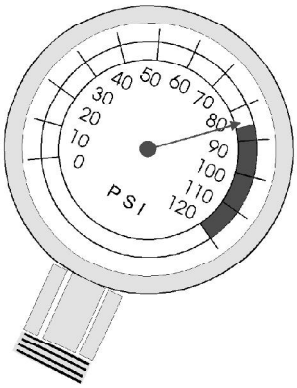
Safetywise



Overview of Pressure Systems in HKUST

Pressure safety mainly concerns with the hazards and risks posed by the compression of fluids, namely liquids and gases. A number of different "pressure systems" are in use at HKUST. They include:

- Boilers
- Air receivers
- Pressurized vessels
- Gas cylinders
- Hydraulic systems

Pressurized fluid is a form of stored energy. When properly stored, handled, and applied, it serves many useful purposes. On the other hand, it has a very high damage potential which can cause serious injury and extensive damage like a high explosive does, if an accident occurs. Therefore, we must be very careful and follow appropriate safety procedures when handling and working with pressurized fluids.

LEGAL REQUIREMENTS

There are laws in Hong Kong governing the design and operation of most pressure systems.

A. Boilers and Pressure Vessels Ordinance

This set of law controls the operation of boilers and pressure vessels in various forms, including air receivers. It prescribes safety requirements for boilers and pressure vessels which are required to be examined and certified safe before they are allowed to be operated. Periodic examinations and certifications are also required.

The Office of Laboratory Services (OLS) has been coordinating the certification of all boilers and pressure vessels used in the laboratories. Users must give sufficient prior notice and information to OLS for the necessary certification process before they put into use any boilers and pressure vessels in their laboratories.

According to the law, the definition of boiler and pressure vessels are as follow:

***Boiler** means any closed vessel in which for any purpose steam is generated under pressure greater than atmospheric pressure and also means any economizer used to heat water being fed into any such vessel, any superheater used for heating steam and any fitting directly attached to such vessel that is wholly or party under pressure when steam is shut off, and any vessel in which oil is heated at a pressure greater than atmospheric pressure.*

***Pressure Vessel** means a steam receiver, an air receiver and a portable gas generator.*

According to the definitions, **autoclaves** in laboratories are defined as boilers.

B. Dangerous Goods Ordinance

The storage and use of compressed gas cylinders are controlled by this ordinance. Compressed gases are classified as Category 2 dangerous goods under this ordinance.

SAFETY PRACTICE AND PROCEDURES

The relevant legal local codes and regulations must be met as a minimum requirement which provides certain degrees of safeguard. However, compliance with the law alone is not an adequate guarantee of safety. Appropriate safety practice and procedures for working with different types of pressure systems must also be established and followed by everybody concerned in order to reduce the risk to a minimal. The relevant safety practice and procedures can be found in our Safety Manual. In this and the subsequent issues of Safetywise, we will review some of the relevant safety practices and procedures for different pressure systems. We will discuss the handling and usage of compressed gas cylinders in this issue.

Safe Use of Compressed Gas Cylinders

STORAGE

- Cylinders must be stored in cool, dry and well ventilated places. Cylinders in excess of the exempted quantity must be stored in approved dangerous goods stores.
- Cylinders must be kept away from sources of ignition or excessive heat.
- Cylinders must be stored upright and secured from falling by chains and straps.
- Cylinders should not be placed where objects may strike or fall on them, possibly damaging the cylinders or their components.
- Cylinders should not be placed along fire escape routes.
- Incompatible gases must not be stored close together. Oxygen cylinders must be stored away from flammable gases.
- Cylinders not in use should be returned to the store.
- Cylinders should be correctly tagged “full”, “in-use” or “empty”. Cylinders should be considered empty while positive pressure (25 psig or greater) still remains, in order to prevent suckback and contamination.
- Cylinder valve of “empty” cylinders must be closed to avoid contaminants from getting into the cylinder.

TRANSPORTATION / HANDLING

- Cylinders should be transported with proper cylinder carts. Cylinders must be securely tied down onto the carts.
- Cylinders must be secured with chains or ropes to a cradle or platform before they are moved by crane, hoist, or forklift.
- Do not drag, roll, or slide cylinders. Cylinder valves should be protected with caps during transportation.
- Never drop a cylinder or permit cylinders to strike each other violently.
- Protect cylinders from any object that will produce a cut or abrasion in the surface of the metal.

USE

- Never accept or use a leaking cylinder.
- Cylinders must be clearly marked with the content of the gases inside. The colour of the cylinders should not be relied upon for identifying their content.

- Some compressed gases are more hazardous than others. Make sure you know the hazardous properties of a cylinder's content and the appropriate precautions in handling the gas. You can get the information by studying the Materials Safety Data Sheets (MSDS) for the gas.

- Any cylinder with a valve that cannot be opened by hand or using a manufacturer supplied opening device must be returned to the supplier. Do not use a pipe wrench, hammer, or extension rod to open or loosen a cylinder valve.

- Cylinder must not be used without an appropriate regulator.

- Compressed gas regulators for different types of gases cannot be used interchangeably. Use only the right type of regulator for the right gas.

- Do not force fit regulators or fittings to cylinders.

- Cylinders, cylinder valves, couplings, regulators, hoses, and apparatus must be kept free of oily or greasy substances. This is especially important for oxygen cylinders. Not observing this may result in an explosion. Store and handle regulators and fittings properly to prevent contamination of oil or grease.

- Fittings and piping which contain copper must not be used for acetylene gas cylinder to prevent the formation of explosive compounds.

- Gases must never be mixed inside cylinders.

- Close cylinder valves when not in active use.

- Whenever an oxidizer and a fuel gas are used (such as in an oxy-acetylene torch), reverse-flow check valves and "flash back arresters" must be fitted for each gas.

- Gaseous acetylene under pressure may decompose with explosive force. Never use acetylene at pressures in excess of 15 psig.

- Regularly inspect gas cylinders for obvious signs of defects, deep rusting, or leakage.

- Hoses and fittings of adequate pressure rating must be used for connection compressed gas cylinders.

- Hoses should be securely connected to cylinders by appropriate fixing device. Flexible hoses should be connected with proper hose clamps. Hose clamp with large contact surface should be used for clamping flexible hose on glass hose tail to prevent damaging the glass fitting.

- Never strike an electric arc or direct a flame at a cylinder, or make a cylinder as part of an electric circuit.

PROPER PROCEDURE FOR OPENING AND SHUTTING DOWN CYLINDER VALVES

- Check if the proper type of regulator is fixed to the cylinder valve outlet. Check if the pipe lines and hoses are properly connected and securely clamped.

- Turn the pressure adjusting screw of the regulator **counter-clockwise** until it turns freely to ensure that the regulator is OFF.

- SLOWLY open the cylinder valve until the cylinder pressure gauge on the regulator reads the cylinder pressure. DO NOT stand in front of the regulator since it is the weakest point of the system and there is a high risk of the regulator being blown off when thing goes wrong. Stand aside when opening the cylinder valve.

- With the cylinder valve open, set the desire deliver pressure by turning the pressure adjusting screw **clockwise** until the desired pressure is reached.

- Always keep the cylinder valve free of obstructions such as tools, rags, and hoses etc. to permit easy and immediate gas cutoff.

- When the work is finished, always turn off the cylinder valve first and then the regulator. The pressure gauges should be brought back to zero. Use the cylinder valve instead of the regulator valve for turning off the gas.

- Before removing the regulator, make sure that the cylinder valve is closed.

A United Front for Safety — Departmental Safety Officer Meeting

Departmental Safety Officers (DSOs, formerly known as departmental Fire and Safety Officers, FSOs) play a key role in the HKUST safety management structure. They are the front line people in each campus unit to serve on, and sometimes chair, the department safety committee, develop and/or implement department safety programs, co-ordinate safety training requests, and liaise with SEPO on other safety related matters.

Most of the DSOs are not trained as safety professionals, and therefore may not have technical safety background or specialized training. This is where SEPO can offer assistance. Through collaborative effort, DSOs can become our partners in each department and office to help promote safety awareness and commitment to safe work practices. We believe safety awareness and commitment are an integral part of all research, teaching and operational activities on campus. In fact we envisage that through fulfilling established safety requirements, everyone working with hazardous materials or engaging in hazardous operations should become a virtual safety professional in his/her own field.

On 27 May 1996, SEPO held an annual meeting for all DSOs. We also invited all the Department Heads to attend. This was an occasion for this special group of colleagues to meet each other, to exchange information and experience, and to refresh our commitment to further strengthen the departmental safety programs at HKUST. We took this opportunity to express our appreciation to all DSOs and their efforts and achievements in the past year, and especially to honor a number of outstanding DSOs, who have contributed to significant improvements in their respective department safety programs. About 60 people representing more than 20 departments and offices attended.

Dr Ming Fang of Research Centre sharing their Safety experience.

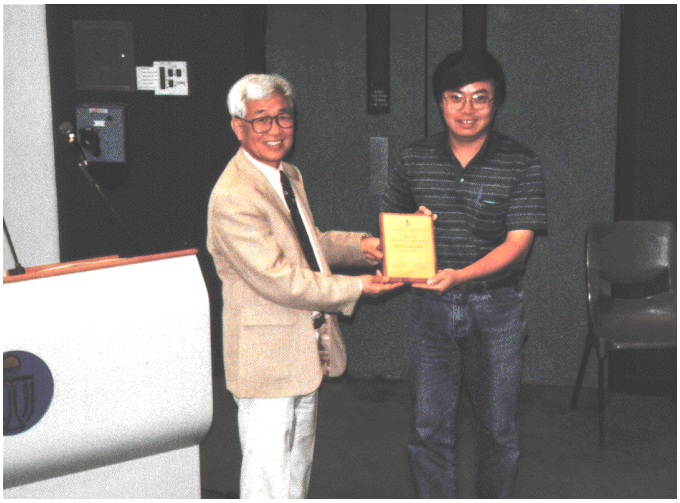
Dr Paul Carlier of Chemistry receiving the honorary plaque from Prof Kung.

Prof S D Kung, the VP-AA, was there to remind the audience the utmost importance of campus safety, and he presented the honorary plaques to the four outstanding DSOs. Dr Joseph Kwan, the Director of Safety and Environmental Protection recapped the essential elements of a department safety program, and encourage all DSOs to continue their good work. We also invited three outstanding DSOs to share their experience and personal thoughts.

Dr Paul Carlier of Chemistry gave an informative presentation of their department safety program, which includes a Chemistry Department Safety Manual modeled after the US requirements of Chemical Hygiene Plan, and the first department personnel safety clearance system. Dr Ming Fang of Research Centre recounted his early safety experience on campus, and introduced the monthly all-hands safety meeting of RC, and a near-miss reporting system in their unit. Dr Yong Xie of Biology talked about his "mixed feeling" of being recognized as outstanding, and the "pressure" to do even better. All of the speakers expressed their gratitude to technical staff who help them in implementing the safety program.

Dr Yong Xie of Biology receiving the honorary plaque from Prof S D Kung.

Refreshment was served at the end of the meeting as a small token to show SEPO's appreciation to all our partners in promoting campus safety.



Mr Hing Sing Tsui of Research Centre receiving the honorary plaque from Prof Kung.

HOW TO CONTACT SEPO

		Ext	E-mail
SEPO General Enquiry		6513	SAFETY
Occupational Hygienist	Mr. Al Clancy	6509	EOCLANCY
Environmental Engineer	Dr. Pete Swearengen	6510	EOPETE
Safety Engineer	Mr. T S Li	6511	EOTSLI
Health Physicist	Dr. Paul Chan	6535	EOMCHAN

Fell free to call any of us or send us an E-mail if you have specific safety or environmental related questions.

Traffic Safety

There had been two traffic accidents on and near campus within a week in June. One accident involved a private car hitting several pedestrian barriers while approaching the campus via University Road. The vehicle was serious damaged and a pedestrian was injured. We learned that the driver momentarily dozed off while driving. Another accident involved a private car knocking over several barriers and a lamp post at the sea front. The car was badly damaged.

The University is built on very steep terrain. Therefore, most part of the roads on campus is very steep and with very sharp bends. Extreme care must be exercised when driving along these roads. ALWAYS DRIVE AT A SAFE SPEED.

The roads on campus are private roads. However, the safety provisions in the Road Traffic Ordinance and its subsidiary Regulations also apply to private roads. Remember to observe the following safety provisions stipulated in the ordinance and regulations:

- Must not drive carelessly or recklessly.
- Must not drive under the influence of alcohol and drugs.
- Must not drive without a valid driving licence.
- Must not drive in excess of speed limit.
- Must not violate traffic signs and road markings. Give way to pedestrians in front of marked pedestrian crossing.
- Must wear seat belts.
- Must wear safety helmets for drivers and passengers on motor cycles.

All vehicles driven on campus must be:

- Properly registered and licensed.
- Covered with a valid motor vehicle third party insurance policy.
- In compliance with the legal requirements in construction and maintenance.

SAFETYWISE

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An Explosive Nitric Acid-Ethanol Mixture

A postgraduate student in a local university prepared 450 mL of an electro-polishing solution by mixing concentrated nitric acid and ethanol in a 1:2 ratio as indicated in a published research paper. The student observed "no significant temperature rise" over 3 hours, he then capped the winchester bottle and went home. About 4 hours later, the bottle exploded, scattering glass fragments to a distance of 12 meters and with enough force to break another winchester bottle containing oil 1.75 meters away, and a plastic shield 4 meters away. Fortunately there was no one in the laboratory at the time, otherwise the powerful explosion could have caused serious injuries.

According to Bretherick's Handbook of Reactive Chemical Hazards, such mixture is "best described as an unstable ... rocket fuel mixture"! In a correspondence between the safety personnel of the tertiary institute and the author of this well-known reference, Mr Bretherick further commented that:

1. It is important for any description of experimental conditions to specify whether the proportions are by weight or volume, the strength of the acid, and the grade of alcohol to be used. Different grades of ethanol can contain up to 5% or more of denaturants, of which some (methanol or isopropanol) could adversely affect the reactivity of ethanol and nitric acid.

2. It has been known for 50 years that mixtures of ethanol with above 10% by weight of concentrated nitric acid are unstable, and that mixtures above 5% wt concentration should not be stored in closed containers, particularly after use as metal etchants, when the dissolved metal may catalyze the decomposition. It has also become clear during that period that nitric acid is the common reagent most often involved in violent chemical reactions, decompositions or explosions. This is a consequence of the fact that nitric acid, unlike other oxidants, still functions as such when cold and dilute, and oxidation is always accompanied by gas evolution, sometimes very slow but progressive. It is also able to form explosive ethyl nitrate by slow acid catalyzed esterification.

3. While mixtures of alcohols with perchloric acid (such mixtures are also used for electro-polishing) are largely free of these gas generation problems, they have their own potential problems. Perchloric acid is an excellent catalyst for esterification reactions. So its mixtures with alcohols will develop explosive alkyl perchlorates. Ethanol denatured with methanol would give both ethyl and methyl perchlorate, the latter being less stable. Through long standing of the open mixture significant evaporation might occur and a dangerous concentration of perchlorate might arise.

4. It is important to establish whether etching solutions should be retained after use, where heavy metals (particularly catalytically active transition metals) may have been dissolved. There are two distinct reasons for this, the first being that such metals may adversely affect the stability of the contaminated solution by accelerating the decomposition rate. Secondly, explosive fulminate salts of heavy metals could form in and separate from the used etching solution. Disposal of the used solutions, either from nitric acid or perchloric acid-based solutions should be considered an integral part of the whole operation.

These are valuable reminders for all material scientists who may need to use such etchant solutions, and in fact for all other researchers who use nitric acid for various purposes.

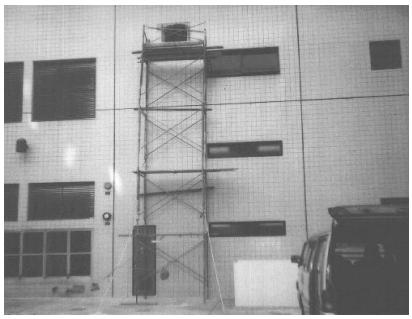
Did you get it right ?

- Answers to Safety Quiz in the last issue of Safetywise.

1

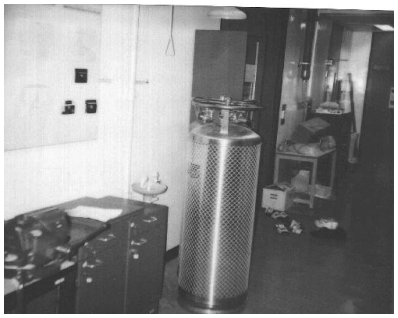
Emergency Exit

2



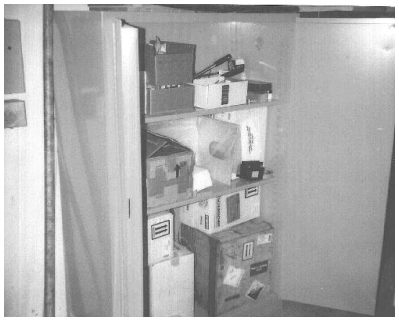
Platform for working at height

3



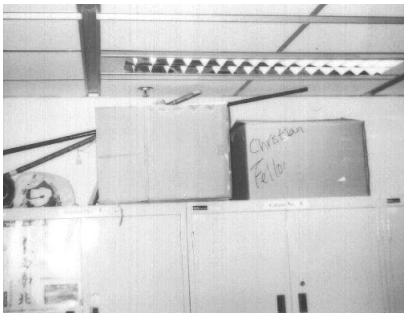
Emergency shower and eyewash

4



Inside a "Flammable" storage cabinet

5

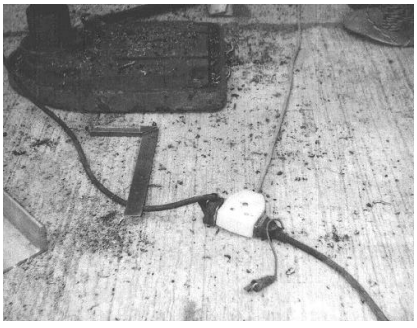


Fire sprinkler

6

Machinary

7



Electrical plugs and cords

Answers :

1. Emergency exit should never be blocked or locked up.
2. Unstable platform, without proper access.
3. Emergency shower and eyewash should not be blocked.
4. Non-flammable materials should not be stored inside cabinet designated for flammables.
5. Fire sprinkler head is blocked by boxes.
6. Machine safety guarding missing.
7. No proper grounding for one of the plugs also the cord presents a tripping hazard.