University of St Andrews

Working with Cyanides

1. Introduction

Because of the extremely rapid and potentially fatal consequences of cyanide poisoning, the following procedure must be strictly observed for all experiments involving cyanide sources. This includes hydrogen cyanide, sodium cyanide, potassium cyanide, trimethylsilyl cyanide, cyanohydrins or any other chemical that can be reasonably expected to liberate hydrogen cyanide. Cyanide sources can be handled safely under controlled conditions by competent researchers using suitable safety equipment. However, if cyanides are handled incorrectly they can be deadly.

In accordance with HSE guidelines, the best method of control is to eliminate a hazard completely by using alternatives to cyanides. Where safer alternatives exist, these should be used unless there is a compelling reason not to do so.

2. Prior Permission

2.1 Cyanide Experiments in Laboratory 367

The School of Chemistry has a fume cupboard in laboratory 367 reserved for reactions involving cyanide. The laboratory is routinely used by researchers from the Ashbrook, Kay and Philp research groups and must be booked in advance.

If you wish to conduct an experiment involving cyanide, you should contact Sharon Ashbrook (sema), Euan Kay (ek28), Doug Philp (dp12) and Kevin Jones (kj34) as early as possible to arrange suitable dates / times. A minimum of one week's notice should be provided, however, providing as much notice as possible is highly encouraged.

Your e-mail should include:

- Proposed date(s) / time(s) of cyanide reaction (**Normal working hours only**)
- The duration of the experiment (or an estimate if not known)
- The cyanide source being used (e.g. sodium cyanide, trimethylsilyl cyanide)
- The scale of the reaction (i.e. the amount of cyanide reagent being used)

Once dates / times have been agreed, members of the Ashbrook, Kay and Philp groups will be made aware that cyanide will be in use.

2.2 Cyanide Experiments in Alternative Laboratory Spaces

It is possible for reactions involving cyanides to be conducted in a laboratory space other than room 367, however, this requires prior permission from the School H&S Manager and Head of School and is subject to the local arrangements outlined below. **It is emphasised that permission from the H&S Manager and Head of School needs to be given each time an experiment involving cyanide is to be performed.**

- Laboratory users should be informed that cyanide will be in use by e-mail. Planned dates and times should be included in this message (**Normal working hours only**)
- When an experiment involving cyanide is being set-up or manipulated, the minimum number of people should be present in the laboratory. For larger laboratories, it is possible to limit the number of people in a given laboratory bay.
- The fume cupboard where the work is being undertaken should not be used for any other purpose or accessed by anyone else during the procedure.
- The entrance to the laboratory and the fume cupboard where the work is being undertaken must display signs that cyanide is in use.
- Once the reaction is complete, the PI must inspect the fume cupboard and sign-off that it is safe for general use.

3. Risk Assessment

For experiments involving cyanide, the PI is responsible for ensuring a robust risk assessment has been completed before practical work commences and that the researcher carrying out the experiment understands the safe working practices that must be followed.

The risk assessment should include a discussion of the following points:

3.1 Buddy System

Lone working with cyanides is not permitted under any circumstances. A “buddy system” must be adopted. The role of the “buddy” is to watch the person performing the experiment and quickly summon the First Aid worker and contact the Emergency Services in the event a worker is exposed to cyanide. The “buddy” should be listed as a worker on the CHARM form.

3.2 Medical Oxygen First Aider

In the event of cyanide poisoning, the required treatment is rapid administration of oxygen and transport to hospital. A qualified oxygen-therapy first aider (and an oxygen therapy first aid kit) must be identified before the work begins and must be on call when the experiment is carried out.

3.3 Roof Access

The proposed date(s) / time(s) of a cyanide reaction should be discussed with the H&S Manager. This will be cross-checked against planned roof access to prevent external contractors being exposed to harmful emissions.

3.4 Signage

The fume cupboard and door entrance should be posted with warning notices clearly indicating that cyanide is in use (this includes the destruction of cyanide residues).

3.5 Engineering Controls

Cyanides must be handled within an efficient, well-ventilated fume cupboard. The fume cupboard should be clean and free of clutter before any work commences. The sash should be kept at the lowest possible height throughout the experiment. The experimental set-up should be designed such that any hydrogen cyanide gas generated during the reaction is bubbled through a trap containing sodium hypochlorite solution or a suitable basic solution.

3.6 Personal Protective Equipment

Appropriate personal protective equipment (PPE) must be worn at all times. This includes laboratory coat, safety glasses, gloves, suitable trousers and closed-toed shoes.

3.7 Scale of the Reaction

The risk associated with a given reaction will be dependent on the amount of cyanide used so the intended scale of the reaction should be clearly stated in COSHH form. Consideration should be given to the amount of HCN that could potentially be evolved and the steps that would be taken if this occurs (see section 3.11 for more details).

3.8 Transportation of Cyanide Sources

Cyanide sources should be transported in a sealed, secondary container packed with absorbent material to mitigate against accidental breakages and release of hydrogen cyanide. If you have used laboratory 367 to conduct an experiment, any cyanogenic products (e.g. cyanohydrins) must also be transported back to your own research laboratory in secondary containment. The minimum amount of cyanide should be transported and returned to a locked storage cabinet as soon as possible. Cyanides should not be transported in the lift. The designated “buddy” should be present when cyanide is being transported so they can seek help if a spillage occurs in a communal area (see section 3.11.4)

3.9 Measures to Avoid and Control Spillages

Liquid sources of cyanide (trimethylsilyl cyanide, acetone cyanohydrin) should be clamped to help prevent accidental spillages when dispensing the cyanide reagent. Small, contained spills of solid material in controlled areas such as fume cupboards can be swept up and destroyed (see below). Small liquid spills and contaminated equipment can be cleaned using an alkaline solution of sodium hypochlorite ensuring that the pH of the solution never becomes acidic. Appropriate PPE must be worn during cleaning operations. Whenever possible, the reaction vessel should be placed in secondary containment so if the reaction vessel were to break the spillage would be contained.

3.10 Disposal of Cyanide Contaminated Waste

The disposal of solutions containing cyanides directly down the drain or of solids contaminated with cyanides directly into a solid waste container is **strictly forbidden**.

All cyanide waste, solid or liquid, must be made safe by addition to a solution of sodium hypochlorite. Sodium hypochlorite solution (typically 8% available chlorine) is available from stores. The minimum amount of hypochlorite solution required to destroy the total amount of cyanide used in the reaction can be calculated, but it is prudent to use a significant excess of hypochlorite solution to ensure all cyanide residues are destroyed.

This process must be carried out in a fume hood and it should be monitored to ensure that the waste never becomes acidic. After at least 24 hours, or when the waste solution a Prussian blue test shows cyanide to be absent, solids should be removed, washed with water, and placed in a controlled waste bin and the solution poured down the sink in a fume cupboard. Gloves and apparatus (e.g. TLC plates) may be decontaminated in a similar way.

3.11 Emergency Procedures

3.11.1 Liberation of Hydrogen Cyanide

If a cyanide source comes into contact with acid, hydrogen cyanide will be generated. In the event of rapid hydrogen cyanide evolution, the sash should be pulled down and the area evacuated. An assessment of further actions can then be undertaken, but it is likely that specialist assistance will be required.

3.11.2 Inhalation

In the event of an accidental inhalation of hydrogen cyanide (or cyanide salts) oxygen therapy first aid should be administered and an ambulance should be called (999 from a mobile or 9-999 from a University landline).

3.11.3 Direct Contact

In the event of coming into contact with cyanide salts (or solutions) any contaminated PPE or clothing should be removed as quickly as possible. The affected area of skin (or eyes) should be washed for 15 minutes, oxygen therapy applied in a safe area and an ambulance should be called (999 from a mobile or 9-999 from a University landline).

3.11.4 Spillages During Transportation

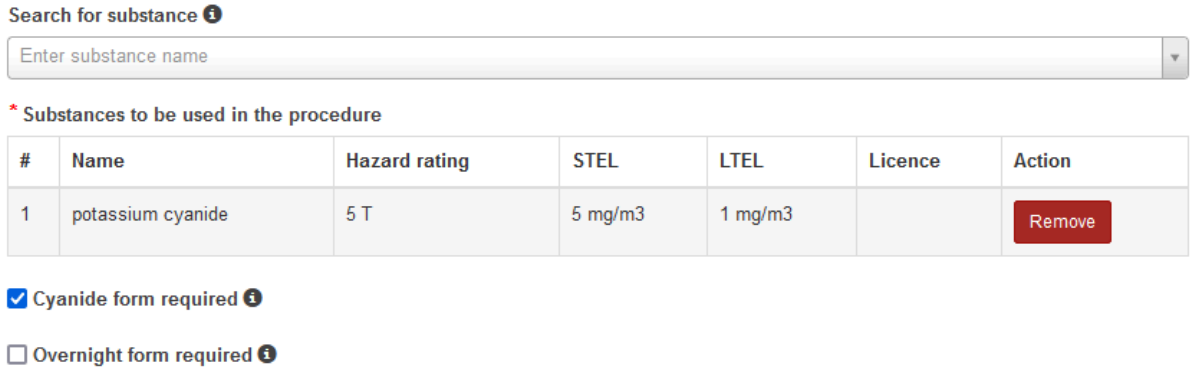
Cyanide sources should be transported in a sealed container with sufficient packing material to absorb any potential spillages. In the event of a small cyanide spillage in a communal area, a spill kit should be used to absorb the material as quickly as possible. In the event of a large-scale spillage, the H&S Manager should be notified immediately, the area will be secured and the building evacuated. These risks will be discussed with the H&S Manager before work commences.

3.11.5 Power Failures or Evacuation

In the event the fume cupboard fails or the fire alarm sounds, the reaction should be removed from any heating source. The reaction set-up should be designed such that any evolved gases pass through a bleach / base solution to prevent release of HCN even if engineering controls fail. The area should be evacuated until the engineering controls are reinstated or the Fire Service state the building is safe for re-entry.

4. Cyanide Form

When completing the risk assessment, the “cyanide form required” check box must be selected.



Search for substance

Enter substance name

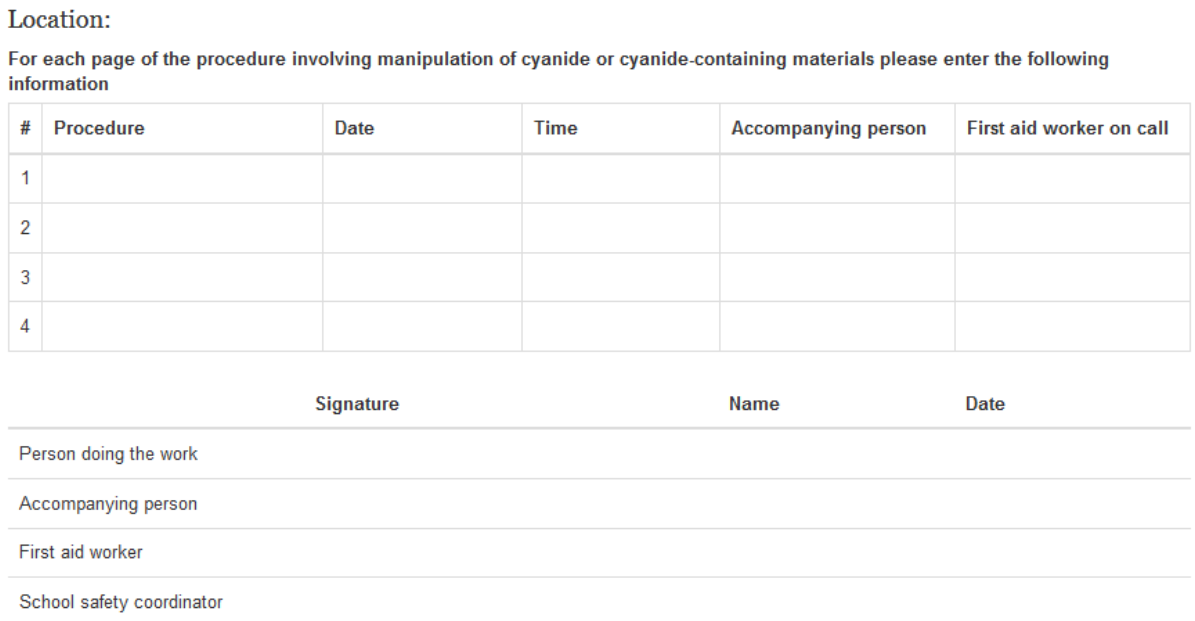
* Substances to be used in the procedure

#	Name	Hazard rating	STEL	LTEL	Licence	Action
1	potassium cyanide	5 T	5 mg/m3	1 mg/m3		Remove

☑ Cyanide form required

☐ Overnight form required

Once the risk assessment has been approved, the option to view / print the cyanide form will be available. This form must be completed showing the dates and times the experiment will be carried out, who is acting as the “buddy” (accompanying person) and the first aider on call. This should be signed by all parties before work commences.



Location:

For each page of the procedure involving manipulation of cyanide or cyanide-containing materials please enter the following information

#	Procedure	Date	Time	Accompanying person	First aid worker on call
1					
2					
3					
4					

	Signature	Name	Date
Person doing the work			
Accompanying person			
First aid worker			
School safety coordinator			

A cyanide form must be completed and signed each time a cyanide experiment is planned.