

Regulation: Handling of Gas Cylinders at Tel Aviv University

The following cause the potential hazards from compressed gas cylinders:

1. Chemical hazards as a result of the gas stored in the cylinder – flammable, oxidant, toxic, corrosive.
2. Inert but "oxidant repellent" – has potential to inflict poisoning, burns or frostbite, choking and tissue damage.
3. Mechanical hazards as a result of a fallen cylinder or from the high pressure with which the gas is compressed that could cause an explosion and the bursting of the cylinder in the lab space and even outside of it.
4. Since every gas bears a specific hazard in accordance with its chemical composition, the work with compressed gas cylinders will only be conducted in accordance with safety data sheet (MSDS/SDS) instructions for the given cylinder.
5. The employee must identify the content of the cylinder before using it, including the characteristics of the gas and the safety instructions for using it. In any case of doubt, the PI should be contacted.
6. Before beginning to work, it is the responsibility of the PI to make certain that the worker is familiar with the work regulations, including the emergency regulations for handling the gases with which he works and that the worker has the protection equipment needed for his work.
7. Any worker involved in transporting gas cylinders, including unloading, loading, transporting and carrying them, will wear safety shoes and a full, transparent, polycarbonate protective face shield at least 2mm thick.
8. Any use of oxygen gas requires care with respect to keeping hands and tools clean of oil and/or grease.
9. A gas cylinder or its accessories are not to be repaired in the lab. Any treatment, inspection and/or repair will be conducted solely by the gas cylinder manufacturer and/or a contractor specializing in installation of compressed gas systems and/or a certified lab.
10. Work in the gas systems in the lab or at the site require written permission of the Safety Department before beginning to use them.
11. It is absolutely forbidden to store flammable and/or toxic gas cylinders inside any building.
12. There is no smoking, no lighting of fire, or work with materials likely to cause sparks in close proximity to flammable gas cylinders.
13. A compressed gas cylinder should not be used when the name of the material in it is erased or unclear.

Ordering compressed gas cylinders

1. Prior to ordering gas cylinders, you must get a permit from the Safety Department.
2. The gas cylinder will be ordered subject to inspection by the Safety Department regarding the terms and settings for their use and the required safety measures, such

יחידת בטיחות טלי 03-6407555 פקס: 03-6408555

as: confirmation that the lab has a proper gas system infrastructure, PPE as required for handling gas cylinders, etc.

3. Compressed gas cylinders will only be ordered through the ERP system.
4. The supplier will issue the compressed gas cylinder requested by an authorized transporter.

Receiving and removing compressed gas cylinders

1. The compressed gas cylinder, product of Israel, will be received after a label has been affixed to it, marking its compliance with Israeli standard 659, with respect to "markings recognizing equipment containing gases and required precautions."
2. The structure of the valve must meet Israeli standard 637 requirements.
3. Upon arrival of the compressed gas cylinder, the party that placed the order must confirm that it meets the specifications of the order detail.
4. It must be confirmed that there is clear and embedded marking on the shoulder of the cylinder that includes the following details: the name of the gas and its chemical formula, permissible refill pressure, and the serial number of the cylinder.
5. A check must be made that there is a protective dome covering screwed on the valve.
6. A check must be made that there are no visible signs of severe oxygenation, damage, or leaking.
7. Compressed gas cylinders made abroad will be marked by the manufacturer's code.
8. Inert gas cylinders manufactured after 2002 will be subject to hydrostatic testing once every 10 years. Inert gas cylinders manufactured prior to 2002 will be subject to hydrostatic testing once every 5 years.
9. The following gas cylinders: carbon monoxide CO, carbon dioxide CO₂, ammonia NH₃, and oxide O₂, will be subject to hydrostatic testing once every 5 years.
10. Corrosive gas cylinders will be subject to hydrostatic testing once every 3 years.

Removal of cylinders from the campus will be executed as follows:

1. Corroded gas cylinders, unidentified gas cylinders, gas cylinders with faded colors, gas cylinders with non-standard colors, and leaking gas cylinders are not to be accepted. The transporter will have to return such cylinders.
2. Removal of a gas cylinder from the campus will be executed exclusively by a certified supplier.
3. Prior to removal of a cylinder, the party holding the cylinder must confirm that the cylinder valve is properly closed and that a dome cover is screwed securely atop it.
4. In the event that a leak was found in the compressed gas cylinder, it is to be evacuated to a remote location, free of people, and the supplier must be contacted immediately to remove the cylinder. The PI, the lab manager, and the Safety Department must be notified.
5. There should be no attempt to repair a leaky cylinder!
6. The PI responsible for the lab will contact the Safety Department when there is concern/uncertainty of any danger regarding gas cylinders in the lab.

יחידת בטיחות טלי 03-6407555 פקס: 03-6408555

7. Periodically, a representative of the Safety Department, in collaboration with the Safety Committee of the faculty under inspection, will conduct an inspection in order to locate hazardous gas cylinders, i.e.,
 - i. Unidentified cylinders.
 - ii. Cylinders that are no longer in use and/or are damaged.
 - iii. Cylinders for which the last hydrostatic test date was more than 4 years prior to the inspection.
 - iv. In consideration of the status of these cylinders, the manner of their subsequent handling will be decided.

Identifying gas cylinders and transmission pipes

Compressed gas cylinders are to be identified exclusively by the name appearing on the cylinder itself and not by what appears on the protective dome covering, considering the possibility of inadvertent exchanges of coverings.

The color of the body of the cylinder manufactured in Israel, marks the type of hazard group with which it is associated as per the following specifications:

1. Yellow – flammable gases, for example: hydrogen, acetylene.
2. Oxygenating gases, for example: oxygen, air, are painted white on the top.
3. Gray – inert gases, for example: nitrogen, helium, argon.
4. Toxic and corrosive gases, for example: ammonia, chloric acid.-colors vary according to the country of the supplier
5. Marking of transmission pipes will be done according to the type of gas flowing through them.
6. The gas transmission pipes will be marked with a sticker with the name of the gas, the working pressure, and an arrow with the direction of flow. The marking will be done in accordance with the Israeli standard 659 every 80 cm. and for every change of pipe direction.

Storage

1. Only compressed gas cylinders meeting standards are permitted to be purchased for the University.
2. Storage of gas cylinders will be in accordance with Israeli standard 712, "Portable cylinders for gases – safety rules."
3. Compressed gas cylinders will be stored in a shaded, covered, well-ventilated, fence-protected, and locked facility.
4. Each compressed gas cylinder will be vertically grounded, hitched by a chain with an anchor point on the upper third of its height to prevent falling.
5. A sign must be placed on the stored gas with the name of the gas, its UN number, and its emergency code, in accordance with the Safety Department's instructions.
6. Compressed gas cylinders are not to be stored in passages or in proximity to corrosive materials having the potential to damage the cylinders.

יחידת בטיחות טלי 03-6407555 פקס: 03-6408555

7. Placing of flammable and/or toxic gases inside a building, including hallways, is strictly prohibited.
8. Flammable and/or toxic gas cylinders will be stored in a designated, ventilated storage space with a (annually calibrated) detectors.
9. Gas cylinders should not be stored adjacent to sources of heat or fire.
10. It is recommended that inert gas cylinders be removed from the lab. In the event that this is not possible, inert gas cylinders can be stored in a designated niche in the lab.
11. Empty or full oxygen cylinders should never be stored in proximity to flammable gases, organic materials, oils or grease.
12. Empty gas cylinders must be separated, stored, and clearly marked.
13. The different groups of gas cylinders should be stored at a distance of six meters separation from a group that might react with it, e.g. **flammable gases**, such as hydrogen, methane, acetylene, pyrophoric gas, for example: silane; **toxic gases**, for example: chlorine, diborane; and oxygenates, for example: oxygen) as described in the following items: -
14. Oxygenating and redoxing gases should be separated from one another.
15. Corrosive gas cylinders, such as ammonia, should be separated from all other groups of gases.
16. Alternately, different groups of gases can be separated by a wall that is fire resistant for at least two hours.

The gas storage location

1. It will be external to any building.
2. It will include 5 partitions between flammable, inert, toxic, oxygenating, redoxing gases. The group of inert gases will always be placed between the other groups.
3. A source panel will be installed adjacent to the gas balloon.
4. The source panel will be connected to the gas cylinder by a safety pipe for high pressure.
5. The safety pipe will contain an internal cable for preventing lashing, and will be fastened accordingly to a stable location.
6. The source panel will be affixed to the wall, and will include at least a pressure regulator and a shutoff valve.
7. Further to the pressure regulator, a safety valve will be installed.
8. The exit pressure from the source panel will be defined according to the working pressure in the lab.
9. Use of a new gas system prior to conducting a proof-pressure test at 150% of the working pressure and inspection of gas tightness at 100% of the working pressure by a certified company is prohibited.

Transport of gas cylinders throughout the University or externally

1. Transport by vehicle within the University or externally will be executed by a certified transporter only, and in accordance with the laws of the State of Israel.
2. Local transport will be executed by workers certified for working safely with gas cylinders, with professional knowledge, and protected by personal protection equipment (PPE): long work clothing, safety shoes with a protective head covering and full face protection.
3. While transporting compressed gas cylinders, it is mandatory for the cylinder nozzle to be covered by a tightly screwed dome protective cover.
4. Gas cylinders should never be transported in passenger elevators in the presence of passengers.
5. Gas cylinder transport will be done in designated carts or a special crat. Gas cylinders should not be dragged or rolled!
6. Transport in an elevator will be done in service elevators or in empty passenger elevators only.
7. If transporting in a passenger elevator, it must be assured that passengers will not enter the elevator if it stops at another floor by affixing a page to the cylinder stating, "Gas cylinder in transport. Entry to the elevator is prohibited."
8. The cylinders are not to be lifted from their protective covers.
9. The cylinders are not to be lifted or carried by a crane of any kind, rather only in a crat designated and adapted for transporting gas cylinders that has been inspected and approved by the Safety Department.
10. Compressed gas cylinders should not be transported in a horizontal position, especially acetylene gas cylinders.
11. For the purpose of transport, the cylinders will be arranged such that all of their valves are pointed in the same direction.
12. Exchange and/or transport for the purpose of closing/opening toxic gas cylinders will always be done in the presence of two people equipped with full PPE who have been trained for such tasks.

Working with compressed gas cylinders

1. Despite the fact that the rules of handling specified below are general for all kinds of gases, there may be changes for the type of handling to be applied to certain gases, in accordance with the SDS, manufacturer's instructions, University regulations, safety rules, or field conditions. In any case of discrepancy, the SDS instructions and specific safety instructions override that stated in this clause.
2. Connecting of compressed gas cylinders will be executed by the supplier/contractor or certified maintenance person.
3. Toxic gas pipes will be in a double pipe structure, with the external part connected for pumping outside of the lab by a connection to the fume hood.
4. The pipe connections will be welded in the event that this is necessary.

יחידת בטיחות טלי 03-6407555 פקס: 03-6408555

5. Certified persons who undergo training at least once a year, and are equipped with appropriate PPE and are familiar with the SDS for the gas will perform the installation.
6. Any person, working with, and/or transporting gas cylinders is required to have basic certification and training provided by professional experts in the field, and/or an expert on the subject from the gas supply company.
7. Lab personnel, who have been instructed and certified for handling compressed gas cylinders will undergo an annual update course on the subject. The identity of these people should be reported to the Safety Department.
8. A main gas valve with a switch and a pressure gauge in a prominent and accessible spot will be installed in every lab for each type of gas in use in the lab.
9. The gas cylinder will be connected to a main shutoff valve and a regulator suited to the type and pressure of the gas. The cylinder valve and the regulator will be fastened to the lab wall or the building on a designated panel in the area permitted by the Safety Department and the University Installation Engineer.
10. Gases should not be used without a two-stage pressure regulator.
11. Gases should not be used without a shutoff valve.
12. **When working with toxic and/or flammable gas, detectors must be installed in the lab for the specific type of gas, that in the event of a leak:**
 - a. **Automatically stops the gas supply.**
 - b. **Sounds an alarm on location and sends an SMS to the lab personnel and the Safety Department 24/7 at telephone number 03-6405555.**
13. Prior to connecting the gas cylinder to the system, especially for gas systems that include more than one compressed gas cylinder, it should be checked that all valves in the system are closed and that they are not under pressure.
14. The cylinder valves should be opened for a brief moment, except for hydrogen and toxic gas cylinders, and closed immediately in order to clean dust and sand that potentially block the flow of gas or cause damage to the regulator.
15. Opening of a compressed gas cylinder will always involve protecting oneself with PPE, including a full facial shield.
16. Prior to opening the gas cylinder valve, a check must be made that the system valves and the regulator are closed.
17. The cylinder valve for the gas flow should be opened slowly when the valve and the regulator are turned in the opposite direction of the person opening it.
18. Standing in front of the gas cylinder opening is forbidden.
19. It must be checked that there is no leakage.
20. After opening the gas cylinder valve, the regulator for gas flow in the system should be opened slowly.
21. Grease and oil should not be used on the pressure regulator or connections, especially with regard to compressed oxygen cylinders.
22. A cylinder should not be emptied beyond 2 atm pressure.

יחידת בטיחות טלי 03-6407555 פקס: 03-6408555

23. Working pressure in labs is limited to 20 bars. Working pressure greater than 20 bars requires an exception permit from the Safety Department, and work instructions.
24. Gas detectors will be inspected and calibrated annually.
25. In any place where there are toxic and/or flammable gases placed in gas fields or on the roof, the worker replacing the cylinders should be equipped with mobile gas detectors in order to ensure the absence of leakage.
26. At the entrance to any area of activity where there are toxic and/or flammable gas cylinders, an emergency cabinet will be installed with a full face mask with a filter appropriate for gas.
27. Work with hydrogen, acetylene, ethylene, and any other gas which potentially could become reactive as a result of static electricity will be conducted with the help of an alloy of beryllium and/or copper, and not steel, in order to prevent the creation of sparks which could cause an explosion.

Removal of empty gas cylinder:

1. Prior to removal of empty cylinder from the system, the pressure in the conducting pipes will be released. It should be checked that the pressure on the line is indeed "0."
2. Prior to shutting off the cylinder, the cylinder valve should first be closed, and afterwards the regulator nozzles and connection valve of other cylinders in the system.
3. In the event that one is working with corrosive, flammable, and/or toxic gas, the line should be purged with the help of nitrogen.
4. Upon releasing the cylinder, PPE should be used as required in accordance with the type of gas and according to the SDS.
5. Upon completion of shutting off the cylinder, the safety dome should be returned to its position, and the cylinder should be marked "empty," and it should be stored where the empty gas cylinders are stored.

Gas cylinder inspection

The lab engineer will conduct a monthly internal inspection in the gas fields where the gas cylinders in use in his lab are located.

The following parameters will be examined in the framework of the inspection:

1. Ventilation of the storage space.
2. Vertical cylinder storage.
3. Fastening of each cylinder individually.
4. The existence of color coding for identifying cylinders, labels, and suitable signage.
5. The standard of the separation partition between the flammable gases and the other gas groups, between the full and empty gases, and with respect to marking of the empty cylinders.

יחידת בטיחות טלי 03-6407555 פקס: 03-6408555

6. PPE at the storage site.
7. The standard of extinguishing means at the storage site.
8. The lab engineer will report safety hazards and dangers to the Safety Department which will define requirements for corrective actions.
9. The PI is responsible in accordance with that specified above.

Design and installation

1. System design will be conducted by a contractor certified to execute design for the system needed.
2. The design will be conducted in consultation with the Safety Department and with its approval.
3. Installation will only be conducted by a company certified to install gas systems.
4. A high pressure systems contractor will prepare a documentation portfolio for each compressed gas system that will be handed over upon delivery.
5. The planning will ensure minimization of the danger of a life endangering event, and/or damage to lab infrastructure by use of suitable engineering protective means, such as: reducing pressure, reducing quantity, reducing supply flow, ventilation, welded pipes, sensors, and shutoff of the source of the gas supply.

Maintenance

1. Maintenance for a compressed gas system will be conducted by an authorized worker only.
2. The components of the gas system should be checked routinely, at least once a year, or in consultation with the system manufacturer, in accordance with the severity of the danger to equipment, the application or the process.
3. Prior to repairs, storage, transport, or upgrading, the pressure in the gas pipe system must first be released, and only thereafter, should the hazardous gas cylinder be removed.
4. It must be assured that the renewed connection of the system will not be allowed until work on the pipeline has been conducted. It must be clearly marked, "**Do not connect. The system is under repair.**"
5. The compressed gas system will be planned so that it will allow preventive maintenance without take apart components.
6. Upon completion of replacing components in the gas system, a leak test will be conducted by a certified company.
7. Following disassembling and significant composition in the compressed gas system and for any case in which the system has been obliged to stop working/has been stopped for a period of 6 months or more, a proof-test will be conducted as well as a leak test prior to renewed use of the system.
8. Prior to use of compressed gas systems, a risk survey will be conducted by the PI or an advisor on his behalf and coordinated with the Safety Department in order to assure work at an acceptable risk level.

יחידת בטיחות טלי 03-6407555 פקס: 03-6408555

9. Work with the system should not be done before authorization by a certified leakage inspector and the Safety Department.
10. The Safety Department should be advised of any new risk factor, such as the intention, for example, to begin working with flammable gas in a lab where heretofore work has been done with inert gas only.
11. The pressure systems in the University are adjusted to work at high pressures, up to 20 bars. The supply system and the gas cylinders will be adapted to work at the given pressure.
12. Special permission is required for work at pressures above 20 bars.
13. In work with oxygen repelling gases in confined places of small volume, one must be equipped with an oxygen sensor in accordance with Safety Department instructions.
14. In work with toxic, flammable, or corrosive gases, one should be equipped with suitable sensors and ventilation supply systems in accordance with Safety Department instructions.

For all work with gases, abidance to the following regulations must be verified:

1. Gas cylinder replacement regulation.
2. Work regulation.
3. Preventive maintenance regulation.
4. A treatment plan for failure/emergency situations, including equipment for handling the situation.
5. Safety instructions for working with hazardous gases.
6. SDS for the gases in the lab.
7. Elimination of hazards.
8. Expired, damaged, unidentified gas cylinders which are no longer in use should be evacuated in accordance with Safety Department instructions.

In an emergency

An emergency hazard situation involving hazardous gases should not be handled alone.

1. Evacuate the lab and / the building.
2. Call the security hotline immediately for help: 03-6405555.
3. Equip yourself with appropriate PPE.
4. Entry to the endangered area without permission from the Safety Department is prohibited.

Instructions for handling a gas leakage situation

1. If a gas leaks, If the main gas valve is far from the gas valve should be closed immediately. The cylinder's gas valve should also be closed, if and only if this can be done without taking a personal risk.
2. If possible, without any personal danger, evacuate people from the location and let the gas evaporate into the ventilated lab.
3. Evacuate people from the area of the leak to a safe distance.

יחידת בטיחות טלי 03-6407555 פקס: 03-6408555

4. Notify the security hotline at 03-640555. Report the precise location, including the building, the floor, room, and name of the PI.

In the event of flammable gas leakage

1. If the main gas valve is far from the cylinder and can be reached without danger, close it.
2. Notify the security hotline at 03-6405555. Report the precise location including the building, the floor, room, and the name of the responsible researcher.
3. If a fire breaks out, call the fire department at telephone number 102.
4. If possible, without any personal danger, evacuate yourself and other people from the location.

The following should be done only by trained personnel:

1. Protect yourselves with appropriate PPE (at least 2 skilled individuals).
2. Remove sources of fire from the area.
3. Remove from the area any materials and equipment that are likely to burn
4. Bring fire extinguishing equipment.
5. Cool the container by spraying water.
6. Allow the gas to be released completely.
7. Ventilate the area well.

In the event of toxic gas leakage

1. If it is possible to close the main gas valve outside of the lab without danger, close it.
2. Notify the security hotline at 03-6405555. Report the precise location including the building, the floor, room, and the name of the PI.
3. If possible, without any personal danger, evacuate yourself and other people from the location.
4. To the extent necessary, notify the fire department at telephone number 102.

The following should be done only by trained personnel and only if possible, without any personal danger:

1. Protect yourselves with appropriate PPE (at least 2 skilled individuals).
2. If the leakage source should not be approached except with protection equipment and appropriate gas detectors
3. Close the cylinder's valve
4. Wait until completion of the discharging of the gas.
5. Ventilate the area well.

In the event of flammable gas catching fire

1. Notify the security hotline at 03-6405555. Report the precise location including the building, the floor, room, and the name of the PI.
2. If possible, without any personal danger, evacuate yourself and other people from the location.
3. To the extent necessary, notify the fire department at telephone number 102.

יחידת בטיחות טלי 03-6407555 פקס: 03-6408555

The following should be done only by trained personnel and only if possible, without any personal danger:

1. If gas bursts out of the cylinder, the main gas valve or the cylinder valve should be closed immediately, **only if this can be done without personal risk.**
2. If a flame burst from the gas pipe and you noticed it immediately, it should be covered immediately with a thick and damp rag, **only if that can be one without any personal risk.**
3. The burning gas flame should not be extinguished with water.
4. Move people away from the area, as well as materials and equipment likely to catch fire.
5. Report the matter to the security hotline at 03-6405555. Report the precise location including the building, the floor, room, and the name of the responsible researcher.
6. Call the fire department at telephone number 102.
7. Until the arrival of help, cool the gas cylinders by spraying water, only if this can be done without personal risk.

In the event of damage from toxic gas

1. To the extent that this can be done without personal danger, evacuate the injured person from the contaminated area.
2. Notify the security hotline at 03-6405555. Report the precise location including the building, the floor, room, and the name of the PI.
3. Call for medical assistance at telephone number 101 and act in accordance with the instructions of the medical staff.
4. Provide first aid if you have completed an appropriate course.
5. In the event of injury from corrosive or irritating gas, infected clothing should be removed, rinse the skin and eyes with running water for at least 15 minutes.

Dr. Menachem Genut
Menachem Genut
Chemical Safety Manager
Tel Aviv University
Phone 03-640-5676
mgenut@tauex.tau.ac.il



ד"ר מנחם גנוט
מנחם גנוט
ממונה בטיחות כימית
מלפון פנימי-5676

6. <https://safety.tau.ac.il/chemical-safety-lobby> <https://en-safety.tau.ac.il/>

.7