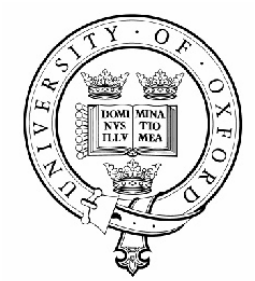

OXFORD UNIVERSITY

PHYSICAL AND THEORETICAL CHEMISTRY LABORATORY

NOTES ON GOOD LABORATORY PRACTICE 2006 - 07

CONTENTS

1. INTRODUCTION

1.1 When you work in a potentially dangerous environment such as a chemistry laboratory, safe operating procedures are vital. This document outlines how to develop and follow such procedures. The steps that you are required to take are not simply a matter of internal PTCL policy; they must also be in accord with policies laid down by the University Safety Office. In turn these are drafted to ensure that the University complies with national and European regulations.

Safe working therefore does not just mean that you must use common sense and follow sound scientific principles when in the laboratory (though both are important). You must also carry out your work in a way that satisfies the relevant formal requirements.

1.2 When undertaking experimental work, you are required to follow the rules outlined below; if you ignore them, your work may be curtailed or halted. Worse, you may put yourself and your fellow workers in danger. Before you start experimental work of any sort in the laboratory, the whole of this manual must be read and understood.

The key topics for most research workers are Risk Assessment and the COSHH (Control of Substances Hazard to Health) Regulations, which are described in more detail in sections 2 and 3. This document also discusses several other important topics.

To ensure that information is as up-to-date as possible, more detailed information is given on several web sites, particularly

http://ptcl.chem.ox.ac.uk/internal/risk/PTCLsafety.html

1.3 The steps that you must take to ensure safe working are, in outline, straightforward. When you plan a new task (for example, a chemical synthesis, the alignment of an exposed laser beam, working at height, or working with radiochemicals), you must first determine the potential hazards associated with it; this is the Risk Assessment. If the task involves the use of hazardous chemicals, there is a second step to take: the preparation of a COSHH Assessment and if the operation itself is hazardous you will in addition need to prepare a Protocol, defining how the operation will be carried out.

When you prepare a Risk Assessment for the first time, you might think the process is tedious or unnecessary. However, even if you think that this is merely a form-filling exercise, it is essential. Appropriate paperwork must be prepared and kept as evidence that the Assessment has been completed. If an accident were to occur and the HSE (Health and Safety Executive) investigated, one of their first actions would be to ask to see the relevant paperwork. More importantly, the process of preparing an Assessment forces you to thoroughly consider the risk in your operations; as a consequence, your work in the laboratory should be safer.

These notes explain how to make a Risk Assessment and prepare the appropriate paperwork. They also outline the procedure for preparing a COSHH Assessment. If you carry out both steps before starting any new experimental procedure, you will have done much to ensure your own safety, and that of your co-workers.

2. RISK ASSESSMENT (See University Safety Policy S2/97)

2.1 <u>You are legally required to assess the risks associated with any operation before work is started</u>. The scope of the relevant legislation is wide: operations which must be assessed include all those which are obviously hazardous, such as a chemical synthesis that uses dangerous materials, but also included are those in which the risk may be less obvious, such as moving a heavy load, using a ladder to paint a wall or moving chemicals from one building to another along a public road. The legislation therefore relates not only to activities within research laboratories, but also to work in the Laboratory's workshops and even in offices and public areas such as lecture theatres and hallways.

Most operations carried out in a research laboratory require risk assessment. For some of them, the Assessment will be quick and will establish that the procedure is essentially risk-free. If the risk is trivial, you need go no further - no paperwork is required.

However, if it is possible that people might be hurt during the operation (a chemical reaction might go wrong, a laser beam might be reflected into the eye, you might injure your back while moving a heavy weight...), you must prepare

and retain a written Assessment. Examples of Risk Assessments can be found on the web site

http://ptcl.chem.ox.ac.uk/internal/risk/radownloads.html

The site contains a downloadable Risk Assessment template and associated Guidance Notes.

If a relevant Assessment is available, you may use one prepared by another group as a starting point, provided that any previous Assessment is modified as appropriate to take into account differences in operation between groups.

2.2 Key aspects of Risk Assessment

The risk assessment process can be summarized as follows:

2.2.1 What should be done first?

For ANY new process or operation, identify the hazards that the process might present; for example, exposure to harmful chemicals, the risk of falling from a height, the risk of being hurt while moving a heavy load, etc.

2.2.2 Is the operation completely safe?

If it is clear that the process involves no significant risk (for example, the handling of harmless, non-toxic solutions), you need go no further; no written Assessment is required.

2.2.3 If there is some risk, can it be reduced to an acceptable level?

Consider whether it is possible to reduce the risks to a level at which they become negligible. You might, for example, be able to substitute a toxic chemical in a synthesis by a less dangerous chemical, or be able to use lifting equipment to move a heavy load, rather than moving it by hand. If the risks can be made trivial by such a change, no written Assessment is necessary.

2.2.4 What if the risk cannot be eliminated?

If there is some risk in the operation, even if the probability of harm is small, a written Assessment is required.

2.2.5 How do I prepare the Assessment?

Download the Risk Assessment template and the associated Guidance Notes from

http://ptcl.chem.ox.ac.uk/internal/risk/radownloads.html

and prepare a written Assessment. Identify those who might be harmed during the process; typically this will be those in the research group who will be performing the operation, but it might also include contractors or visitors to the laboratory.

The Assessment may need to include checks on safety equipment that are required before the operation can be begun.

2.2.6 Who should have a copy of the completed Assessment?

Issue a hardcopy of the Assessment to all who will be involved in the operation and ensure that each person has signed and dated a master copy of it. File the Assessment in a safe location and provide the Departmental Safety Officer with

(i) a hardcopy of the signed Assessment; and
(ii) an electronic version of it.

2.2.7 Can I forget about the Assessment once it has been prepared?

If significant changes are made to the operation for which the Assessment has been prepared, review the Risk Assessment and if necessary update it. The Assessment exists to inform workers and to guide them in a potentially hazardous procedure, so it should be referred to periodically, especially if new research workers enter the group.

2.2.8 Is that all?

No. At the start of your time in the PTCL you must also (normally with the help of your supervisor or a senior member of the group) prepare a personal risk assessment, which is a very general statement of the kinds of risks that you may encounter in your work in the laboratory and the persons responsible for ensuring that you can handle those risks effectively. A Personal Risk Assessment, which can be downloaded from

http://ptcl.chem.ox.ac.uk/internal/risk/radownloads.html

must be completed before work in the laboratory starts. It must be reviewed and re-signed annually, and should be amended if any significant new risk is introduced.

A copy of the signed Personal Risk Assessment must be provided to the Departmental Safety Officer.

3. COSHH (See University Safety Policy S6/05)

3.1 If you use a chemical that presents a hazard to health (which may be as a result of skin contact, inhalation or ingestion, but could also be through the potential for fire or explosion), you are required to make a COSHH Assessment of it before the chemical is used.

Like Risk Assessment, the creation of a COSHH Assessment is, in principle, quite simple: you identify the hazards that the chemical may present, then decide how those hazards will be reduced to an acceptable level. This might be done by ensuring that the chemical is used only in a fume cupboard, by containing it completely within a vacuum system or (best of all) by using a less hazardous chemical. It is often convenient to prepare the Assessment electronically, but you must eventually print out and retain a signed hardcopy of it.

3.2 Most COSHH Assessments have as their starting point MSDS ("Material Safety Data Sheets") data from a chemical supplier. Suppliers are legally required to provide MSDS data on the chemicals purchased from them if asked, and the data on such a sheet will help you to identify the risks that a chemical might pose. When you order a chemical through PTCL stores, write NO in the "Have you used this chemical before?" column if you wish to receive MSDS data from the supplier.

Before purchasing a chemical for the first time, try to determine the risks associated with its use so that you do not discover, once it is delivered, that the chemical is too dangerous for the procedure you had in mind. Abbreviated safety data is available in supplier's catalogues; more extensive data can be found at supplier's web sites and at

http://ptcl.chem.ox.ac.uk/MSDS

If you have not had to interpret MSDSs before, consult the following web site for an outline of the format and use of MSDS information:

http://ptcl.chem.ox.ac.uk/MSDS/interpretingmsds.html

3.3 Once an Assessment has been prepared for a particular chemical it is not necessary for each new worker in the same research group to prepare a fresh

Assessment unless the way in which the chemical will be used is very different. However, incoming workers must sign the COSHH Assessments for all chemicals that they will use to indicate that they have read and understood the Assessment.

3.4 Key aspects of COSHH Assessments

3.4.1 What chemicals are covered by COSHH?

The range of substances covered by the COSHH regulations is very broad. The regulations apply to most pure chemicals used in chemistry laboratories, as well as to many products such as glues, fluxes, solders, oils, paints and cleaners. All substances that are classified as toxic, harmful, corrosive, irritant or sensitising and also those that may present carcinogenic or reproductive hazards, that present a biological risk, create harmful airborne powders or have workplace exposure limits in place fall within the scope of the regulations.

In simple terms, if there is an orange hazard warning label on the package, a COSHH Assessment may be required.

3.4.2 What about “harmless” chemicals?

It seems from point 3.4.1 as though you need to prepare a huge amount of paperwork, but fortunately the situation is not that bad. Every chemical needs to be “assessed”, but for relatively harmless chemicals, that assessment will probably amount only to establishing that normal safe laboratory practice will be sufficient to prevent harm.

If the MSDS sheet contains the designation “Non-hazardous according to Directive 67/548/EEC”, no COSHH form is required

If the MSDS data does not contain this designation, but the chemical is comparatively harmless, it can be included in a generic assessment. This is simply a list of chemicals for which you have considered the potential hazards and decided that no individual assessment is required. You should prepare one list electronically for each research group and add low risk chemicals to it as they are acquired.

For those who are interested in such things, an outline of the relevant legislation, *The Directive on Dangerous Substances*, is available at

http://europa.eu.int/comm/environment/dansub/home_en.htm

3.4.3 An Assessment is necessary for one of my chemicals - what do I do?

Some chemicals do merit an assessment. Chemicals that present any of the following risks must ALWAYS be formally assessed:

(i) Highly toxic chemicals;
(ii) Known or suspected human carcinogens;
(iii) Sensitizers;
(iv) Chemicals that may cause reproductive damage or harm the unborn child;
(v) Chemicals that cause drowsiness;
(vi) Those for which special first aid provision is required; in particular phenol, hydrofluoric acid, cyanides;
(vii) Chemicals for which a workplace exposure limit (see http://ptcl.chem.ox.ac.uk/MSDS) is established and there is a possibility that this could be exceeded;
(viii) Where there is a risk of asphyxiation;
(ix) Explosive, pyrophoric and biological hazards.

In addition, any other chemical which appears to present significant hazards not listed above must be formally assessed.

When you find you must use a chemical which presents significant hazards, either ask for a blank COSHH Assessment from the Departmental Safety Officer, or if you wish to use an electronic form, download a copy from the safety web site

http://ptcl.chem.ox.ac.uk/internal/risk/radownloads.html

Complete the Assessment, bearing in mind throughout that the aim of the Assessment is to help you to work safely, not just to list the dangers that the chemical might pose.

Note that it is entirely acceptable to prepare a generic assessment for a group of similar compounds. For example, if you will use potassium cyanide and sodium cyanide in similar procedures, you do not need to prepare a separate assessment for each chemical, provided that the assessment refers to both. This is the “activity-based approach” recommended in Policy Statement S6/05.

3.4.4 What should I do once the Assessment is finished?

Assessments must be signed and dated by each worker who will use the chemical. (The forms do not need to be signed by the Head of Department, even though this requirement appears on the form issued by the Safety Office.)

Store the Assessments, once signed, in an easily accessible place in the laboratory in which the chemical will be used. Assessments are meant to be read and used, so locate them where they can be easily consulted; the file in which they are stored should be neatly organised with entries in alphabetical or some other logical order. If the same chemical will be used in several very different ways, it may be necessary to prepare more than one assessment for it, since the purpose of the Assessment is not merely to list hazards, but to specify how those hazards will be mitigated.

3.4.5 Is that all?

You may need to modify an Assessment if changes in the procedure in which the chemical is used render it out of date. Each Assessment must in any case be reviewed, brought up to date if necessary, and re-signed at least once every five years.

4. COMMON SENSE

4.1 Perhaps the most important contributor to safe working is common sense. The majority of accidents in the laboratory (just like those on the roads) occur because someone has done something stupid or foolhardy. Follow the rules, but also think about each process that you and your co-workers carry out and make sure that it is sensible. Bear in mind the cause of the accidents, and their severity, that you will have heard about in the safety introduction at the start of your work in the PTCL.

5. LATE AND DANGEROUS WORKING

5.1 <u>You are not permitted to perform experimental work at any time unless there is at least one person within calling distance. You are not permitted to carry out experimental work between the hours of 8.00 p.m. and 7.00 a.m. unless there is at least one other person present with you in the laboratory.</u> <u>When working between 8.00 p.m. and 7.00 a.m., you must fill in a Late Working slip, obtainable by reception, and leave it on the clipboard there before you start work.</u>

5.2 You are not allowed to do any dangerous experiments outside normal working hours (8.00 a.m. - 5.00 p.m.) without written permission from your supervisor. This written permission must be given to the Departmental Safety Officer before work starts, unless the supervisor himself or herself will be present throughout the work.

6. DISPOSAL OF WASTE

6.1 Paper and "household" waste

Normal non-hazardous waste, such as newspaper or plastic coffee cups can be put into waste bins for collection by the cleaning staff.

6.2 Glass and sharps

Glass and sharps, such as used syringe needles, must not be placed into the normal waste bins, where they may pose a danger to the cleaners. (In addition, our contract with the waste collection company does not include disposal of such material.) If your research group will generate significant amounts of scrap glass and/or sharps, obtain a suitable container from our Stores. If you have small amounts of waste glass (for example, as a result of breakage of glassware), ask if you can add the waste to the glass bin in a neighbouring lab. Ken Roberts will accept waste glass, which must be CLEAN, on Tuesday morning at 11.15 - 11.30 at the bottom of the stairs by the loading bay. Waste sharps must be disposed of through the University Safety Office.

Do not allow waste glass to collect in the laboratory. Never store waste glass (for example disposable pipettes) in such a fashion that if someone tripped they could fall onto the glass.

6.3 Biologically-active waste

If your research work will produce biologically active or clinical waste, special procedures apply - see the Departmental Safety Officer.

6.4 Chemical waste

The responsibility for safely disposing of chemical waste, including waste solvents, rests with each individual research group. The University can only dispose of chemicals that are correctly identified, so all chemicals used in the laboratory must be suitably labelled at every stage.

A few chemicals can be disposed of into the drains, but most cannot. You should be aware that many chemicals interfere with biological processes at water treatment plants. Unless you are certain that disposal down the sink is entirely safe (and legal), arrange for disposal through the Safety Office as outlined below. Consult the Departmental Safety Officer if you are uncertain how to proceed.

When you have chemicals to dispose of, email details of the identity and quantity of the chemicals to: **frances.russell@safety.ox.ac.uk**. Include a statement of the hazards that the chemicals pose. Ms Russell will provide further instructions.

Do not allow waste chemicals to build up in the laboratory. If there is no possibility that a particular chemical will be used again, dispose of it - do not leave it to sit on a shelf and possibly decompose.

6.5 Oil, batteries, aerosol cans

Oil should not be added to waste solvent containers as it can be recycled; there is a special collection point for it. Ask at Laboratory Services for details.

Batteries should not be thrown out with household waste but returned to stores for safe disposal.

Empty aerosol cans should be disposed of through the Safety Office; contact Frances Russell for details.

7. REPETITIVE STRAIN INJURY - RSI

(See University Safety Policy S3/03)

7.1 RSI (or Work-related Upper Limb Disorder, WULD) can arise as a result of a variety of repetitive operations. Although it is commonly associated with computer keyboard use, violinists or piano players can also suffer, as can laboratory technicians who must perform the same operation repeatedly, such as using a mechanical pipette.

RSI is a potentially disabling condition and must be taken seriously. You are unlikely to suffer from its effects, even if you are a heavy computer user, provided that you follow the advice given in the University Safety Policy referred to above. However, if you believe that you may be developing some symptoms of RSI, immediate treatment is important. Contact the Departmental Safety Officer without delay.

8. PROTOCOLS

A protocol is a recipe for safe working; it spells out how an operation which is potentially hazardous must be performed so that the risk is controlled.

Examples of operations for which protocols should be in place before work begins include, but are not limited to: aligning a laser beam if the beam cannot be fully enclosed throughout the operation, weighing carcinogens, diluting concentrated sulfuric acid, working with perchlorates, handling organomercury or organoselenium compounds, working with high voltages, working with extreme poisons such as aflatoxins.

If in doubt about whether a protocol is required for a particular operation, consult the Departmental Safety Officer. Experimental work which merits a protocol must not be started before one has been prepared and submitted to the Departmental Safety Officer.

9 MISCELLANEOUS

9.1 Peroxide testing

Some types of chemicals form peroxides when stored in contact with air. The presence of peroxides may lead to destructive explosions if solutions containing them are heated. A list of chemicals prone to the formation of peroxides is given at

http://ptcl.chem.ox.ac.uk/MSDS/peroxides.html

If you will be using any chemicals susceptible to peroxide formation, you should test for the presence of peroxides at least once every six months and dispose of any samples showing anything above trace levels of peroxide. The Departmental Safety Officer holds a stock of peroxide test papers.

9.2 Electrical equipment

It is illegal for you to attempt to repair any electrical equipment other than items that operate at low voltage (typically below 40V DC). All repairs of equipment operating at line voltage must be undertaken by the Electronics Workshop or Laboratory Services; see the Staff Handbook for details.

All electrical equipment used in the laboratory, whether owned personally or by the department, must bear a current electrical testing sticker. It is your responsibility to ensure that the equipment that you use is suitably tested. If you find equipment that is out of date, or for which testing will shortly be due, contact Laboratory Services (tel 75458) to arrange for it to be tested.

9.3 Pregnancy

If your work involves the use of chemicals and you become pregnant, you must inform your supervisor. The growing foetus is vulnerable to toxins because of the rapid rate of cell division and it may be advisable for you to modify the nature of any experimental work during pregnancy.

9.4 Fire extinguishers

Most fire extinguishers in the department are either carbon dioxide or foam. Because of the force with which gas is expelled, CO_2 extinguishers are not suitable for dry powder fires such as those involving metal powders. Be careful if using this type of extinguisher on a fire in a confined space, such as in a waste paper basket, because the backdraught may throw burning material at you. Foam extinguishers are effective on most types of fire but are somewhat messy. Training in the use of fire extinguishers is provided by the University Safety Office annually.

9.5 Sensitizers

A variety of chemicals are categorized as sensitizers. Most people show no reaction when exposed to such chemicals, but a small number may show a mild allergic reaction on first contact. The allergic reaction often becomes more severe on subsequent exposure, and may eventually lead to a sensitivity to the chemical so great that any exposure at all is disabling or, in the worst cases, life-threatening.

It is important, therefore, to be cautious when dealing with known sensitizers, such as platinum compounds; they may present a considerable hazard to you if you are susceptible. If you believe you may be developing symptoms of an allergic reaction, immediately cease use and consult your supervisor and the Departmental Safety Officer.

9.6 Food and drink

Food and drink are not allowed in any experimental laboratory.

9.7 Smoking

Smoking is not permitted anywhere within the Laboratory. An ashtray is provided beside the steps outside the front door.

9.8 Liquid nitrogen

Liquid nitrogen can produce serious cold burns, but a further danger is that of asphyxiation. If a large quantity of liquid nitrogen is spilled, a thick layer of oxygen-depleted gas will form at floor level. If you take a couple of breaths in this layer (for example, you bend down to tie a shoe lace and take a breath while bent over) you are likely to collapse and continue to breathe air containing insufficient oxygen; death will result within minutes.

For this reason be especially careful when handling liquid nitrogen Dewars. You must always wear safety glasses when filling or moving Dewars because of the risk of implosion, and liquid nitrogen should never be transported in a lift at the same time as people. If you need to move small quantities of liquid nitrogen, use the stairs; to move large Dewars send the Dewar up in the lift unaccompanied with a notice on it to warn people not to enter the lift.

9.9 Gas cylinders

Treat gas cylinders with respect - they contain a considerable amount of stored energy. Large cylinders must always be chained securely; small cylinders can be chained or left in a trolley, but must not be left free-standing. Always remove a regulator before moving a cylinder. Get help if moving large cylinders up or down stairs.

Never open up, modify or tamper with regulators - this is potentially hazardous. On no account use oil or any other material to lubricate or clean a regulator. When gas expands from the cylinder into the regulator body there is substantial compressive heating. This can easily raise the temperature of any oil in the regulator above its flash point, possibly leading to a devastating explosion.

9.10 Inspections

Every part of the laboratory is inspected on a regular basis. If the inspection of your laboratory indicates unsafe working practices your supervisor will receive a written request that action be taken. In extreme cases, a laboratory may be (and on occasions in the past has been) closed until suitable remedial steps have been taken.

There is further information relating to many of the topics dealt with in this document at the web site

http://ptcl.chem.ox.ac.uk/internal/risk/PTCLsafety.html

You should consult this site regularly. Useful MSDS data and a wide variety of other types of data are accessible through

http://ptcl.chem.ox.ac.uk/MSDS

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