



OCCASIONAL GUIDANCE NOTE

The Water Supply Industry Standards for Chlorine Gas Installations

INDUSTRY GUIDANCE

1st Edition

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Foreword

The Occupational Health and Safety Group has been instrumental in developing industry specific Occasional Guidance Notes (OGNs) that, in some instances, have been used as the benchmark for other industries. Working closely with the Health and Safety Executive (HSE) the Group has developed a relationship of trust and mutual respect that has been of great benefit to the industry.

The HSE acknowledge that they are not always the most appropriate people to devise industry specific guidance and are reliant on the working relationship that they have with industry representatives in order to ensure that such guidance is fit for purpose. For this reason when a representative of the HSE Stakeholder Group requested that an OGN be developed for the use of chlorine gas in the water industry we were pleased to be able to use our combined experience to produce this guidance.

This document has been written by safety professionals within the water industry, passed by the Water UK Occupational Health and Safety Network and authorised by the Standards Board

A handwritten signature in black ink, appearing to read 'J Marshall', written in a cursive style.

Dr Jim Marshall

Policy and Business Advisor and member of Water UK Standards Board

14 March 2011

Introduction

The Chlorine User group was formed by water companies in response to meeting which had taken place between the HSE, Chemical Industries Association (CIA) and Water UK representatives. The HSE wanted confidence that Chlorine usage was being managed within the Water Industry.

The remit of the group was to establish a series of common areas where industry best practice could be developed. These are:

- Chemical delivery procedures
- Personal Protective Equipment
- Maintenance and Statutory inspections
- Leakage detection and emergency procedures
- Valves and Valve conditions
- Human Factors – including training.

The group took “HSG 40 – Safe handling of Chlorine Drums and Cylinders” as their guidance and worked through the various sections identifying issues and sharing good practice from all group members.

Angela Gregson

Chair

1.0 Risk Assessment

Risk assessments that address the risks associated with chlorine gas should be performed for each chlorine installation with reference to HS(G)40 and this OGN. Depending on the size of the installation, consultation may be required with the following:

- Operators with experience of operating chlorine installations
- Engineers with experience of designing chlorine installations
- Suppliers of chlorine gas
- A security advisor/manager
- An environmental advisor/manager
- A fire risk assessor
- The site manager
- A occupational health & safety professional

2.0 Training

All persons who are likely to encounter toxic gases as a result of activities at a water treatment site, or who are required to perform work with systems containing toxic gases, should be trained and competent proportional to their likely exposure and responsibility (e.g. visitors may simply require a verbal induction or be required to watch a generic DVD). This training should be refreshed at a frequency determined by risk. This training should be supported by an assessment of competence.

2.1 Working on Chlorine Systems

Operatives required to work on chlorine systems should undertake such chlorine and breathing apparatus training as well as such confined space awareness training as is deemed to be appropriate to the risks associated with working within a chlorine store.

Additional considerations:

- Formal training should be refreshed at regular periods not exceeding every three years.
- Formal confined spaces training should ideally be to a nationally recognised standard (e.g. NVQ or EU Skills)
- Donning practice for BA and gas tight suits should be refreshed at regular intervals not exceeding one year.

2.2 Cylinder Changes

All operators connecting drums or cylinders should be trained in the correct method of connection. This method will be documented, available and followed by operatives. This training should be refreshed at regular intervals not exceeding three years.

Operatives should be trained to the manufacturer's recommendations for the release of sticking valves. Posters explaining the approved techniques are available from suppliers and should be displayed in chlorine rooms. When the approved technique is ineffective, containers should be returned to the supplier.

2.3 Transporting Cylinders

Transport of chlorine drums/cylinders to be compliant with the Carriage of Dangerous Goods Regulations and relevant provisions of ADR. Each organisation should refer to any additional national security provision, as directed by DEFRA/DWQR their Dangerous Goods Safety Advisor (DGSA) or security advisor, in the event of any doubt regarding the requirements.

2.4 Maintenance

Operatives maintaining chlorine plant should work to approved written instructions, e.g. for isolation, purging, reconnection and testing.

Regular checks of BA to be undertaken by an appointed person in line with the COSHH regulations and results recorded.

2.5 Emergency Procedures

Operatives who work with chlorine should be trained in the appropriate emergency procedures. This training should be documented and refreshed at regular intervals. This training should include the following:

- Investigating alarms
- Controlling any releases
- Shutting down plant
- Alerting personnel
- Criteria for evacuation
- Escalation
- Reporting to assembly area/accounting for people
- Responding to alarms
- Liaising and cooperating with the emergency services

Additional Considerations

- Where risk assessment identifies a significant risk, due to the presence of large numbers of people or significant quantities of gas an emergency exercise should be undertaken every three years
- Consideration should be given to inviting the emergency services to participate in joint exercises.

3.0 Personal Protective Equipment PPE

PPE will be issued as appropriate to the foreseeable exposure to the toxic gas based on risk assessment and supplier recommendations. Operators must be aware of the location and correct method of donning any PPE supplied. Where reasonably practicable a written record of issue and competence to don will be maintained.

3.1 Respiratory Protective Equipment RPE

RPE provided should incorporate eye protection. All RPE is subject to monthly inspections according to the Control of Substances Hazardous to Health Regulations.

For changing drums or cylinders and for any intrusive work Working Breathing Apparatus (BA) sets are advisable. The BA should be positive pressure and air flow must be controlled via a demand valve. Such intrusive work should not be undertaken when lone working.

Additional Considerations

- A “clean-shaven” policy should be in place to ensure the best fit of any RPE issued.
- Upon issue of Working BA sets RPE it is strongly advised that a face fit test be performed and records maintained. Where considered necessary a program of retesting of face fit should be in place.
- Consideration should be given to the means of preventing visors from misting during use (many BA sets are self demisting however where chemical suits are provided optical anti-mist applications can be obtained)
- BA must be at least 80% full or have a 20 minute supply, whichever is the lesser prior to commencing work.

3.2 Protective Clothing

For operations where exposure will not exceed 3ppm, normal work clothing will offer sufficient protection. Where there is potential for chlorine gas release in excess of 3ppm, due to asset condition, maintenance or other reason, then lightweight splash proof suits should be considered.

Additional Considerations

- Where justified due to the scale of a foreseeable release (>25ppm), consideration should be given to the provision of Level 1 chemical suits. Where Level 1 chemical suits are provided a “dresser” will be required in order to assist with the donning, and checking of correct fit

3.3 Gloves

For most routine applications nitrile, vinyl or rubber gloves / gauntlets are adequate.

3.4 Footwear

Steel toe capped boots with suitable grip should be provided for all operatives. Where type 1 chemical suits have been identified as necessary for foreseeable emergencies, Wellington boots that are either integral or compatible to go over type 1 suits should also be provided.

4.0 Plant Maintenance

Spares availability should be verified prior to commencing any high hazard activity involving a chlorine installation.

4.1 Pig-tail Connections

Pig tail flexible connections should be visually inspected each time that they are used or moved. Following connection or any movement that may have compromised the integrity of the connection, this visual inspection should be backed up by the use of an

ammonia puffer detector consisting of a 10% solution of .88 aqueous ammonia solution absorbed in cotton wool.

Pig tails should be replaced as preventive maintenance using a frequency based on risk with regard to manufacturers recommendation, the number of reconnections, duration of use, and any past incidents. As a guide a change after every 10 reconnections or at least annually is recommended.

Additional Considerations

- Each pigtail should be tagged with the date of installation and/or the number of reconnections made thus providing an accessible record of the age and possible condition of the pigtail.

4.2 Gas Manifolds

Following any maintenance, the system should be dried to exclude any moisture and hence reduce the likelihood of corrosion, e.g. Methods could include purging with oxygen free dry nitrogen.

4.3 Other Plant Items

Other plant items including:

- Auxiliary header valves
- Fixed and rigid pipework
- Catchpots
- Gas changeover panels
- Chlorinators
- Vacuum regulators
- Ejectors/Solution Dosing Lines
- Gas leak detectors
- Pressure gauges
- Ventilation
- Remote Closure Systems (where provided)

Should be subject to periodic inspection as part of a planned maintenance program. Consumable components (e.g. diaphragms) should be replaced on a life expiry basis regardless of perceived condition, other components may be replaced based on condition monitoring.

Additional Considerations

- When designing new plant, lines should be mounted to ensure that they are readily accessible and can be inspected periodically (i.e. they may be below ground but should not require the use of an excavation tool for access to inspect).

5.0 Delivery Acceptance

5.1 Cylinder and Drum Deliveries

During the delivery process. Appropriate measures may include, but are not limited to:

- Impact protection or vehicle segregation at fill / load points
- Trained and competent supervision
- Wherever possible deliveries only accepted during daylight hours.
- Unscheduled deliveries to be refused.
- Vehicles to be chocked or similarly immobilised when performing bulk deliveries.
- Driver and operatives to have emergency equipment, including RPE, to hand and have instructions regarding emergency response procedures.
- A pre-delivery check of the plant and installation should be made prior to connection.
- Quality assurance checks should be made prior to offloading delivery.

Additional Considerations

- A clear documented procedure, preferably with photographs, to provide guidance on acceptable and unacceptable practice for deliveries of chlorine

5.2 Container (Drum / Cylinder) Connections

- Drums and cylinders should not be stored in direct sunlight.
- Stock rotation should be employed in order to minimise the risk of valve seizure.
- Drum caps should remain in place until connected to the live system.
- Trained and competent operatives should oversee all drum and cylinder movements.
- Drum and cylinder connections require a minimum of two persons.
- Driver and operatives should have emergency equipment, including RPE, to hand and have appropriate training in emergency response procedures.
- Crane design and speed to be as specified within HS(G)40
- Cylinder and drum mating devices to be thoroughly clean and new gaskets used on every connection.
- Following connection a leak test should be performed using an ammonia puffer.

Additional Considerations

- Wherever practicable, Cylinders should not be rolled on their rims, instead specifically designed cylinder trolleys should be used.
- Operators should perform an initial on-line pressure check by cracking open the valve, reclosing the valve and then checking for any pressure drop via an installed gauge.
- Vehicles for transporting gas cylinders should be equipped with mechanical lifting equipment e.g. tail lift or hi-ab (for cylinder cages and drums).
- All over pressure connection events should be recorded as a near miss.
- All returns or rejections should be pursued with a written request for a report

6.0 Emergency Preparedness

6.1 Siting and Access

Installations housing chlorine gas should be provided with adequate vehicular access taking into consideration the need for access, not only by vehicles delivering or removing chlorine, but also for the emergency services in the event that they are called to respond to an incident.

Wherever reasonably practicable, the access route should be oriented sensitive to prevailing winds and local topography to ensure the highest likelihood of safe access/egress.

Additional Considerations

- The minimum expectation is for a suitable primary emergency escape route however wherever practicable consideration should be given to the provision of a secondary emergency access/egress route so that, whatever the prevailing wind conditions, a safe means of access/egress is available.
- When designing new plant or installations, the site/building layout should be designed so as to eliminate the need for vehicles to reverse.

6.2 Evacuation Routes

Consideration should be given to the safe evacuation routes and assembly points for any staff that may be affected by a significant gas leak.

On COMAH sites, where risk assessment identifies the necessity, i.e. where escape from a gas leak is unlikely to be viable, safe havens should be provided for staff. Windows and vents should be closed and occupants to remain inside until the all clear is given.

6.3 Gas Detection

Fixed gas detection should be installed in all rooms where gas is stored or used. Sensor heads should be mounted low (as a guide approximately 150-300mm above floor level assuming no ducting within the room) and located with due consideration to the likely flow of any gas escape. Where there is a risk of flooding consider the installation of a pump and a remote sampler.

Additional gas detection should be placed at locations where it is foreseeable that a failure of plant could lead to an accumulation of gas e.g. in ducting carrying vacuum lines.

Sensors should be calibrated following any high level activation and every 12 months as a minimum. They should be replaced on a risk based approach taking into account manufacturers recommendations.

Wherever practicable, a suitable means of ensuring that operatives are not exposed to chlorine levels in excess of the Workplace Exposure Limit (WEL, at the time of publication 0.5ppm) should be in place. This may be via the fixed gas detection system however where the fixed system cannot be set to the WEL, or where planned

work may lead to isolated gas pockets, it is recommended that a personal gas monitor should be provided.

Additional Considerations

- End-to-end testing of the gas detection system should be undertaken annually. This testing should verify that the alarm is received by the control room and that any associated automatic equipment (e.g. exhaust ventilation or RCS devices) function as expected.

6.4 Alarm Systems

A system must be in place to warn those persons who may be affected by an escape of toxic gas of the presence of danger.

Chlorine rooms should be equipped with an external visual signal, such as a warning light, indicating the status of the chlorine alarm. When an alarm is activated this should be supported by an audible signal that is also audible within the gas plant room.

For COMAH sites, neighbours within the Consultation distance of the chlorine store as part of the Emergency Planning requirements have to be provided with information and instructions regarding the danger. For such installations a roof siren should be in place and subject to planned audibility tests every three years.

Gas leaks, other than those that could be reasonably expected as a result of routine operations, should be recorded and investigated.

Additional Considerations

- Consideration should be given to the provision of a positive indication of safety as well as a positive indication of an active hazard outside of each chlorine room i.e. it is better to know that a room is safe to enter by the presence of a green light rather than relying on an assumption that a room is safe to enter due to the absence of a red light.
- Consideration should be given to an external indication of the chlorine concentration within the plant room. The display can either be mounted externally or give a reading to the control room. This would assist in determining whether chemical suits are required for entry to a room.

6.5 Remote Closure Systems (RCS)

Where the likely response time to an uncontrolled discharge, coupled with the possible scale of release and proximity of neighbours suggests that there is a foreseeable chance of harm, consideration should be given to the provision of an RCS in order to automatically shut off the flow of gas from the supply when the high alarm is reached.

Where fitted an RCS should be tested by using the closure system to shut off cylinders at a frequency determined taking into account manufacturers recommendations but ideally at each cylinder change or, as a minimum, every 6 months.

Additional Considerations

- The air intake for an RCS should always be taken from outside of the chlorine installation and away from any discharge vents.

6.6 Containment

Rooms housing gas plant should be designed to minimise the uncontrolled dispersal of gas but equipped with adequate forced ventilation in order to allow controlled dispersal when required.

Rooms are not required to be gas tight therefore where doors and openings are external a small amount of leakage is permitted in order to allow dispersal of any gas. Where doors or openings are internal and there is a risk of gas accumulation within other parts of the building, gas tight fittings should be used. Any floor level ducting should be sealed.

6.7 Extraction / Ventilation

Where provided mechanical ventilation should provide at least six to ten air changes an hour. Airbricks able to provide two air changes an hour are sufficient for small storage rooms though it must be remembered that in the event of a significant leak containment may be necessary and require an ability to seal these openings. The intake for any forced ventilation should be positioned so as to ensure that only fresh air is drawn in (i.e. not adjacent to the exhaust). The exhaust point should be mounted so as to minimise the likely hazard from any chlorine discharge e.g. either:

- high enough to encourage dispersal so that hazardous concentrations are not reached when the plume reaches ground level or
- at ground level so that the plume can disperse provided there are not areas where sudden updrafts of the plume or accumulation of gas can present a hazard.
- Minor chlorine leaks should be dispersed in order to prevent accumulation of the gas to harmful levels. This can be achieved by linking the activation of the extraction system to a low level alarm.
- Significant chlorine leaks should be contained in order to prevent the toxic gas from harming anyone outside of the gas store. This can be achieved by linking the shut down of the extraction system to the high level alarm.

Additional Considerations

- It is advisable to ensure that ventilation is tested periodically in order to ensure that the expected number of air changes over a given time are achieved.

6.8 Venting

Venting of the chlorine line for maintenance should be controlled in order to prevent harmful concentrations of gas accumulating. When systems are shut down for any length of time (greater than 3 weeks) system should be purged and isolated.

Additional Considerations

- As a minimum expectation Vacuum Regulator vents should be safely vented. Wherever reasonably practicable this should be internal and utilize a filter or scrubber unit in order to minimize the occurrences of nuisance alarms.

6.9 Wind Direction Indicators

All COMAH sites should incorporate a suitable means of indicating wind direction.

Additional Considerations

- All sites using chlorine should be equipped with an effective means of indicating wind direction.

6.10 Emergency Equipment

Emergency equipment, such as breathing apparatus, should be sited so that in an emergency it is accessible without the need to enter a potentially hazardous environment. This may be via individual issue or by locating the emergency store sensitive to the prevailing winds and local topography.

6.11 Communication

Each organisation should ensure that in the event of an incident, effective communication can be maintained between all parties that may be involved in the response.

Additional Considerations

- The minimum standard expected is that suitable and effective communication be maintained between all parties that may be involved in the response. Consideration should be given to radio based communication systems that are compatible with BA as this will ensure that the operator who may be in the position of greatest danger is able to communicate with a team operating outside of the danger zone.

6.12 Emergency Information

Emergency instructions for visitors and contractors should be available at the signing in point to the site.

Chemical hazard information should be accessible near to the gas store.

Additional Considerations

Where justified by risk assessment, helpful items and information should be prepared to be available for the emergency services. As a guide, some items that may be of use in an emergency include.

- A laminated ordinance survey map of the local area;
- A laminated site map showing buildings, all access points and fire exits, emergency showers and any relevant hazard information for the emergency services (hazardous chemicals, high voltage equipment etc.)
- Isolation points for services such as gas and electricity.
- Laminated safety data sheets for chemicals held on the site.
- Laminated step by step instructions on how to shut off the gas
- Valve Keys or equipment for accessing and shutting off gas
- The emergency number for the control room;

It would also be advantageous to have access to a portable gas monitor.

6.13 First Aid

First aid equipment suitable and sufficient to deal with foreseeable incidents should be accessible at all locations where it may be required (e.g. within safe havens or at assembly points).

First aid provisions should include some form of CPR device e.g. face shield. Where justified by risk assessment this may include the use of oxygen therapy.

All first aid provisions should be supported by appropriate training.

6.14 Drench Facilities

Emergency drench facilities should be located at convenient locations when justified by risk assessment. Where provided they should be subjected to routine testing, inspection and maintenance procedures.

Glossary

ADR	European agreement on the transport of Dangerous goods by road. An abbreviation from the “Accord européen relatif au transport international des marchandises Dangereuses par Route”
BA	Breathing Apparatus
COMAH	Control of Major Accident Hazards Regulations. These apply whenever the conditions in Schedule 1 of the regulations are met.
COSHH	Control Of Substances Hazardous to Health Regulations.
CPR	Cardiopulmonary resuscitation
DEFRA	Department for Environment, Food and Rural Affairs
DGSA	Dangerous Goods Safety Advisor. A DGSA must be appointed when transporting chlorine.
DWQR	Drinking Water Quality Regulator
HS(G)40	Health and Safety Guidance 40, Safe handling of chlorine from drums and cylinders.
mm	millimetres
OGN	Occasional Guidance Note. Water industry specific safety guidance produced by Water UK for the benefit of its members.
PPE	Personal Protective Equipment
ppm	parts per million
RCS	Remote Closure System
RPE	Respiratory Protective Equipment
WEL	Workplace Exposure Limit