinder / bottle contents are under high pressure and are sometimes hazardous; there are special safety regulations for handling bottled gases. These include chaining bottles to prevent falling and breaking, proper ventilation to prevent injury in case of leaks and signage to indicate the potential hazards.

42. Institute is making all efforts to construct gas bank for different laboratories, hence it is advised to never keep any gas cylinder in the laboratory. Particularly, all flammable and dangerous gas cylinders should avoid keeping in the laboratory.

43. **Please be aware of standard colour code of each gas cylinder (Annexure II)**. Never accept any gas cylinder having poor or worn colour. Before, connecting gas cylinder to the line please read twice the name of gas and enters in the log book.

44. Dry all wet glassware before storing it in the given or allotted container / place.

45. If some glassware falls from you (for example), do not reach to catch it since this usually leads to getting cut.

46. Keep a cloth towel in your place for wiping your hands.

47. To insert glass tubing or a thermometer into a rubber stopper, lubricate the stopper hole with water or glycerine and insert the tubing cautiously, using a towel to protect your hands. If handled improperly glass tubing can break and become razor sharp when inserted into a stopper.

48. All broken glassware waste must be placed into the special glass disposal box placed in the laboratory and labelled with Broken Glasses.

49. Be sure that water line is turned-off at the close of laboratory.

50. Use the utility carrier for carrying the chemicals / flasks etc. from one place to another place. If needed please cover up flasks / beakers with aluminum foil / paraffin film.

51. Mercury vapor is invisible, but toxic. A broken thermometer that releases liquid mercury should be reported immediately to the laboratory in-charge. Open the windows and leave the room for 15 - 20 minutes.

52. Safety first - use common sense to avoid any accidents

53. Make sure to be in a safe position/place before helping others.

54. **Fire.** If a person's clothing catches on fire, he/she needs help. Prevent him from running. If he/she is close enough, put him/her under the safety shower because it is more effective than a blanket. If not, make him lie down and smother the flames by rolling, wrapping with lab coats, blankets, towels, etc. *Never turn a carbon dioxide extinguisher on a person.*

55. If a fire breaks out, (if time allows) turn off all burners, hotplates and remove solvents, place the chemical and equipment safely to the nearest possible table/bench, exit the building calmly.

56. There are carbon dioxide extinguishers in and around the laboratory and the positions and operation of these should be known. Point the extinguisher at the base of the flames.

57. Very small fires can be put out with a damp towel by smothering.

58. In case of emergency such as fire, personal injury due to chemicals; please ask for assistance (if effected person is unable to do same, then nearby person need to do the same immediately).

59. Doors of laboratory shouldn't be blocked by any items and shouldn't be locked permanently. Glass window of each door of laboratory / seating room shouldn't be covered / painted. Please ask the carpentry section to make a glass window in each door of laboratory and seating room.

60. All the signs / Notices for safety requirements (Annexure III) should be properly placed near the equipments and on the doors of such rooms/laboratories. The necessary safety gears must be present near the equipment and in those laboratories.

61. Report the location of the emergency with need of help; give your name, laboratory name, Division name, and lab location etc. on following emergency numbers:

Security (IIP)	: 779, 734
Security Officer (IIP)	: 779, 9897298098, 9411310821 (M)
Health Centre (IIP)	: 907, 749, 761
Dr. Lalita Bakaya, RMO	: 761 (D), 760 (R), 9412992523 (M)
Dr. Ghanshyam Thakkar, RMO	: 749 (D), 8265973476 (M)
Ambulance (IIP)	: 761, 907
Fire section (IIP)	: 826
Ambulance (External)	: 108
CMI Hospital (Emergency)	: 2520044
Electric sub-station (IIP)	: 713, 740
Dr. O.P. Khatri	: 767 (O), 9412050551 (M)
Dr. Umesh Kumar	: 788 (O), 7579048444 (M)

62. And finally, Violations of any rule will not be tolerated.

GUIDELINES FOR HIGH PRESSURE REACTORS & PILOT-PLANTS

1. Perform high-pressure operations only in special chambers equipped for the purpose.

2. Commercially available high pressure reactor vessels are designed and manufactured to ensure safe operation when used within the temperature and pressure limits for which they are rated.

3. Any documentation and manuals that pertain to the reactor vessel in use must be thoroughly read and understood. However, in the end it is the user's responsibility to make sure that the selected vessel is compatible with the reagents and conditions to which it will be exposed during the experiment.

4. Select a vessel which has the capacity, pressure rating, corrosion resistance and design features that are suitable for its intended use.

5. Operate the vessel within a suitable barricade, if required.

6. Laboratory In-charge / Supervisor should provide comprehensive training to ensure that any person handling the equipment knows how to use it properly.

7. Maintain the equipment in good condition, and test periodically to ensure that the vessel is remains structurally sound.

8. Complete a hazard assessment before initiating the experiment, including assessment of any intermediates, side-products and products that may form and their behavior within the vessel, including their corrosive nature and their tendency to violently decompose at elevated temperature and pressure.

9. Determination of maximum temperature and pressure limits expected, taking into account the energetics of the reaction being conducted and any pathways that might cause the reaction to run out of control.

10. Maintain adequate ventilation. This can be achieved by installing the reactor within a fume hood, attaching tubing to the rupture disk that extends to an appropriate exhaust such as the interior of a fume hood, or by ensuring that the lab area as a whole has adequate ventilation and that the reactor is installed near an exhaust fan (in the case of larger reactors).

11. Run preliminary experiments using small quantities of reactants when starting work with new or unfamiliar materials.

12. Use appropriate safety glasses, chemical resistant gloves, a lab coat, and also a face shield for operations that present particular hazards.

13. Keep a log of usage for each vessel. Information on the log book should include temperature, pressure, reagents/solvents used, and any inspections and tests it has undergone.

14. There are a number of functional group categories whose presence within a structure is a common indication of explosive potential. Use of reagents containing these functional groups in a high pressure reactor is contraindicated. Some of these functional groups are: Metal acetylide, Amine oxide, Azide, Chlorate, Diazo and diazonium', Fulminate, N-haloamine, Hydroperoxide, Hypohalite, Nitrate, nitrite, nitro and nitroso, Ozonide, Peracid, Perchlorate, Peroxide

15. **Loading Limits**: Overloading of a pressure vessel is a significant hazard. Dangerous pressures can develop suddenly and unexpectedly when a liquid is heated in a closed vessel if adequate head-space is not available to accommodate the expansion of the liquid. This is particularly true of water and aqueous solutions, whose volume may increase up to a factor of three when heated to 374 ◦C. A vessel must never be filled to more than three-fourths of its available free space. Frequently, the maximum fill level must be reduced even more to insure safe operation. If a table of volume multipliers is available for the solvent in use, use this data to calculate to maximum allowable loading using the formula:

Max. Loading Volume = (0.9)(Vessel Volume)/Volume Multiplier at Max. Temp.

Volume multiplier tables for water can be found in "Steam Tables : Thermodynamic Properties of Water Including Vapor, Liquid, and Solid Phases/With Charts"Joseph H. Keenan, Frederick G. Keyes, Philip G. Hill , Joan G. Moore, Krieger Pub Co, 1992, as well as in the Parr Instrument Company document No. 230M: "Safety in the Operation of Laboratory Reactors and Pressure Vessels".

16. **Limitations of the Material of Construction**: Pressure vessels of identical design but of differing materials of construction will have vastly different pressure and temperature limits, as well as differing corrosion resistance towards solvents and reagents (acids and bases in particular). The material of construction of the vessel must be known and its limitations understood before initiating an experiment. For commercial reactor vessels, the user's manual and other documentation is an excellent resource for this information.

Points to be insured before switching on any pressurised unit

Step	Action Point	Check List
1.	Make sure all gases cylinders as well as gas regulators are closed	
2.	Switch On the Exhaust system	
3.	Switch on the gas detectors	
4.	Start recording the observations hourly in Log – Book	
5.	Switch on the reactor setup i.e. PC and Control Unit	
6.	Reduce the set points of Temperature controllers to ambient temperature. i.e. 25 oC	
7.	Switch on the three phase supply to the furnace / heaters	
8.	Open the gas cylinders and slowly regulate the pressure in the secondary gauge of the gas regulator	
9.	Check for gas leakage in the unit (10% above the reaction pressure before start-up using N2 /any other inert gas	
10.	Check if all the Pressure safety release valves and Pressure safety seals are in place and their exhaust is connected to the	

	vent outside the laboratory	
11.	Check for trip alarm set points for both temperature and pressure raise to 5 % of your reaction temperatures and pressures	
12.	Trace the reaction media flow manually and make sure that no closed valve/interruption in the flow.	
13.	Now start the feed input into the reactor, i.e. switch on the liquid pump and gas Mass Flow Controller (gMFC).	
14.	Raise the reading of the liquid pump and gMFC gradually to prevent sudden shocks to the system	
15.	Once the desired flow is achieved, raise the reactor temperature and pressure gradually in ramps to the desired reaction temperature and pressure.	
16.	In case of Batch reactors – Please make sure of the loading limits as per the procedure given below. A reactor setup should never be loaded to ¾ th of its original empty volume	

FIRST AID MEASURES

1. Wear safety goggles at all times in the laboratory. (Eyes are very susceptible to chemical injury and must be fully protected all the time. Even when you are not working, a person nearby may be carrying out a chemical procedure that might affect you).

2. If a chemical splashes into your eye, get help immediately. Shout out, "I have chemical in my eye!".....Seconds count! Immediate removal of the chemical is necessary to prevent possible damage to the eye.

3. If someone nearby gets a chemical in his/her eye, you should: (1) shout for help from the lab members, (2) provide help. A person who has just gotten a chemical in his/her eye usually is frightened, confused, and may be unable to help himself/herself.

4. Wash the eye thoroughly with a stream of water or any other water source. Hold the eyelids open. After thorough washing (15 minutes is the recommended time) the affected person must be taken to Health Centre or call to Doctor in the case of emergency.

5. **Contact lenses should not be worn in the laboratory.** (All types of contact lenses may trap a chemical vapours and cause permanent eye damage. Check with your instructor if needed)

6. Do not apply a burn ointment. If the *chemical is spilled in the eye*, it should immediately be washed out thoroughly with water using the eyewash. Notify an assistant immediately and ask for help.

7. Any chemical that comes in the contact with your skin should be washed off immediately and the skin should be flooded with water for several minutes. Bromine should be washed off with water and the skin then massaged with ethanol or glycerine.

8. **Do not touch your face or rub your eyes after handling chemicals**; wash your hands after handling chemicals; always wash your hands before leaving the laboratory. Even after removing gloves, you should wash your hand carefully.

9. Proceed cautiously when handling hot objects. Use a towel as a hot pad when handling hot objects. Hot glass looks just like cold glass. In case of burn, immerse in water immediately. Apply clean moist cloth or bandage. Seek medical attention if any question about treatment.

10. Immediately report any accident to your supervisor or lab in-charge no matter how minor it may seem to you. Cuts, burns, chemical burns, and inhalation or ingestion of chemicals should be treated as soon as possible by a professional medical person. We are not qualified to make medical decisions.

11. In the case of minor cuts or burns, an instructor / staff member / labmate may escort you to the Health Center for treatment, however, in case of an accident, if there is an emergency requirement; RMO must be called. Please check the list of doctors for emergency and note down there numbers as well.

12. All laboratory and sections must have First Aid box. Following items must be maintained in the First Aid box:

    - Savlon lotion
    - Cotton
    - Bandage
    - Bandaid
    - Sprit
    - Eye drop Ciplox
    - Tab Calpol
    - Tab Meftalspas (Stomacache)
    - Tab DomDT
    - Antibiotic ointment

    These items can be collected from our Health Centre.

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Laboratory Rule and Safety Instruction Form

I have read and understand the laboratory rules and safety instructions. I agree to follow these regulations when I am in the laboratory.

Name	:
Contact number and Full address (in emergency)	:
Supervisor / Head of Area	:
Laboratory Name	:
Area and Division Name	:

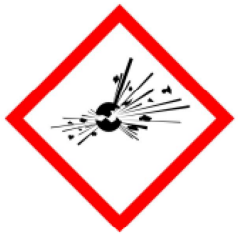
Candidate`s signature Date

Supervisor`s signature Date

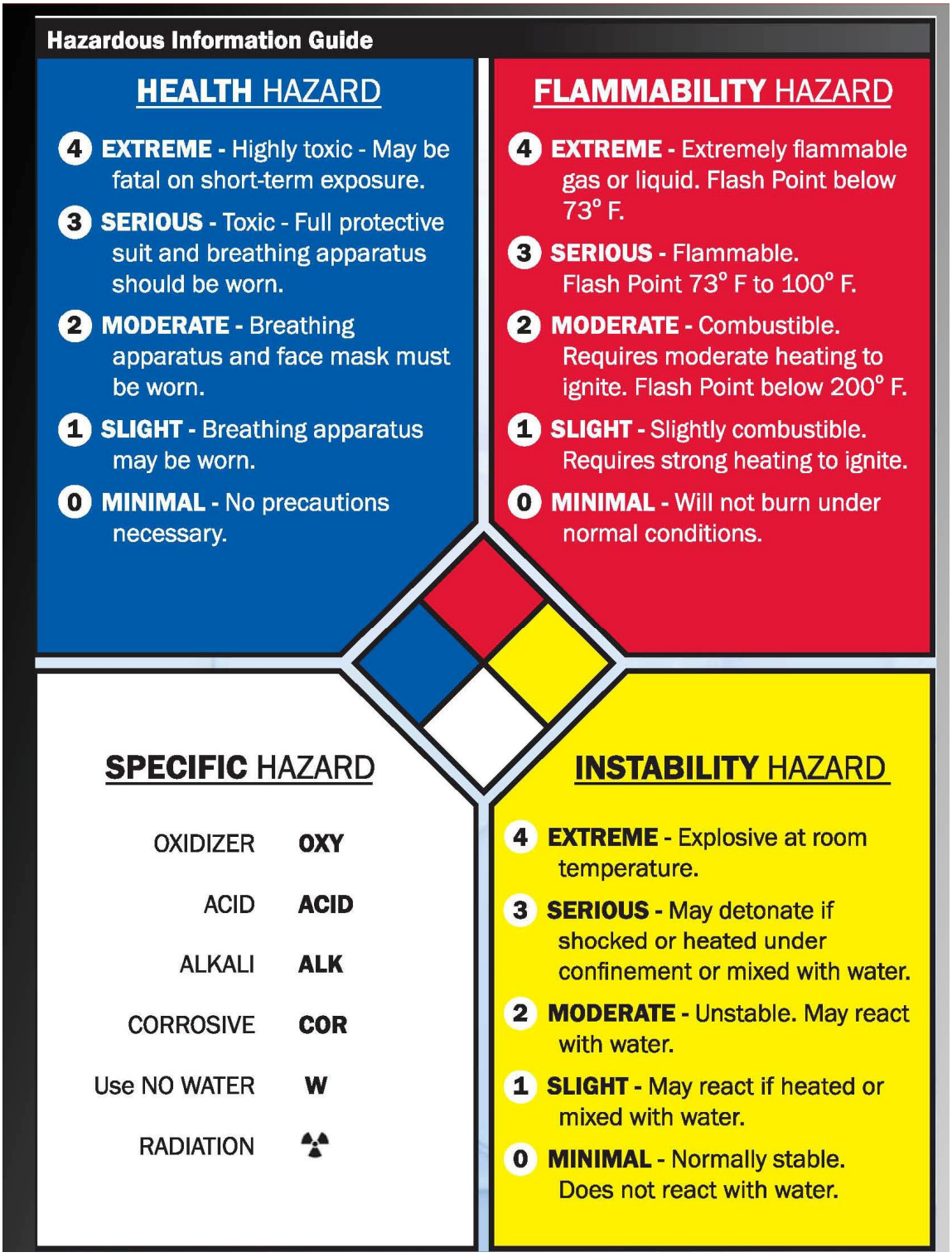
Head of Area's signature Date

Head of Division Date

Annexure I

Health Hazard	Flame	Exclamation Mark
		
• Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	• Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides	• Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (Harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non-Mandatory)
Gas Cylinder	**Corrosive**	**Exploding Bomb**
		
• Gases Under Pressure	• Skin Corrosion/Burns • Eye Damage • Corrosive to Metals	• Explosives • Self-Reactives • Organic Peroxides
Flame Over Circle	**Environment** (Non-Mandatory)	**Skull and Crossbones**
		
• Oxidizers	• Aquatic Toxicity	• Acute Toxicity (Fatal or Toxic)

Description of Hazard Categories and Rating Scale



Annexure II

COLOUR SPECIFICATIONS FOR SELECTED INDUSTRIAL GAS CYLINDERS (NON-MEDICAL)

Name of the Gas	Oxygen (O_2)	Nitrogen (N_2)	Carbon Dioxide (CO_2)	Ammonia (NH_3)	Freon 12 (CCL_2F_2)
Visual Identification					
Distinctive Colour: Body	Black	Grey	Black	Black	Bottom Grey, Neck end Violet
Band	None	Black	White	Red & Yellow	None
Pressure when fully charged at 30 deg C (approx.) Kg/sq.cm	139	139	18	11	8
Lbs/sq.cm	1980	1980	260	155	115

Name of the Gas	Argon (A)	Chlorine (CL_2)	Hydrogen (H_2)	Acetylene (C_2H_2)	LPG. Commercial Butane (C_4H_{10}) (80%)	Air
Visual Identificationt						
Distinctive Colour: Body	Blue	Yellow	Red	Maroon	Red	Grey
Band	None	None	None	None	None	None
Pressure when fully charged at 30 deg C (approx.) Kg/sq.cm	139	8	139	18	3	139
Lbs/sq.cm	1980	114	1980	250	45	1980

ACETYLENE

HELIUM

AIR

HYDROGEN

AMMONIA

NITROGEN

ARGON

NITROUS OXIDE

CARBON DIOXIDE

OXYGEN

Annexure III


CAUTION
Hazardous chemicals.
Can cause eye damage.
Wear eye protection when handling chemicals.


CAUTION
Laser in use.
Serious eye damage may occur.
Wear eye protection in this area.


CAUTION
Chemical waste storage area


CAUTION
Wear hearing protection in this area


CAUTION
Wear
mask


Wear safety
helmets


Danger
Hot
surface


FIRST AID KIT


Wear personal protective equipment


Safety helmets must be worn where appropriate
Foot protection must be worn where appropriate
Use ear protection where appropriate
Wear eye protection where appropriate
Use hand protection where appropriate
Face masks must be used where appropriate

R & S Phrases

Introduction

The so called R-Phrases give hints to special risks which may arise by the handling of hazardous substances or formulations. The letter “R” is the abbreviation for “Risk”. After the “Ordinance on Hazardous Substances”, the R-Phrases have to be selected due to the classification of a substance and used for its labelling. Selection of R-Phrases follows the same criteria of the guidelines as for the assignment of hazard symbols and hazard descriptions. R-Phrases and the combination of R-Phrases are listed in the “Ordinance on Hazardous Substances”. (See also “Legal Conditions for the Handling of Hazardous Substances” and “Technical Guidelines on Safety in Chemical Laboratory Courses”). The R-Phrases consist of one or several code letters and the related descriptions (e.g., R41: Risk of serious damage to eyes). A particular attention is given to R10 (flammable), since this category does neither have a hazard symbol nor a code letter.

The so called S-Phrases give hints to safety informations of a hazardous substance. They should enable the user to avoid risks during the handling of hazardous substances and formulations, and to take measures against the release of these substances, to control the consequences of accidents, and recommend to give first aid. The letter “S” is the abbreviation for “Safety”. After the “Ordinance on Hazardous Substances”, the S-Phrases have to be selected due the classification of a substance and used for its labelling. S-Phrases and the combination of S-Phrases are listed in the “Ordinance on Hazardous Substances”. Analogous to the R-Phrases, they consist of one or several code letters and the related descriptions (e.g., S22: Do not breathe dust).

While labelling a substance with several R&S Phrases these can be separated from each other by a hyphen (- : individual phrases) or a slash (/ : combination of phrases). Certain R-Phrases are always combined with certain S-Phrases, e.g., R45 with S53. The R&S Phrases are important parts of an operating instruction and they must be strictly followed.

In practice chemists will often be faced with the problem, that different R&S Phrases are assigned to the same substances depending on their origin (producer). The reason for this is following: The EU assigns obligatory classification and labelling for a series of substances (i.e., R&S Phrases). But for all other substances not listed by the EU, the producer has the obligation to assign the hazard symbols and R&S Phrases by himself (Council Directive 67/548/EEC of 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances). Classification is done by the EU guidelines on the basis of physical-chemical and toxicological data of the substances. In these cases, there are no standards and each producer classify his product after own test data leading to non-uniform labelling. The data base for these classifications are usually not available and the classification is, therefore, not comprehensible. It is, therefore, recommended that in case of different labelling of the manufacturers one should follow the most strongest R&S Phrases given.

R-Phrases – Hints to special risks

The separation of two R-Phrases by a hyphen (- , e.g., R12-20) means that the R-Phrases R12 **and** R20 have to be considered (and not R12 to R20). If R-Phrases are separated by a slash (/ , e.g., R26/27/28) then all three R-Phrases are indicated: R26 **and** R27 **and** R28 (combination of R-Phrases).

List of R-Phrases

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 source 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 highly flammable gases

R16: Explosive when mixed with oxidizing substances

R17: Spontaneously flammable in air

R18: In use, may form flammable/explosive vapor-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 acids 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

R38: Irritating to skin

R39: Danger of very serious irreversible effects

R40: Possible risk of irreversible effects

R41: Risk of serious damage to 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: Possible risk of impaired fertility

R63: Possible risk of harm to the unborn child

R64: May cause harm to breast-fed babies

R65 Harmful: may cause lung damage if swallowed

R66 Repeated exposure may cause skin dryness or cracking

R67 Vapors may cause drowsiness and dizziness

R68 May cause irreversible effects

Combinations of R-Phrases

R14/15:	Reacts violently with water liberating highly flammable gases
R15/29:	Contact with water liberates toxic, highly flammable gas
R20/21:	Harmful by inhalation and in contact with the skin
R20/21/22:	Harmful by inhalation, in contact with the skin and if swallowed
R20/22:	Harmful by inhalation and if swallowed
R21/22:	Harmful in contact with the skin and if swallowed
R23/24:	Toxic by inhalation and in contact with the skin
R23/24/25:	Toxic by inhalation, in contact with the skin and if swallowed

R23/25:	Toxic by inhalation and if swallowed
R24/25:	Toxic in contact with the skin and if swallowed
R26/27:	Very toxic by inhalation and in contact with the skin
R26/27/28:	Very toxic by inhalation, in contact with the skin and if swallowed
R26/28:	Very toxic by inhalation and if swallowed
R27/28:	Very toxic in contact with the skin and if swallowed
R36/37:	Irritating to eyes and respiratory system
R36/37/38:	Irritating to eyes, respiratory system and skin
R36/38:	Irritating to eyes and skin
R37/38:	Irritating to respiratory system and skin
R42/43:	May cause sensitization by inhalation and skin contact
R48/20:	Harmful: danger of serious damage to health by prolonged exposure through inhalation
R48/20/21:	Harmful: danger of serious damage to health by prolonged exposure through inhalation and in contact with the skin
R48/20/21/22:	Harmful: danger of serious damage to health by prolonged exposure through inhalation, in contact with the skin and if swallowed
R48/20/22:	Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/21:	Harmful: danger of serious damage to health by prolonged exposure in contact with skin
R48/21/22:	Harmful: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/22:	Harmful: danger of serious damage to health by prolonged exposure if swallowed
R48/23:	Toxic: danger of serious damage to health by prolonged exposure through inhalation
R48/23/24:	Toxic: danger of serious damage to health by prolonged exposure through inhalation and in contact with the skin
R48/23/24/25:	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with the skin and if swallowed
R48/23/25:	Toxic: danger of serious damage to health by prolonged exposure through inhalation and if swallowed

R48/24:	Toxic: danger of serious damage to health by prolonged exposure in contact with skin
R48/24/25:	Toxic: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/25:	Toxic: danger of serious damage to health by prolonged exposure if swallowed
R50/53:	Very toxic to aquatic organisms, may cause long term adverse effects in the aquatic environment
R51/53:	Toxic to aquatic organisms, may cause long term adverse effects in the aquatic environment
R52/53:	Harmful to aquatic organisms, may cause long term adverse effects in the aquatic environment
R68/20:	May cause irreversible effects by inhalation
R68/21:	May cause irreversible effects in contact with skin
R68/22:	May cause irreversible effects if swallowed
R68/20/21:	May cause irreversible effects by inhalation and in contact with skin
R68/20/22	May cause irreversible effects by inhalation and if swallowed
R68/21/22	May cause irreversible effects in contact with skin and if swallowed
R68/20/21/22	May cause irreversible effects by inhalation, in contact with skin and if swallowed

S-Phrases – Safety Recommendations

The separation of two S-Phrases by a hyphen (- , e.g., S10-23) means that the S-Phrases S10 **and** S20 have to be considered (and not S10 to S23). If S-Phrases are separated by a slash (/ , e.g., S36/37/38) then all three S-Phrases are indicated: S26 **and** S27 **and** S28 (combination of S-Phrases).

List of S-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 liquid to be specified by the manufacturer)

1 … water
2 … kerosene
3 … paraffin oil

S6 : Keep under.....(inert gas to be specified by the manufacturer)
1 … nitrogen
2 … argon
3 … carbon dioxide

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 feedstuffs

S14: Keep away from..... (incompatible material to be indicated by the manufacturer)
1 … reducing agents, heavy metal compounds, acids, alkaline
2 … oxidizing and acidic substances and heavy metal compounds
3 … iron
4 … water and alkaline
5 … acids
6 … alkaline
7 … metals
8 … oxidizing and acidic substances
9 … flammable organic substances
10 .. acids, reducing agents and flammable materials
11 .. flammable substances

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

S23: Do not breathe gas/fumes/vapor/spray (appropriate wording to be specified by the manufacturer)
1 … gas
2 … vapor
3 … spray
4 … fumes
5 … vapor/spray

S24: Avoid contact with the skin

S25: Avoid contact with eyes

S26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice

S27: Take off immediately all contaminated clothing

S28: After contact with skin, wash immediately with plenty of.....(to be specified by the manufacturer)
1 … water
2 … water and soap
3 … water, soap, and polyethylene glycol 400, if available
4 … polyethylene glycol 300 and ethanol (2:1), then water and soap
5 … polyethylene glycol 400
6 … polyethylene glycol 400, then cleaning with water
7 … water and acidic soap

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
1 … through treatment with 2% sodium hydroxide

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 (to be specified by the manufacturer)

S41: In case of fire and/or explosion do not breath fumes

S42: During fumigation /spraying wear suitable respiratory equipment (appropriate wording to be specified by the manufacturer)

S43: In case of fire, use....(indicate in this space the precise type of fire fighting equipment. If water increases the risk, add "never use water")
1 … water
2 … water and powder extinguishing agent
3 … powder extinguishing agent, do not use water
4 … carbon dioxide, do not use water
6 … sand, do not use water
7 … metal extinguishing agent, do not use water

8 … sand, carbon dioxide, or powder extinguishing agent, do not use water

S44: If you feel unwell, seek medical advice (show the label where possible)

S45: In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)

S46: If swallowed, seek medical advice immediately and show the container or label

S47: Keep at temperature not exceeding .... °C (to be specified by the manufacturer)

S48: Keep wetted with .... (appropriate material to be specified by the manufacturer)

S49: Keep only in the original container

S50: Do not mix with... (to be specified by the manufacturer)
1 … acids
2 … alkaline
3 … strong acids, strong alkaline, heavy metals and their salts

S51: Use only in well ventilated areas

S52: Not recommended for interior use on large surface areas

S53: Avoid exposure - obtain special instructions before use

S54: Obtain the consent of pollution control authorities before discharging to waste-water treatment plants

S55: Treat using the best available techniques before discharge into drains or the aquatic environment

S56: Do not discharge into drains or the environment, dispose to an authorised waste collection point

S57: Use appropriate containment to avoid environmental contamination

S58: To be disposed of as hazardous waste

S59: Refer to manufacturer/supplier for information on recovery/recycling

S60: This material and/or its container must be disposed of as hazardous waste

S61: Avoid release to the environment. Refer to special instructions/ material safety data sheet

S62: If swallowed, do not induce vomiting: seek medical advice immediately and show the container or label

S63: In case of accident by inhalation: remove casualty to fresh air and keep at rest

S64: If swallowed, rinse mouth with water (only if the person is conscious)

Combinations of S-Phrases

S1/2: Keep locked up and out of reach of children

S3/9: Keep in a cool, well ventilated place

S3/7/9: Keep container tightly closed in a cool, well ventilated place

S3/14: Keep in a cool place away from..... (incompatible materials to be indicated by the manufacturer)
1 … reducing agents, heavy metal compounds, acids, alkaline
2 … oxidizing and acidic substances and heavy metal compounds
3 … iron
4 … water and alkaline
5 … acids
6 … alkaline
7 … metals
8 … oxidizing and acidic substances

S3/9/14: Keep in a cool, well ventilated place away from. ..... (incompatible materials to be indicated by the manufacturer)
1 … reducing agents, heavy metal compounds, acids, alkaline
2 … oxidizing and acidic substances and heavy metal compounds
3 … iron
4 … water and alkaline
5 … acids
6 … alkaline
7 … metals
8 … oxidizing and acidic substances

S3/9/49: Keep only in the original container in a cool, well ventilated place

S3/9/14/49: Keep only in the original container in a cool, well ventilated place away from. ..... (incompatible materials to be indicated by the manufacturer)
1 … reducing agents, heavy metal compounds, acids, alkaline
2 … oxidizing and acidic substances and heavy metal compounds
3 … iron
4 … water and alkaline
5 … acids
6 … alkaline
7 … metals
8 … oxidizing and acidic substances

S3/14: Keep in a cool place away from.....(incompatible materials to be indicated by the manufacturer)

S7/8: Keep container tightly closed and dry

S7/9: Keep container tightly closed and in a well ventilated place

S7/47: Keep container tightly closed and at a temperature not exceeding ..... °C (to be specified by the manufacturer)

S20/21: When using do not eat, drink or smoke

S24/25: Avoid contact with skin and eyes

S27/28 Take off immediately all contaminated clothing. After contact with skin, wash immediately with plenty of .....(to be specified by the manufacturer)

S29/35 Do not empty into drains. This material and its container must be disposed of in a safe way.

S29/56: Do not empty into drains: dispose of this material and its container to hazardous or special waste collection point

S36/37: Wear suitable protective clothing and gloves

S36/37/39: Wear suitable protective clothing, gloves and eye/face protection

S36/39: Wear suitable protective clothing and eye/face protection

S37/39: Wear suitable gloves and eye/face protection

S47/49: Keep only in the original container at a temperature not exceeding ..... °C (to be specified by the manufacturer)