TIC Council

Petroleum and Petrochemicals Committee

Safety Code

Part 2: Laboratory Safety

FIRST EDITION

April 2023

TIC Council
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Glossary of Terms, Abbreviations and Acronyms

DRA	Dynamic Risk Assessment
EmS	IMO Emergency Procedures for Ships Carrying Dangerous Goods
ERP	Emergency Response Plan
FRA	Formal Risk Assessment
FRC	Flame Resistant Clothing
FS	Fire-hazardous Substances
GHS	Globally Harmonized System of Classification and Labeling of Chemicals
HSE	Health, Safety and Environment
IATA	International Air Transportation Association
IMDG	International Maritime Dangerous Goods
JHA	Job Hazard Assessment
LEC	Local Emergency Coordinator
PetCom	TIC Council Petroleum and Petrochemicals Committee
PPE	Personal Protective Equipment
SDS	Safety Data Sheet
SWA	Stop Work Authority

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1. Introduction

The service provided by independent laboratories to the petroleum and petrochemical industries has, inherently, a portfolio of risks that ranges from the routine type that any business should address and manage, to the very specific ones that the materials, processes, and workflow in any such facility will generate.

The TIC council members engaged in providing industry with analytical services on oil, petrochemicals, and gasses publish this document with three goals:

- To provide a baseline document that all stakeholders can refer to and that sets out broad principles and best practice guidance. It should be noted in this context that given the national and other specific legislation in force at any given location, this document does not seek to address every contingency, but rather allows the user to build the necessary specifics into a local program, including the documentation within that program.
- To set out the principles to be used by laboratory management staff when assessing, managing, and documenting risk in the laboratory.
- To encourage the staff and management of any TIC council member company to utilize appropriate training, monitoring, and corrective action tools to not only manage risk, but to proactively assess and eliminate it where possible, and where it is not, to minimize it.

This document was drafted on a cooperative basis by the working group within the TIC Council Petroleum and Petrochemicals Committee (PetCom) and represents the collective best practice and experience of the membership. It sets out in general terms the expectations of the TIC Council of member companies with respect to the safe conduct of all activities within and associated with their laboratory facilities.

The key areas of any effective safety management system, and a functional laboratory safety program are outlined in this document. Responsibility for the overall safe operation of any such facility rests with the site management, but specific roles and responsibilities should be clearly assigned within the overall system for it to be effective.

Information and lessons learned have been shared between member companies for many years and this document is built of these foundations. Should anyone have new data, advice, or lessons learned they are encouraged to share the same by submitting them via the TIC council web site at https://www.tic-council.org/contact-us. Given the sensitivity of HSE data any such submissions will be treated as confidential.

This document has been drafted and reviewed by a variety of members, but in order to ensure its continued relevance and applicability, it remains under periodic review, and revisions will be published as required. Any user should check on the website to ensure that before use, they have the most recent edition and any updates. In this context users should also check the TIC Council PetCom technical bulletins as these may be relevant to laboratory safety:
https://www.tic-council.org/publications/bulletins/petroleum-committee-bulletins

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2. Responsibilities

2.1 HSE Representative appointed

Location managers are ultimately responsible for implementing and maintaining the HSE culture. They should demonstrate that safety is a value and should convey their expectations to all their employees. They may appoint a safety officer representative for each location. Safety officers should have a clearly defined role, responsibilities, autonomy, and authority for ensuring that the HSE management system requirements are established, implemented, and maintained for all spheres of operation within the organization.

The location manager should ensure that sufficient resources are available for the effective operation of a recognized HSE management system. This should include resources for:

- Prompt rectification of HSE-related deficiencies, identified by the company or regulators;
- On-going verification that the system function is in accordance with the design intent and objectives;
- On-going training to maintain and enhance competencies;
- Accident Investigation and case management.

The location manager or delegated safety officer is responsible for the composition, maintenance, and distribution of HSE related instructions to all personnel, based on the minimum safety and environmental requirements mentioned in this code of practice and in compliance with local law and regulations.

It is the duty of each employee to comply with the company safety policy and to co-operate with the management of the company to ensure that the workplace remains as safe as possible or reasonably practical.

2.2 HSE management review

An HSE management review should be carried out with appropriate participation and minutes including HSE metrics on display.

The location manager or safety officer should maintain, communicate, and review the company's health and safety policy and evaluate HSE objectives.

Random site visits at the laboratory and related offices should be performed to verify compliance. Compliance is to be measured by metrics that probe into all aspects of the laboratory's operations and provide feedback for any preventive and corrective actions needed. Examples of laboratory metrics can be found in Annex A.

Recorded metrics are to be formally discussed at least on an annual basis. They are to be reviewed and any actions taken are to be properly documented.

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2.3 Employee Health screen

Routine medical screening and monitoring of the health of employees are valuable tools both when establishing statistical baselines and trends, and as a secondary defense to hazards. Clearly primary barriers such as engineering, administrative controls and training to establish best working practice within the workforce, including the correct use of PPE is a more fundamental control. It is highly recommended that the management of any laboratory facility consider the implementation of an employee health assessment and monitoring program. Recommended elements of surveillance found in Annex C.

3. Emergency Response Plan

Unforeseen circumstances, natural events, and other emergency situations may affect member organization employees, property, or business functionality. Organizations are encouraged to consider the following guidance for development, implementation, and review of an Emergency Response Plan (ERP).

Emergency Response Plan: ERPs can cover a broad spectrum of business functions and geographies. Member organizations should prepare individual plans for each laboratory location depending on specific challenges and situations that may affect it.

Local Emergency Coordinator: Clear leadership is necessary in an emergency situation. In drafting an Emergency Response Plan, member organizations are encouraged to include identification of a Local Emergency Coordinator (LEC) for each location laboratory, and an overall Emergency Coordinator for the organization. Along with local laboratory leadership, the LEC should assist in executing Formal Risk Assessments (FRAs), and conducting periodic, evacuation drills.

Risk Identification: FRAs, as well as risks identified during DRAs (Dynamic Risk Assessments), should be documented in the system.

Emergency Evacuation: The ERP should include procedures for emergency evacuation and Evacuation Drills addressing all the requirements of local legislation.

ERP Event Considerations: Member organizations are encouraged to perform individual FRA / Job hazard assessments (JHA) for each location. Differences in geographical location will present with different risk profiles and the ERP should reflect these.

4. Visitor safety

It is imperative that whenever visitors enter the laboratory facilities, they do so in a safe, secure, and controlled manner. All visitors must be given a simple safety briefing / orientation, during which key elements should be covered.

Site Orientation Meeting: Immediately after receiving the visitor into the facility, a Site Orientation Meeting should be conducted by the host organization. At minimum, the below should be discussed:

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- Emergency Evacuation Notification Systems (Alarms, Sirens, Strobe Lighting)
- Evacuation Muster Points/Safe Zones
- Any scheduled facility emergency drills
- Areas of restricted access/visitor observation zones
- Location of Restrooms/Personal hygiene rooms
- Situational special considerations (acute medical/allergy considerations)
- PPE instructions

Visitors must not be allowed to proceed without this briefing, without clear identification and without a member of staff to accompany them.

Visitor Entry/Exit Log: A register of visitors to the facility should be kept in case of emergency evacuation. The log should indicate the time of arrival and departure of the visitor. Records should be retained for a period of time once the visitor has left for the purpose of contact tracing in case hazard exposure is identified. This log may be written or electronic.

Visitor Personal Protective Equipment: Facility-minimum, PPE should be made available to all visitors prior to facility entry. This PPE should be worn at all times.

Visitor Identification: A uniquely colored garment, visitor badge or item should be provided to the visitor to be worn at all times to visually distinguish them at a reasonable distance.

Visitor Escort: Within the laboratory itself, or within associated restricted areas such as storge rooms, visitors should be escorted by a representative of the host organization.

5. HSE Training

5.1 Comprehensive onboarding for new employees covering all HSE issues

Before joining - recruitment is a key stage to ensure prospective employees understand the values of the company and to assess their attitudes towards HSE. Key elements are onboarding and induction, followed by ongoing training on a regular basis in accordance with company procedures and local law.

Setting a clear plan for the first weeks/months helps the employee and peers carve a learning/development path which should be tailored to the job, environment, and experience. Records of all training should be maintained.

HSE should be a key element throughout the journey and there are verification points like 1:1 meetings, test witnessing assessments, walkabouts, etc., where effectiveness of training can be assessed. Training can be delivered in many ways and should include a mix of personal on-the-job training, group exercises, distance learning/classroom type training, buddy systems, etc.

All employees are required to complete training in; general HSE awareness, fire & emergency, and manual handling/ergonomics using internal or independent training providers. Other

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training specific to job function should also be identified during induction and added to the training plan.

A training checklist should be compiled consistent with the tasks undertaken for a given employee's role. Typical elements in a checklist can be found in Annex E.

It is important that the employee understands that training is not just completing some training sessions but is a continuous process where feedback should always be sought and provided (two-way communication between employee and peer/supervisor). A key element of good safety culture is learning from these interactions and learning from their own and others' mistakes (hence the need for safety alerts, toolbox talks, etc.).

Individuals should be trained and competent in all activities they are expected to undertake. Training programs for laboratory staff including training levels should be specified and clearly defined. The training needs to be continuous, inclusive of refresher training.

6. Personal Protective Equipment

Where hazards cannot be eliminated or be effectively managed through engineering and administrative controls, appropriate personal protective equipment (PPE) should be provided and properly used. PPE is considered the last line of defense for personal protection.

6.1 Provisions

Standard PPE for eyes, face, head, body and extremities, protective clothing, respiratory devices and protective shields and barriers should be provided when stipulated within the control measures of a task, used and maintained in a sanitary and reliable condition. Nominated personnel with appropriate training should perform necessary checks to ensure that equipment is maintained as required and replaced when damaged. Employees should not be allowed to carry out tasks without proper PPE.

PPE should be provided to protect against the hazards identified by risk evaluations where exposure could cause injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact / exposure for the following hazards:

- Operational
- Environmental
- Chemical
- Radiological
- Physical
- Mechanical Irritants

6.2 Design

All personal protective equipment should be of a safe design and construction for the work to be performed. International or Country approved equipment is to be used, and applicable standards, codes, and regulations should be followed in the design and construction of protective equipment.

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Minimum protection requirements and type of protection are to be defined by PPE Hazard Assessments.

Below is a table overviewing various types of PPE and its respective application:

TYPE	APPLICATION
Protective Clothing 	Suitable clothing for the task being performed should be worn. Areas where flammable materials may be present, require Flame Resistant Clothing (FRC) to be worn as the outermost layer. Routine laboratory tasks require personnel to use laboratory coat, smock, or coverall. They are usually supplied by uniform companies, that also cleans them on a regular schedule. It should have long sleeves (which should always be worn rolled down), fasten with front closures and protect to approximately knee length. They should be made of cotton or materials such as “Nomex”, “Tybek” or equivalent. Polyester, rayon, and nylon should never be worn. Any clothing that will be taken home for cleaning should be covered by protective clothing at the workplace. In addition to the clothing use for daily work, there is additional personal equipment for routine use and emergency incidents that needs to be taken into consideration: • Acid resistant bib style aprons for use with corrosive materials, constructed from heavy-duty butyl rubber, neoprene, nitrile, or vinyl. • Vinyl, polyurethane, or neoprene one-piece coverall with attached hood for emergency operations like spill or splashes clean up, for large size laboratories. • Chemical resistant boots for emergency operations. The number of protective articles and units per laboratory is dependent upon its size and the arrangement of Emergency Response Teams. Body hazards to consider include: · Flash Fires · Extreme temperatures (heat or cold) · Splashes of molten metal or hot liquids · Sharp edges or points (puncture risk) · Material handling · Hazardous chemicals / particulates · Radiation · Visibility

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Eye and face Protection 	Protective eye and face equipment is required for all laboratory personnel and visitors in areas where there is a reasonable probability of injury. Eye and face protection should meet the following requirements: • Provide adequate protection, including side protection for most tasks. • Be reasonably comfortable. • Fit snugly and do not unduly interfere with movements. • Be durable. • Capable of being disinfected / cleaned. • Damaged glasses should be repaired or replaced. Nonprescription safety glasses with side shields are to be worn in areas requiring eye protection. Operators who wear prescription lenses will use eye protection that incorporates the prescription in its design with appropriate side shields, or wear eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses. Minimum acceptable eye protection specifications are as follows: • Impact resistant. • Flammability test passage. • Lens-retaining safety frames. The use of contact Lenses is strongly discouraged in Laboratories, as gases and vapors can concentrate under lenses causing permanent eye damage. Face shields and goggles should be used to mitigate certain hazards. Face shields need to be used in addition to safety glasses or goggles. Goggles are not intended for general use. They are intended for protection against splashes and flying particles. Examples of eye and face hazards: · Chemical splashes. · Dust. · Smoke and fumes. · Lasers / optical radiation. · Molten metal or hot liquids.

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Hearing Protection 	Hearing Protection is required in areas of with noise of 85 dBA or greater regardless of the time spent in the area. Personnel working with tools or equipment that generate noise levels of 85 dBA or greater should wear hearing protection during the time the noise is being generated.
Respiratory Protection 	To be used when the following contaminants exceed allowable exposure limits: · Particulate contaminants. · Gaseous or vapor contaminants. Air purification and ventilation in laboratories is achieved using laboratory fume hoods. Procedures performed in a well-ventilated installation, with sufficient air changes per hour do not require the use of respirators or air purifying respirators. Operators performing certain types of field work, hazardous waste disposal, and emergency spills response, may use a full-face negative pressure air purifying respirator and emergency escape respirator. These employees should be trained, and annual refresher training, medical evaluation, and fit testing are highly recommended. For certain tasks, operators may use an air-filtering face-piece respirators (dust mask) for comfort in a non-hazardous environment only.
Hand Protection 	The use of the appropriate type of gloves according to the hazard assessed is required. Gloves should be gauntlet style, made of non-absorbent materials (latex, rubber, vinyl plastic, neoprene, butyl rubber, nitrile, viton, etc.). Leather, cotton, or woolen gloves may only be used as inner liners in cold weather or as part of a thermal liner in specific circumstances. A comprehensive list of hazards should be compiled for each workplace and suitable protection provided for each hazard identified. Ensure gloves selected meet international Standards for the specific glove type. Refer to Manufacturers Glove Charts to select the proper glove for type of chemical or physical hazard identified.

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	Specialty gloves are to be worn to protect against cuts, scrapes, and exposure to extreme cold (e.g., cryogenic liquids) and excessive vibration. Examples of uses and protections can be found in Annex D.
Foot Protection 	Provide adequate protection from injury as a result of dropped / heavy objects, ankle twisting, chemicals, slips and comfortable support for the feet. Safety footwear is required in laboratories due to the different hazards met during routine operations. The required footwear will be dependent on job role and what products are being tested in a specific laboratory. Safety-toe footwear will be necessary for operators that routinely handle solid objects weighing around 15 pounds (6.8 Kg) that could fall on their toes. Leather should be avoided as petroleum products will be absorbed permanently, alternative materials should be considered, taking into account the nature of the chemicals to be exposed to and their reactivity to materials. Static-dissipative footwear needs to be used near flammable substances and explosives.

7. Emergency equipment

7.1 Laboratory showers & Eye wash stations

Laboratory showers and eye wash stations should be available on each level of the facility consistent with local law. Each emergency station should be maintained and tested on a regular basis to ensure functionality at all times. It is highly recommended that all emergency showers and eye was stations be plumbed with tepid water given the typical rinsing requirements necessitate a duration of 15 minutes.

7.2 Industrial Hygiene & air quality

Air ventilation is a tool for controlling exposure. Chemical Fume Hoods and Snorkel Exhaust Hoods are engineering controls to improve air quality thus reducing work related hazards. It is recommended that best practice be followed and total air changes per hour are between 8 and 12 times (typically a face velocity of 100 fpm/ 0.5 mps is recommended but local regulations should be checked). Ventilation rates may be higher if figures for exposure limits as defined by local legislation are exceeded.

All Fume hood types should be maintained and function properly as per the manufacturers' instructions including the statutory inspections required by local law.

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7.3 Fire Prevention

The following information is provided to help prevent laboratory fires.

Housekeeping

Chemicals, especially liquids, should never be stored on the floor, except in closed door cabinets suitable for the material to be stored. Nor should large bottles (2.5 liter or larger) be stored above the bench top.

Stored items or equipment should not block access to the fire extinguisher(s), safety equipment, or other emergency items.

Stairways, hallways, passageways/aisles and access to emergency equipment and/or exits should be kept dry and not be obstructed in any fashion, including storage, equipment, or cabling.

No combustible material such as paper, wooden boxes, pallets, etc., should be stored under stairwells or in hallways.

All containers should be labeled with at least the identity of the contents and the hazards those chemicals present to users.

Fire Extinguishers

Fire extinguishers should be of an appropriate size, type (e.g.: water, powder, CO_2), and provided in sufficient numbers consistent with the hazards assessed. Other fire counter measures such as fire blankets and fire suppression systems may be advisable consistent with the size and complexity of the facility. Laboratory personnel should be adequately trained in the use of all fire suppression equipment. Fire extinguishers should never be concealed from general view or blocked from access. All fire extinguishers should be situated in an easily accessible position.

Electrical

Electrical problems and deficiencies are one of the leading causes of lab fires so all electrical equipment should be properly grounded and enough room for work should be present in the area of breaker boxes. All circuit breakers and fuses should be labeled to indicate whether they are in the "on" or "off" position, and what appliance or room area is served. Fuses should be properly rated.

Equipment, appliance and extension cords should be in good condition.

Extension cords should not be used as a substitute for permanent wiring.

Electrical cords or other lines should not be suspended unsupported across emergency showers, overhead pipes or frames, metal racks, etc. Do not run cords through holes in walls or ceilings or through doorways or windows. Do not place under carpet, rugs, or heavy objects. Do not place cords on pathways or other areas where repeated abuse can cause deterioration of insulation.

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Multi-outlet plugs should not be used unless they have a built-in circuit breaker.

Vacuum Operations

When a vacuum is supplied by a compressor or vacuum pump to distill volatile solvents, a cold trap should be used to contain solvent vapors. Cold traps should be of sufficient capacity and low enough temperature to collect all condensable vapors present in a vacuum system. If such a trap is not used, the pump or compression exhaust should be vented to the outside using explosion-proof methods. All equipment subject to vacuum should be adequately shielded. All vacuum equipment should be used in accordance with the manufacturer's instructions.

Explosion-Proof Refrigerators

An explosion-proof refrigerator is to be used if necessary. This refrigerator is designed as such that any flammable vapors in the refrigerator do not contact sparks. This refrigerator should not be used for the storage of food. Non-explosion proof domestic refrigerators should never be used to store flammable liquids.

Flammable-Liquid Storage

The storage of flammable and combustible liquids inside buildings in general and laboratories in particular are usually governed by national and local regulations, and these always take precedence over anything contained in this safety code. Cabinets designed for the storage of flammable liquids should be properly used and maintained in accordance with the manufacturer's instructions and local law.

Compressed Gas

Compressed gases may be combustible, explosive, corrosive, poisonous, inert, or a combination of hazards. Gas cylinders should always be appropriately secured to prevent tipping and be stored in a well-ventilated area. Signs should be conspicuously posted in areas where flammable compressed gases are stored, identifying the substances and appropriate precautions. When stored outside, cylinders should be shaded from direct sunlight.

Cryogenic Liquids

Neither liquid nitrogen nor liquid CO2 should be used to cool a flammable mixture in the presence of air because oxygen can condense from the air and lead to a potentially explosive condition.

Adequate ventilation should always be used to prevent the build-up of vapors of flammable gases. It is also required when using gases such as nitrogen, helium, or hydrogen. In these cases, oxygen can be condensed out of the atmosphere creating a potential for explosive conditions.

Open Flames

Use of open flames are part of everyday operations in many labs. As well as keeping flammables away, ensure that long hair is tied back during use of a controlled flame. Never leave an open flame lit in an unattended lab.

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Doors and Corridors

Self-closing fire doors will protect the corridor and exiting system from smoke and toxic gases in the event of a lab fire. Because of this protection associated with the fire doors they should not be propped open.

Locate flammable storage cabinets away from exit routes, so an accident won't cut off your exit.

Flammable liquids are NOT permitted to be stored in corridors under ANY circumstance.

8. General housekeeping

Laboratory housekeeping is a critical part of laboratory safe operation and chemical hygiene. A key part of housekeeping is the storage of hazardous materials, and waste disposal, as well as the attendant knowledge needed to maintain safety as part of good chemical hygiene.

Spills should be cleaned and remediated at once using appropriate cleaning materials by staff wearing the required PPE.

8.1 Storage of all hazardous materials controlled

General Storage Information

Chemicals should be stored by hazard class, segregated as necessary by type, and kept in appropriate storage conditions. Appropriate guidance on storage can be obtained from government agencies and from chemical suppliers. Generally, flammable liquids should be stored with flammable liquids; oxidizers should be stored with oxidizers, and so on. It is vital to check compatibility of chemicals within broad hazard classes are there are exceptions. Chemical information, usually contained in a chemical data sheet or SDS, may list some of the chemicals hazards and incompatibilities. Incompatible or inter-reactive chemicals should be stored separated by distance or an effective barrier.

Chemicals should be stored in original containers or in appropriate secondary containers and labeled in accordance with regulation. Clear labeling with chemical name, constituents where required, and hazards promotes safe handling and prevents accidents and injury in the laboratory. Due notice should be taken of the pictograms on a label.

Hazardous chemicals should be stored at an appropriate height and accessible within a comfortable reach and should be stored on sturdy shelves or in cabinets designed to safely hold the weight of the stored chemicals. Do not overload shelves. In general, chemical storage shelving should be painted or covered with a chemical resistant paint or coating to prevent deterioration and loss of mechanical integrity of the shelving, but again detailed guidance can be obtained from government sources and/or chemical suppliers. Chemical shelving should have a containment lip on the outer edge.

Shelving or cabinets should be secured to a wall or otherwise secured to prevent toppling, especially in areas subject to seismic activity, and in accordance with regulation.

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Avoid storing chemicals under sinks or in fume hoods. Chemicals in use on bench tops or in fume hoods should have secondary containment to prevent spreading of spilled material.

When required, chemicals should be stored in refrigerators designed for laboratory operations and consistent with manufacturer recommendation. Flammable liquids and gases pose a heightened risk of fire or explosion when stored in non-laboratory grade refrigeration.

Acids and Bases Storage

Large containers should be stored on the lower shelves of chemical storage or in specially constructed resistant cabinets.

All acids should be stored away from bases and reactive or alkali metals, such as sodium, calcium, magnesium, zinc, aluminum, and potassium.

All acids should be stored away from reactive materials that release toxic gases, such as cyanides or sulfides.

Oxidizing acids should be stored away from organic acids, combustible or flammable materials.

Acids and bases should be stored in appropriate secondary containment to prevent the spreading of leaked contents. Never store strong acids and bases together.

Flammables Storage

Consult local regulations for maximum storage volumes in enclosed laboratory spaces. Do not exceed regulated volumes in storage areas.

Flammable liquids should be stored in original containers or in containers approved for storage of flammable liquids and in approved storage cabinets or in storage rooms with adequate ventilation.

Only intrinsically safe or laboratory grade refrigerators should be used to store flammable liquids or gases.

Flammable gases stored in pressure cylinders should be fitted with plugs or caps on the open ends of the cylinder valve when not in use.

Proper maintenance of pressure cylinders should be performed in accordance with regulations.

Bonding and grounding wires should be used on large or bulk containers where flammables liquids are dispensed or transferred between metal containers.

Peroxide-forming Chemicals Storage

Peroxide-forming chemicals should be stored in appropriately non-reactive tightly closed containers away from heat, and which prevent contact with air and exposure to light.

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Avoid storing peroxides or solutions of peroxides at or below the crystallization or solidification temperature of the material. Such materials are subject to violent decomposition or explosion when shocked or heated.

Peroxide-forming chemicals and peroxides that should be stored at lower temperatures should be stored only in approved refrigeration units only. Laboratory grade or explosion-proof units should be used.

Dispose of peroxide-forming chemicals prior to the expected date of peroxide formation. Where available, consult local regulations for guidance on use and storage of peroxides.

Explosive and shock sensitive chemical containers should be stored in secondary containment large enough to hold the contents of the primary storage container.

Peroxides and peroxide-forming chemicals can form crystals on container closures and other areas where spills are not remediated promptly.

Oxidizers Storage
Always confirm compatibility of oxidizers.

Oxidizers should be stored away from reducing agents (such as alkali metals), flammable chemicals, and combustible materials.

Hydro-reactive Chemical Storage
Chemicals which react with water should be stored in a cool, dry place and by compatibility with other chemicals.

Water-reactive chemicals should be identified as such and a policy set for use of appropriate fire extinguishers.

Take precautions to prevent contact with water, provide secondary containment. In the case of alkali metals stored under a hydrocarbon (such as dry petroleum distillate liquids), ensure the storage containers have adequate secondary containment and are adequately labeled according to regulation.

Toxic Chemicals Storage
Appropriate security measures should be taken to assure only authorized personnel have access to the chemicals. Always wear appropriate PPE when handling containers of toxic chemicals and ensure secondary containment is employed. Ensure proper ventilation is employed for the use and storage of toxic chemicals.

8.2 Waste disposal and recycling programs

Ensure that local regulations are understood prior to disposing of samples, analytes, reagents used in testing, or expired chemicals.

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Safety
Ensure that chemical compatibility is known prior to disposal of chemicals in a collection drain, sump, collection drum, or tank. Use segregated collection for incompatible materials.

A central collection point for waste is more easily managed in terms of security and safety. Ensure that only authorized personnel have access to the waste collection area.

Ensure that appropriate PPE is used while handling waste chemicals and materials and that waste disposal takes place in a well-ventilated area.

Record Keeping: Records may be needed for regulatory purposes and to ensure the correct management of waste.

Waste Reduction: Where possible, explore waste reduction policies in the laboratory.

9. Specific Safety Areas

9.1 Eating/drinking

Eating, drinking, smoking, and/or consumption of alcohol and similar activities are not allowed in the operational area of the laboratory premises.

The lab premises should not include any area where eating and drinking is allowed. The separate areas where food and drink are consumed are arranged outside the lab premises in a clean zone away from the workspace of the lab facility.

No vending equipment and/or coffee machines are allowed to be in the petrochemical lab where personnel are engaged in testing operations and works.

Lab coats, gloves and other PPE should be removed, and proper hygiene measures (e.g.: thoroughly cleaning hands) should be taken before entering the eating and coffee areas for all personnel.

The eating and coffee zone should be clearly and visibly marked.

9.2 Working alone

Working alone should be avoided when possible. If it cannot be avoided due to limited personnel, a suitable control measure should be taken such as a fall down alarm which automatically sends an alert call to the Response Team if the wearer suffers an incident.

Staff should be both trained and properly briefed as to the appropriate working practices to be followed when working alone or in isolated areas in order to absolutely minimize the risks. The training should include elements of raising the alarm, the availability of first aid and evacuation drills.

Resources should always be available and provided by the management in order to ensure sufficient personnel are available in the event of staff illness and injuries, subject to excessive fatigue etc.

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9.3 Slips Trips and Falls

Slips, trips and falls can happen in any workplace. The necessary precautions should be undertaken by managers and safe working practices established to ensure safety of personnel from these hazards.

Managing slips, trips and falls

The common way of preventing slips, trips and fall injuries is to develop a risk management plan which identifies, assesses, controls and monitors safety hazards and risks. Information regarding, slips, trips and falls risk management should be provided in line with both local legislation and the specific circumstances of the facility.

9.4 Glassware handling / Risk of cuts / Sharps disposal

In a laboratory, various types of glassware will be handled. Utmost care should be taken to avoid injuries. Regularly inspect glassware for chips and cracks. If any chips and cracks are discovered, the glassware should not be used. Broken glass and sharps should be disposed of in a dedicated glass container or glass disposal bin. Glass disposal bins should not be overfilled to reduce risks of injury when disposing of glass.

Appropriate PPE should be used at all times when handling glassware.

9.5 Spills

Instructions should be given on potential dangers and precautions to be taken in the instance of a spill or leak. This information can be found in the International Maritime Dangerous Goods (IMDG) Code, the IMO Emergency Procedures for Ships Carrying Dangerous Goods (EmS Guide)

Action in the event of a leakage or spillage

Recommendations on emergency action differ depending on lab layout, where the goods are stored and whether a substance is gaseous, liquid, or solid. When dealing with incidents involving flammable gases or flammable liquids, all sources of ignition (e.g., naked lights, unprotected light bulbs, electric hand tools) should be earthed.

Consideration of the hazards presented by the substance should be given including whether they are toxic, corrosive, flammable, or may produce dangerous vapors. PPE should be selected and worn in accordance with information provided by the IMDG Code and/or material safety data sheet, and may include eye protection, a dust mask and protective clothing. If the substance is a significant toxic hazard, self-contained breathing apparatus should be used.

Disposal of dangerous substances is to be done as per Emergency Plan by the authorized government organization. The spillages and leakages of substances, articles and materials identified in the IMDG Code should be collected in receptacles for safe disposal to the certified facility. Absorbent material should be used for liquids.

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9.6 Lifting and carrying / sample transferring

Lifting weights is one of the main causes of injuries due to improper form which can cause muscle strains, tears, serious back problems, joint pain, and much more. Lifting weights by practicing proper form leads to injury prevention. Follow appropriate procedures as necessary to avoid injury.

9.7 Chemical Safety & Hazardous materials handling

When working in a chemical laboratory, handling of harmful substances should be undertaken in accordance with national and international regulations.

Work with caustic and poisonous substances, as well as with organic solvents is carried out only in fume hoods.

Pipetting by mouth is forbidden.

When determining the smell of chemicals, one should sniff carefully, directing the vapors or gases to yourself with a movement of hand.

Works that may increase the pressure, overheat the glass device or break it with the splashing of hot or caustic products are also performed in fume hoods. The worker should wear the appropriate PPE.

When working with fume hoods, the sash should be raised to a height to maintain airflow while ensuring that only the hands are in the hood, and the monitoring of the process should be conducted through the hood windows if available.

Mixing or dilution of chemicals, accompanied by the release of heat, should be carried out in heat-resistant or porcelain dishes.

Under no circumstances should liquids be allowed to heat up in flasks or devices that would result in a pressure change.

A heated vessel should not be closed by a glass stopper until it reaches the ambient temperature.

Work with acids and alkalis

Work with concentrated acids and alkalis should only be carried out in a suitable fume hood using the appropriate PPE.

When acids are transported within the lab, they should be in suitable secondary containers.

Concentrated acids, alkalis, and other caustic liquids should be transferred using special siphons with a pear or other pumping means.

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For the preparation of solutions of acids, they should be poured into water in a thin stream with continuous stirring. For this purpose, heat-resistant dishes are used since the dissolution process is accompanied by strong heating.

It is forbidden to pour water into acids, as it can boil and splash concentrated acid.

In case of acid contact with the skin, the affected area should be immediately washed for 10 to 15 minutes with a fast-flowing stream of water, and then neutralized with a 2 to 5% solution of sodium carbonate.

Spilled acid should be covered with sand. After cleaning the sand, the place where the acid was spilled is sprinkled with lime or soda, and then washed with water.

Spilled caustic solutions should be properly treated prior to their removal.
Used chemical vessels and appliances containing acids, alkalis and other caustic substances should be cleared of residues and rinsed with water before being sent to the sink.

Working with flammable liquids (fire hazardous substances)
Only employees who have the appropriate training should be allowed to work with Flammable Liquids and other fire-hazardous substances. Hereinafter referred as FS

Before working with FS, it is necessary to check the availability of fire extinguishing equipment.

If any work with flammable liquids is taken outside of a fume hood, proper measures should be taken.

Distillation and heating of low-boiling flammable liquids should be carried out in round-bottomed flasks installed on baths filled with the appropriate heat carrier (water, oil, sand). For heating baths, electric stoves should be used only with closed heating elements.

When distilling FS, it is necessary to constantly monitor the operation.

Flammable liquids that are reactive with water should not be placed in a water bath if they need to be heated.
Laboratory installations in which FS was heated can be disassembled only after they have cooled down to room temperature.

In case of spillage or ignition of FS it is necessary to switch off all electric heating devices, and if necessary, to de-energize the laboratory by disconnecting the main power supply.

It is necessary to strictly ensure that the containers with FS are not close to ignition sources.

When filling glass bottles of FS to near capacity, leave sufficient headspace to allow for temperature expansion.

Refer to the chemical safety data sheet for the appropriate fire extinguisher to be used.

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Work with mercury

The use of metallic mercury is allowed only in cases when it cannot be replaced by suitable alternatives.

Work with mercury should be isolated from the rest of the room, equipped with ventilation.

When working, one should strive to minimize the open surface of mercury to reduce the area from which it evaporates.

Small mercury devices in which mercury is well isolated is allowed to be carried out in the General laboratory premises provided an appropriate mercury spill kit is provided.

To prevent the contact of mercury with metals and the formation of amalgams, the metal parts of the equipment in contact with mercury are covered with oil paint or varnish.

Mercury devices should not be placed directly at doors, windows, and also near heating devices or heated surfaces.

Storage of unused and damaged mercury equipment should not be allowed in the working premises. Disposing of such devises should be done following appropriate best practices.

In rooms where there are mercury devices, the air should be analyzed routinely for the content of mercury vapor. If you find an excess of the maximum permissible concentration, you should stop working and de-gassing the room to be made as per Sanitary Rules.

9.8 Sample reception / Safety evaluation

Careful handling and examination of the sample container ensures the analytical integrity of the sample and the safety of laboratory personnel.

Sample containers should be appropriately labeled for receipt into the laboratory in order to ensure safe handling and appropriate PPE is worn. When using sharp blades or Stanley knifes to open boxes of samples, or supplies and consumables, these blades should not be left idle on the bench with the blade exposed.

In all cases, appropriate PPE should be worn when handling sample containers. Pressurized cylinders, corrosives samples, toxic samples, and other hazardous samples should be handled only by personnel wearing appropriate protective equipment.

Sample Integrity and Safety Evaluation

It is important that the sample container is appropriate for the material sampled and the test to be performed.

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Sample containers must be inspected for integrity on receipt into the laboratory. Samples that are leaking, unlabeled, or otherwise compromised should be noted and should be rejected for analysis.

Leaking samples, especially compressed flammable gases, should be removed from the laboratory immediately to prevent unsafe conditions in enclosed areas. Leaking liquid containers should be removed in appropriate secondary containers to prevent spills of material.

General Considerations

Follow established company or laboratory procedures for sample receipt.
Samples should be received and recorded promptly and should not be left in the receiving area for an extended period.

While in the receiving area or awaiting analysis, samples should be stored safely and securely in appropriate ventilation or catchment as required by the hazard class of the sample.

After analysis is complete, sample disposition should follow an orderly process as outlined by procedure or practice. Sample inventory records should be maintained in the case of the need to store samples as required by regulation, customer requirements, or company and laboratory requirements.

Safely Storing Samples in the Receiving Area

Safely storing chemicals samples in a laboratory receiving area requires diligence in safe practice.

Provide a sufficient space for each sample container.

Samples that are volatile, toxic or odoriferous should be placed in appropriately ventilated spaces, which may include actively vented cabinets or fume hoods.

Store flammable liquids in approved flammable liquid storage cabinets or sufficiently separated from laboratory operations that might cause ignition.

Separate all samples according to compatible groups. Understand chemical compatibility and follow all precautions regarding storage of incompatible materials.

It is helpful to have a chemical compatibility chart or information for review.

Keep corrosive samples in the receiving area in appropriate resistant secondary containers.

Where needed and as practicable, use designated coolers or laboratory grade refrigerators to store volatile samples while awaiting distribution into the laboratory for analysis.
Follow safety precautions while moving or storing samples in the receiving area.

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Large, heavy containers or liquids samples should be stored on lower shelves. Samples should be accessible to all people, irrespective of their height. Safety/step ladders should be provided in order to access shelving where necessary.

Where necessary use secondary containment for samples in the receipt area.

Safe Transport of Samples in Receiving
Where possible do not move visibly degrading samples or leaking containers or pressure cylinders into the laboratory

Place bottles in appropriate, leak-proof secondary containers to protect against breakage and spillage whenever moving samples from receiving into the laboratory. A good example is using a special plastic tote for carrying larger glass bottles of corrosives or solvents or using a sturdy sample cart with containment to move samples.

Ensure carts are in good condition and that the wheels are appropriately sized for floor conditions. Make sure that secondary containment is liquid-tight and has sufficient capacity to prevent spills in case samples leak.

9.9 Shipment of Samples

The regulations governing the transportation of hazardous materials are complex and according to the mode of transportation, air, road and sea.

Each mode of transportation has its own set of regulations that are typically established by national legislation; however, most regulations associate with shipping hazardous materials by air reference the IATA Dangerous Goods Regulations, established by the International Air Transportation Association. For regulations covering carriage of dangerous goods by road, rail and sea refer to ADR (Agreement for Dangerous goods by Road), RID (Regulations for Dangerous Goods by Rail) and IMDG (International Maritime Dangerous Goods Regulations) respectively.

Everyone involved with the transportation of hazardous materials should be trained in the requirements and may also, as in the case of air transportation, have successfully completed an approved training course.

9.10 Safety data and awareness / The Right to know

A hazardous chemical is a substance or material that has properties which potentially do harm to human or animal health, the environment, or property.

Hazardous chemicals are frequently tested and used in testing in a laboratory. Employees can potentially be exposed to Hazardous chemicals in the normal course of laboratory operations.

Chemicals are frequently used in the workplace, both as reagents and as samples.

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There a several categories of Hazardous chemicals, such as:

- Flammable or explosive
- Irritating or corrosive to skin, lungs, and eyes
- Toxic chemicals

Extreme caution is to be taken when handling, storing, transporting, and using hazardous chemicals.
In all cases people handling such hazardous chemicals should wear appropriate protective clothing and personal protective equipment to prevent injury.

Hazardous chemicals are accompanied by SDSs that outline the severity of the potential risks as well as the safety measures that should be in place when handling these substances.

Regulations in most of the world have been updated to provide clearer information to everyone who uses chemicals. These changes may constitute a "Right-to-Understand" or "Right-to-Know" system of regulations.

Most regions in the world have agreed to use the United Nations promulgated Globally Harmonized System of Classification and Labeling of Chemicals (GHS). The basic elements of the GHS include standardized hazard testing criteria, universal warning pictograms, and harmonized safety data sheets.

Safety Data Sheets
A safety data sheet (SDS) is used as an informational source about hazards, including environmental hazards, and to provide guidance on safety precautions. The safety data sheet (SDS) was created for use primarily in the workplace. It provides important information about the listed chemical that allows employers and workers to obtain accurate information concerning the hazards, uses and risk management of the chemical. Safety data sheets (SDS) are a component of the Globally Harmonized System (GHS) of Classification and Labeling of Chemicals. The new safety data sheets (SDS) are standardized into a 16-section format. Manufacturers are required to use the standardized hazard and precautionary statements on the SDS as prescribe by the GHS. The SDS will now provide additional safety information to the user that will be consistent between manufacturers.

All employees working with or near hazardous materials should receive Right-to-Know training to become knowledgeable about chemical hazards, personal protective equipment, and Safety Data Sheets.

9.11 Labelling

Labels are one of the most important safety features of all materials in a laboratory and they provide two basic informatory functions.

- They identify what the material is and where it came from.
- They provide precautionary information regarding hazards associated with the material sampled.

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All subsequent handling, such as, transportation, packaging, shipping, storage, disposal, etc., is centered around knowing the exact nature of the material that is inside the container.

All samples and containers should be labeled, regardless of whether they are hazardous.

Various governmental agencies and industrial groups mandate, control or provide advice concerning labeling of hazardous material. However, the TIC Council recommends that its members use, where possible, the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), which is an internationally agreed-upon system, created by the United Nations. It is designed to replace the various classification and labeling standards used in different countries by using consistent criteria for classification and labeling on a global level.

9.12 H2S

Hydrogen Sulfide is a poisonous gas which can be present in petroleum products. Special considerations should be made to protect laboratory workers from exposure past known limits. Member organizations are encouraged to implement an H_2S exposure minimization program in laboratory facilities. The program should consist of employee training, workspace monitoring and exposure alarming. See TIC Council Safety Code Section – Part 1 section 3.9.2 and TIC Council Bulletin 17-02 on Upper limits for H_2S in the breathing zone for further information.

Member organizations are encouraged to include H_2S training for new laboratory employees. The training should include the following content:

- Exposure limits: including occupational and professional group recommendations or regulations regarding workspace air concentrations.
- Proper Use of PPE, Ventilation, and Monitoring equipment
- Evacuation procedures
- Local emergency medical providers

Workspace should be monitored for potential exposure to H_2S gasses. Laboratory airspace monitors or laboratory staff personal lapel monitors should be installed to provide for an early warning system for potential over-exposure.

9.13 Electrical safety

Electrical infrastructure is a key component of a petroleum laboratory. If installed or maintained insufficiently, it can be one of the most significant sources of risk. A poorly installed or unmaintained laboratory electrical system can lead to a fire, loss-time incidents, injury, or death.

Whenever there is an exposed energized part, the employee should isolate the energy source and turn off the source and lock and tag out the energy source (Only qualified electricians can work on an exposed energy source).

Protective shields, protective barriers or insulating materials as necessary should be provided.

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Component Inspection

Electrical equipment, tools, and appliances should be inspected prior to each use. Faulty equipment, tools, or appliances should be removed from service immediately and tagged "Out of Service", dated and signed by the employee applying the tag.

Electrical Equipment Repairs

Only authorized and qualified personnel may make repairs to supply cords on electrical tools and to extension cords. Only properly authorized professional should be contracted to make repairs to electrical equipment and wiring systems.

Employees should not enter spaces containing exposed energized parts unless specifically authorised.

Personnel should not wear conductive apparel such as rings, watches, jewelry, etc. (unless they are rendered non-conductive by covering, wrapping, or other insulating means) while working on or near open energized equipment.

Extension Cords

- Use only grounded, robust extension cords and cables that comply with local legislation Cords should not be run through doorways, under mats or carpets, across walkways or aisles, concealed behind walls, ceilings or floors, or run through holes in walls, or anywhere where they can become a tripping hazard.
- High current equipment or appliances should be plugged directly into a wall outlet whenever possible.
- All extension cords should be plugged into a safe power supply.
- All extension cords and or electrical cords should be inspected regularly.

Ladders

- Only approved, non-conductive ladders, may be used when working near or with electrical equipment, which includes changing light bulbs.
- Wood ladders should not be painted, which can hide defects, except with clear lacquer.
- When using ladders, they should be free from any moisture, oils, and greases.
- When possible, power lines should be de-energized and grounded or other protective measures should be provided before work is started.
- It is recommended that all non-essential employees do not approach energized high power voltage lines any closer than 3 meters / 10 feet.
- Follow applicable/suitable safety guidelines when working at height with ladders.

A clear working space should be maintained in the front, back and on each side of all electrical enclosures and around electrical equipment for a safe operation and to permit access for maintenance and alteration.
Flammable material should be kept clear of electrical equipment.

A Lock Out/Tag Out procedure should always be followed.

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Approved and appropriate fire extinguishers should be provided near electrical breaker panels and distribution centers.

All equipment should be adequately grounded, and the grounding tested periodically.

9.14 Permit to work system

A suitable work permit system should be implemented addressing non-routine specific types of work (e.g., hot work, cold work, electrical work, confined space entry etc.) as necessary. This system is applicable to all internal and external staff.

9.15 Compressed gases / leak checks / maintenance

Procedures specific to the safe handling of compressed gases should be incorporated into a facility's work processes including but not limited to transportation, storage, proper equipment design, and leak testing procedures. The procedures adopted for the safe handling of compressed gases are mainly centered on containment, to prevent gases from escaping to the atmosphere, and proper control of pressure and flow. Users of compressed gases are responsible for having knowledge and familiarity of the properties, intrinsic hazards, and proper use of the gases they utilize. All rules and regulations are directed toward these ends.

There are unique properties to compressed gases that merit special controls and work practices: contents under pressure, low flash points for flammable gases, low boiling points, and no visual and/or odor detection of many hazardous gases. Extra care is needed to prevent leaks, fires, explosions, and uncontrolled release of pressure.

Key Requirements
Please make note that the following requirements are not an exhaustive list.

The use and handling of compressed gases should only be conducted by properly trained individuals.

Facilities handling compressed gases should have an emergency plan that specifically includes addressing incidents involving compressed gases.

In a laboratory handling petroleum products, particular care should be exercised when dealing with oxidizers in the presence of fuel samples.

Compressed gases which are not clearly labelled, stamped, or otherwise identifiable should not be used and should be returned to the supplier. Additionally, the compressed gas cylinders should be visually inspected for dents, gouges, corrosion (other than light surface) that would be indicative of loss of metal thickness, and any other indication that the cylinder may be damaged. Any questionable cylinders should be returned to the supplier.

With the exception of toxic gases, compressed gas cylinders should have pressure relief devices installed in accordance with applicable regulations. Never tamper with pressure relief devices in valves or cylinders.

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Compressed gas cylinders should be secured by means of straps, latches, bands, racks, heavy gauge wire, etc. to prevent falling. All cylinders, whether full or empty, should be secured in the upright position, in such a way as to prevent tipping or falling. Cylinders not in use should have their valve caps secured.

Avoid dragging, rolling, or sliding cylinders. Cylinders should be moved by using a suitable hand truck. The valve-protection caps should be left on each cylinder until it has been secured and ready to be put into service.

When connecting a cylinder for use, never force a valve connection that does not fit or thread on properly. Threads on regulator connections should match those on the cylinder valve outlet. Connections can vary specific to the hazard class of the compressed gas being utilized.

When using compressed gases, wear appropriate PPE.

Never drop cylinders or permit them to strike each other violently.

Full and empty cylinders should not be stored together.

Cylinders should not be exposed to extreme temperatures of heat and cold as specified by the supplier. A flame should never be permitted to come in contact with any part of a compressed gas cylinder. Conversely, cylinders should not be exposed to extremely low temperatures as it may affect the ductility and strength of the steel. Special stainless-steel cylinders are available for low temperature use. If ice or snow accumulates on a cylinder, thaw at room temperature.

Do not place cylinders where they may become part of an electric circuit.

Bond and ground all operational cylinders, lines, and equipment used with flammable compressed gases.

Cylinders should be used in rotation as received from the supplier. Storage areas should be set up to permit proper inventory rotation.

Leak Detection

It is necessary that gas distribution systems under pressure are checked for leaks at all connections prior to first use of compressed gases. Commercially available leak detectors or soap and water solutions can be used to detect and isolate leaks. Routine monitoring of gas usage versus calculated consumption rates is an invaluable tool in identifying when leaks have developed. Additionally, it is highly recommended to leak check all connections at a regular frequency.

When toxic gases are being utilized, it is advisable that some devices be used to warn of the presence of toxic concentrations.

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Gas Storage

Cylinders should be stored in a detached and well-ventilated or open-sided building. Storage areas should be fire resistant, well ventilated, located away from sources of ignition or excessive heat, and dry. Such areas should be prominently posted with the names of the gases being stored. Indoor storage areas should not be located near boilers, steam or hot water pipes, or any sources of ignition. Outdoor storage areas should have the proper drainage and should be adequately protected from direct sunlight.

Where gases of different types are stored at the same location, cylinders should be grouped by types of gas, the groups arranged to take into account the gases contained – for example, flammable gases should not be stored near oxidizing gases. Storage in a laboratory should be confined to only those cylinders in use. In all cases, storage areas should comply with local, regional, and national regulatory requirements.

Without exception, all cylinders should be kept in a secured location and protected against tampering by unauthorized personnel.

10. Communications

Communication in a laboratory environment is critical to provide important information to facility workers and visitors. Effective conveyance of this information contributes to a safe and efficient working environment. TIC Council member organizations should include the following considerations when developing facility communication plans.

10.1 Signage, notice boards and visual materials

Facility notice boards and visual materials should be placed in prominent locations where employees and visitors typically congregate. Signage should meet all regulatory requirements. Additional considerations should be made for general public comprehension and effective range of view. TIC Council member organizations are encouraged to use accepted international signage convention when not required by local regulations.

10.2 Meetings

Intra-facility communication is vital to deployment of safe laboratory working practices. Regular facility staff meetings should be implemented to facilitate effective and efficient communication among facility staff. Topics to be discussed at periodic meetings should cover communication of any change to typical operation at the facility as well as a wide range of topics for periodic review. TIC Council member organizations should incorporate practicable or “real-world” examples of application of safe working practices to maintain awareness of organization safety practices. Staff attendance at the periodic meetings should be tracked, and goals for attendance be set for an annual period. TIC Council member organizations are encouraged to strive for 100% attendance of facility staff at the periodic meetings.

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11. Strong HSE culture and infrastructure to encourage reporting and intervention

11.1 Risk / Hazard Assessment

Hazard identification and risk assessment is the foundation of HSE management and culture. The activity is a requirement of many government regulations around the globe.

The assessment goes by many names and may be referred to as Formal Risk Assessment, Job Hazard Assessment, Job Safety Analysis, Critical Task Assessment, and similar terms, but the purpose is fundamentally the same: identify hazards to prevent harm from injury, illness, and property damage. Further information can be found under section 3.3 Risk Assessments and Hazard Awareness of TIC Council's Field Inspection Safety Code.

All employees have a responsibility to immediately correct hazards when possible and if not then to immediately report the hazard to their supervisor.

11.2 Near miss reporting

Reporting of near misses (sometimes also referred to as near hits, unsafe conditions, or unsafe acts) and other safety related incidents is a vital way for companies to strengthen and promote a culture of safety.

Laboratories should implement training on near miss reporting as a requirement for all employees, and their responsibility to report events accordingly.

All near misses should be reported to the employee's supervisor as soon as possible. If the near miss occurred on customer property, the customer should also be sufficiently informed. Minimum reporting details should include who, what, where, when, and how.

Near misses should be investigated promptly and thoroughly to ensure the condition is addressed and corrections are made to prevent a repeat of the near miss in the future. Corrective actions identified during the investigation should be recorded, enacted, and shared across the organization to promote lessons learned and continuous improvement.

11.3 Stop Work Authority

"The right and responsibility to stop any operation, which has imminent hazard to safety, health, equipment, and/or the environment."

While SWA is very common in the inspection field, it is just as important and critical in the laboratory environment. Laboratories are work environments where personnel may be exposed to hazardous substances and gases such as flammables, corrosives, and acutely toxic such as hydrogen sulfide. Refer to TIC Council Bulletin 16-01 Stop Work Authority for further information.

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12. Conclusion

In conclusion, this document was created to aid in the improvement of safety and health during laboratory operations with three specific focus points. It is intended that all TIC members utilize the code as guidance when authoring their own documents:

A) As a reference norm when reviewing and improving their own existing facility performance and establishing internal facility guidance

B) As training material for management and supervisory staff at each facility, bringing forward:

I) Industry norms, including local and corporate.
II) Industry best practice and shared information.
III) Feedback, shared experience and discussion as means of improvement

C) To establish HSE consistency within TIC Council member laboratories that then gives confidence to clients, and demonstrate the importance of health and safety within the work place and the value associated with being a TIC Council member company.

The effort put toward HSE is a journey that has no ending as there are always new lessons to learn and new circumstances to address. The intent of this document is to provide real assistance to the membership in their efforts to manage risk within laboratories, improve their overall HSE performance and keep their staff safe and healthy. All associated feedback can be emailed to secretariat@tic-council.org.

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Annex A (Laboratory KPIs - Examples only)

- How many newly hired workers have not received HSE orientation and training within the first week of work.
- Number of safety meetings organized, including minutes of each meeting, formally registered, documented, and duly signed by the attending employees.
- Number of laboratory site visits conducted by location manager or safety officer.
- Number of employees HSE pro-active reporting.
- Review and analysis of self-assessments performed by employees.
- Assessment of use of stop work authority.
- Maintenance program for utilities and equipment.
- Assessment of housekeeping and occupational hygiene.
- Number of emergency response drills organized.
- Assessment on use of proper personal protective equipment (proper lab attire) including any additional training for how to use the equipment correctly and how to maintain it.
- Number of fires, spills, or other safety emergencies.
- Assessment of types of injuries that have occurred.
- Number of days absent due to injury/illness.
- Number of incidents that required medical aid but did not include time loss.
- Number of hazards identified during site visits that have been corrected.
- Number of formal risk assessments performed.
- Number of incidents that were properly investigated to find and correct root causes.
- Number of employees who attended refresher training.
- Assessment of chemical handling and contact avoidance.
- Assessment of product signage and availability of recent SDS.
- Assessment of waste disposal procedures.
- Employees' knowledge of emergency equipment and exit routes.

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Annex B (Laboratory Fire Safety Checklist - Example only)

Laboratory fire safety checklist:

Laboratory: Location:

	GENERAL FIRE SAFETY	YES	NO	N/A
1	Exit signs are lit and emergency lights operational. Emergency lighting provides minimal lighting levels in case of power failure	☐	☐	☐
2	Staff knows the location of fire extinguishers and other firefighting systems. Labs will have multi-purpose fire extinguishers mounted inside the laboratory and sample storage areas	☐	☐	☐
3	Corridors and walkways are clear of surplus equipment, trash, empty containers, etc. Corridors are intended to provide a safe and efficient means of exiting a building in emergencies and during normal work activities.	☐	☐	☐
4	Laboratory doors remain closed at all times. Building ventilation systems ad fume hood designs depend on laboratory doors remaining closed.	☐	☐	☐
5	Warning signs are listed on entrance doors, storage areas and cabinets, etc. Warnings about any unusual chemical, biological or physical hazards are required to be posted.	☐	☐	☐
6	Emergency evacuation routes and outside meeting point posted. Evacuation routes from each laboratory to the two closest exists and the area where everyone is to meet for a “head count” should be posted.	☐	☐	☐
7	Emergency procedures are written and available. Alarm activation, building evacuation, equipment shutdown, spill control, etc.	☐	☐	☐

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8	Equipment maintenance plans are written and available. All equipment used in the laboratory should have a readily available maintenance plan.	☐	☐	☐
9	A current inventory and SDS/MSDS for all chemicals used is available. All chemicals should be listed on an inventory and there should be an SDS/MSDS readily available for each chemical.	☐	☐	☐
10	Laboratory fume hoods have current inspection. Each fume hood should be inspected annually, including air-flow face rating.	☐	☐	☐
11	Quantity of flammable/combustible liquids does not exceed storage limits. As defined by local regulation or per Section 6.4.5 of the Group Safety Manual	☐	☐	☐
12	Refrigerators for flammables storage are explosion proof type and are properly marked. Residential type refrigerators cannot be used to store flammable liquids.	☐	☐	☐
	GAS CYLINDERS	YES	NO	N/A
13	Only cylinders in use are located in the laboratory. Full or empty cylinders not connected to equipment should not be stored in the laboratory	☐	☐	☐
14	All cylinders not in use are stored in an appropriate location. Wherever possible cylinders should be stored in an outside, secured location.	☐	☐	☐
15	All cylinders are properly secured. All cylinders, regardless of their fill condition, should be anchored by chains, clamps or stands.	☐	☐	☐
16	All cylinders without regulators are capped. All cylinders not in current use should have the regulator removed and the cap secured	☐	☐	☐

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	CHEMICAL STORAGE	YES	NO	N/A
17	Chemicals are stored correctly according to compatibility and in the correct location. In general flammable chemicals should be stored away from oxidizing chemicals. Acids bust be separated from bases. All chemicals should be stored and used away from any area used for eating or drinking	☐	☐	☐
18	Flammable liquids stored away from ignition sources, such as, burners, hotplates, electrical units, etc. If a container of flammable liquid failed, would the leaking liquid or vapor contact any item that could cause ignition?	☐	☐	☐
	ELECTRICAL SAFETY	YES	NO	N/A
19	All electrical wiring is free of fraying and cuts. Electrical cords should not show any signs of wear or breakage of their insulation.	☐	☐	☐
20	All electrical devices are grounded (earthed). Three pronged plugs should be used for all electrical items; except, double insulated tools.	☐	☐	☐
21	Extension cords are not used for permanent wiring. Any fixed or permanent equipment should be hard wired into the power system or within reach of an outlet without an extension cord.	☐	☐	☐
22	Controls that turn equipment on and off are labeled. Both On and Off positions are to be identified, unless the equipment that is controlled by the switch is obvious	☐	☐	☐
23	Electrical receptacles, switches and controls are located so as not to be subject to spills. A Ground Fault Circuit Interrupter (GFCI) should be used on outlets within 2 meters (6 feet) of a water source.	☐	☐	☐
24	Circuit breaker panels and electrical transformers are free of storage within 1 meter (3 feet) of the panel in laboratories and mechanical spaces. To assure immediate access if needed	☐	☐	☐

Signed: Date:

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Annex C (Recommended elements of surveillance - Examples only)

Typical elements of surveillance include but is not limited to the identification of workers to monitor, pre-hire and routine screening, post-incident medical exams, and risk analysis and action plans when hazards are identified.

However, requirements vary widely depending on the laboratory, location, and products handled. Trained health and safety or healthcare professionals should be consulted in the development and management of any program.

Commonly, our laboratories may require personnel to be physically capable of performing their job functions and these functions may include use of a respirator. Since using a respirator may place a burden on an employee's health, medical screens should be conducted at time of hire and periodically as required by local legislation.

Medical screens should be at no cost to the individual, confidential, during normal working hours, convenient and understandable. The tested individual should have the right to discuss the results with the physician or other licensed health care professional.

Medical screens should be conducted by licensed medical professionals and should include, but not limited to:

- Medical Evaluation – comprehensive assessment of a patients overall medical history and current condition. The purpose of this evaluation is to confirm that the employee will not be a danger to themselves or others in the workplace.

- Pulmonary Function Test – a broad range of tests that measure how well the lungs take in and exhale air and how efficiently they transfer oxygen into the blood. The purpose of this test is to determine whether the employee is capable of using a respirator.

- Respirator Fit Test – a series of tests used to determine the suitability of a respirator mask for a specific user. Each respirator model will fit on the face of a user differently and a mask fit test helps to assure the best and safest fit.

    - Complete Blood Count for Benzene – a test used to detect blood disorder or other conditions that causes changes in the status of the blood (e.g., exposure to Benzene). Benzene is a known carcinogen and may be found in products handled in our laboratories.

    - Baseline Audiograms – an audiometric test that provides a static reference point for future audiometric tests, documenting any changes in hearing capabilities over time. Employees may be exposed to noises in the laboratory that can induce hearing loss, such as a CFR engine room.

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Annex D (Hand protection examples)

Glove	Description	Cromwell Code	Primary use	Benefits
	Maxicut oil grip	ATG9613481L Sz 10	Machine Shop. Cut resistant glove wet/oil conditions	Liquid repellent, cut-resistant glove. It combines cut protection with oil grip. ¾ Nitrile coating on a cut resistant glove. Reinforced thumb crotch.
	Ansell mercury glove	ANS9612409J Sz 10	Dry hot tests / heat treatment	Heat resistance up to 350°C. Machine washable at 40°C. Cut protection level 5. Some dexterity maintained.
	ATG Maxitherm 30-201	ATG9613640L Sz 10 ATG9613640G Sz 8	General cut resistance glove (dry conditions). Picking up hot beakers	Ultra-thin cut resistant glove. Maintains dexterity. Cut protection level 3. Contact heat level 2 (250°C) latex. (Nitrile or neoprene gloves to be worn underneath for substance protection).
	Uvex.6643 UNIDUR DYNEEMA KNIT	UVX9614030D Sz 10 UVX9614010B Sz 8	Chemistry lab sawing and prep	Flat nitrile coating to minimise contamination. Cut protection level 3. Maintains dexterity. Deters oil and grease and resists oil soak up.
	Polyco.273-MAT MATRIX NITRI-CHEM	PLY9610230P Sz 10 PLY9610228M Sz 8	General immersion in substances	Longer immersion times, reusable, longer cuffs.
	Tuffsafe.NITRILE DISP. GLOVES	TFF9614052C Sz L TFF9614051B Sz M	General chemical use inc. acids, alkalis and solvents	(Blue) Disposable.
	Ansell.25-101 NEOTOUCH DISP. GLOVES	ANS9611357G Sz L ANS9611355E Sz M	Use with hydrofluoric acid	(Green) Good acid resistance. Disposable.
	Hide glove with knitted wrist, thinsulate lined.	Direct from BOC	Use with liquid nitrogen	Cold resistant. Protection from LN2 splashes. Cuffs so no liquid can get inside.

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Annex E (Training checklist - Examples only)

- Fire Safety Awareness
- Ergonomics & Manual Handling.
- HSE System Training.
- Training record/training plan (issue and completion)
- Introduction to risk and Control of Substances Hazardous to Health (COSHH) assessments (to be completed prior to commencing independent work)
- Relevant risk assessments – read and understood (to be completed prior to commencing independent work)
- Introduction to work procedures (to be completed prior to commencing independent work)
- Display Screen Equipment (DSE) assessment and training.
- Environmental awareness training.
- Handling and use of gas cylinder training.
- Packaging and transport of dangerous goods training.
- Practical Manual Handling training.
- Awareness training.
- Specific client standards (state standards in details below)

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