

Mining Environmental Management

CODES OF PRACTICE

Use of Cyanide

Guyana Geology and Mines Commission
Rev 3.0

May 2014

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	REGULATORY AUTHORITY/MANDATE.....	1
1.2	JUSTIFICATION FOR THE USE OF CYANIDE CODE OF PRACTICE	1
1.2	ADMINISTRATION OF CODES AND RESPONSIBILITIES OF OWNERS AND WORKERS.....	1
2.0	GLOSSARY OF TERMS	3
3.0	MISSION AND OBJECTIVES	5
3.1	MISSION STATEMENT.....	5
3.2	OBJECTIVES	5
4.0	SCOPE.....	6
5.0	PRINCIPLES AND CODES OF PRACTICE	7
6.0	GENERAL INFORMATION AND HEALTH ISSUES	30
7.0	REFERENCES	48

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAGEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	---	---

1.0 Introduction

This Code of Practice for **Use of Cyanide** in ALL gold mining (that intend to use cyanide) proposes to provide environmental management guidance and promote the related best management practices. It is not a design manual¹.

1.1 Regulatory Authority/Mandate

The Mining (Amendment) Regulations 2005² were promulgated in 2004. Regulation 237 of the Mining (Amendment) Regulations 2005 stipulated that the Guyana Geology and Mines Commission (GGMC) prepare Codes of Practice for Mercury use, Cyanide use and disposal of effluents prior to their incorporation into the Regulations.

The Codes of Practice were intended to provide critical guidance (with respect to environmental management) to the Mining Industry, particularly small and medium-scale gold mines.

1.2 Justification for the Use of Cyanide Code of Practice

The Mining (Amendment) Regulations (2005) Articles 237 stipulates that GGMC prepare a Code of Practice to provide further guidance for the Use of Cyanide in small and medium scale mines.

1.2 Administration of Codes and Responsibilities of Owners and Workers

A useful strategy for sustainable environmental management in the small and medium-scale gold and diamond mining is co-regulation by the various stakeholders including the GGMC, and the Miners, and Mining Industry.

GGMC's mandate or role as defined by the Mining Act 1989 and the Mining (Amendment) Regulations 2005 is to develop, administer and enforce the mining regulations. Specific responsibilities include:

- Development and upgrading of the codes of practice
- Consultations with the stakeholders in the mining industry including mining organizations and miners on the development, and utility of the Codes Of Practice.
- Public education, orientation and training
- Enforcement of, and monitoring compliance with, the Mining (Amendment) Regulations 2005

The prime responsibility for the implementation of, and compliance with, the Mining (Amendment) Regulations 2005, and the application of sound environmental management practices rests with the Mine

¹ This document is **NOT** a design manual. Users of this document shall assume full responsibility for the design of facilities and for any action taken as a result of the information contained in this document.

² The Mining Regulations, made under the Mining Act (1989), was amended by the Mining (Amendment) Regulations 2005: Collectively they address all the important aspects of mining environmental management.

MINING (AMENDMENT) REGULATIONS 2005	ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE	Version: 3.0 Revision Date: 2019-04-23
--	---	---

Owners and operators. Specifically, with the respect to the Use of Cyanide, the Mine Owners and operators must:

- Manage their operations in compliance with the Mining (Amendment) Regulations 2005, the related Codes of Practices and Guidelines
- Provide their employees with required training and orientation on the Use of Cyanide, and the related the regulations, best management OHS practices, codes and guidelines

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

2.0 Glossary of Terms

<p>Best practice</p>	<p>The best way of doing things. The objective of best practices is to prevent or (when that is not possible) minimize risks to human health, as well as adverse environmental, social and economic impacts.</p>
<p>Co-Regulation</p>	<p>The mechanism whereby a Community legislative act entrusts the attainment of the objectives defined by the legislative authority to parties which are recognized in the field (such as economic operators, the social partners, non-governmental organizations, or related industry associations).</p>
<p>Code of practice</p>	<p>Means the Environmental Code of Practice for the operation of mines that is published by the Commission and which shall be read as part of the Mining (Amendment) Regulations 2005.</p>
	<p>(A collection of rules and ethical principles related to a specific field of activity. A code of practice describes procedures and sets out standards considered to be best practices in the said field of activity. The code may be voluntary or mandatory)</p>
<p>Guidelines</p>	<p>A non-binding document, usually designed to provide users with information, explanations, guidance and help with respect to a specific topic. Guidelines are a tool frequently used to enforce new regulations. Users can be either the Regulator itself or the industry.</p>
<p>Medium-scale mine</p>	<p>A mine for which a mining permit has been issued and from which a volume in excess of 200m³, but less than 1000m³ of material, inclusive of any overburden, is excavated or processed as an aggregate in any continuous period of twenty-four hours.</p>
<p>Mine</p>	<p>Includes any excavation, processing facility and/or related facilities for the recovery of metal, mineral or quarriable material and excludes any excavation, processing facility or related facilities that excavate or process less than 20m³ in any continuous period of twenty-four hours</p>
<p>Regulations</p>	<p>A type of “delegated legislation” enacted by a state, or local government agency given authority to do so by the appropriate legislature</p> <p>Regulations are generally very specific and are also referred to as rules or simply administrative law. Regulations are official rules and must be followed.</p>

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Small-scale mine	A mine for which a claim license has been issued and from which a volume in excess of 20m ³ , but less than 200m ³ , of material, including any overburden, is excavated or processed as an aggregate in any continuous Twenty-four hour period.
STEL	Short-Term Exposure Limit
Sustainable Development (SD)	Development that meets present-day needs without compromising the ability of future generations to meet their needs.
Tailing Storage Facility (TSF)	An impoundment used to place mill effluent containing the leached ore in a water slurry that may contain cyanide. The solids remain in the TSF for disposal and the water may be recycled back to the mill for reuse or may be treated and discharged.
TWA	Time Weighted Average
WAD	Weak Acids Dissociable

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

3.0 Mission and Objectives

3.1 Mission Statement

The following is the Code's mission statement:

Promote sound cyanide management practices in Guyana's small and medium scale gold mining industry so as to minimize impacts on workers, communities and the environment.

3.2 Objectives

- 1) Protect workers, indigenous and non-indigenous communities and the environment from the misuse and mismanagement cyanide in mining.
- 2) Ensure and promote proper cyanide management in the Guyana gold mining industry.
- 3) Promote the Code's use by gold mining operations.
- 4) Raise the awareness of and educate all parties with respect to the effects of cyanide.
- 5) Ensure that cyanide management practices are credible and verifiable.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

4.0 Scope

This Code of Practice is a mandatory code that applies to ALL gold mining operations that use cyanide. It addresses all issues related to cyanide management in the Guyana gold mining industry, namely:

- Occupational health and safety (OH&S);
- Health hazards for communities;
- The environment.

This Code is subject to the Mining (Amendment) Regulations 2005. The Code is intended to complement the regulatory requirements, not to replace them. Compliance with the rules, regulations and statutes is therefore required.

The application of the Code is intended to prevent hazards, accidents, incidents or injury to workers and/or members of the public at any specific site where cyanide is used for gold beneficiation.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
--	---	---

5.0 Principles and Codes of Practice

5.1. PRODUCTION

Principle: Encourage responsible cyanide manufacturing by purchasing from manufacturers that operate in a safe and environmentally protective manner.

Code of practice 5.1.1: Purchase cyanide from manufacturers employing appropriate practices and procedures to limit exposure of their workforce to cyanide, and to prevent releases of cyanide to the environment.

Audit criteria:

1. The operation's contract with all cyanide manufacturer(s) or distributor(s) must require that the cyanide be produced at a facility that has been certified as being in compliance with international or industry standards.
2. Cyanide purchased by the gold mine must be manufactured at a facility or facilities certified as being in compliance with international or industry standards.
3. Verify that in cases where cyanide purchased from an independent distributor(s), the distributor(s) provide evidence that the cyanide shipped to the gold mining operation is from a manufacturer(s) that is certified in compliance with international or industry standards.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

5.2. TRANSPORTATION

Principle: Protect communities and the environment during cyanide transport.

Code of Practice 5.2.1: Establish clear lines of responsibility for safety, security, release prevention, training and emergency response in written agreements with producers, distributors and transporters.

Audit criteria:

1. There must be a written agreement between the operation, the cyanide producer, distributor, and transporter(s) designating responsibility for the following, as applicable:
 - a) Packaging as required by the United Nations for international shipments and by the political jurisdiction(s) the shipment will pass through
 - b) Labeling in languages necessary to identify the material in the political jurisdiction(s) the shipment will pass through, and as required by these jurisdiction(s) and by the United Nations (for international shipments)
 - c) Storage prior to shipment
 - d) Evaluation and selection of routes, including community involvement
 - e) Storage and security at ports of entry
 - f) Interim loading, storage and unloading during shipment
 - g) Transport to the operation
 - h) Unloading at the operation
 - i) Safety and maintenance of the means of transportation (e.g., aircraft, vessels, vehicles, trains, etc.) throughout transport
 - j) Task and safety training for transporters and handlers throughout transport
 - k) Security throughout transport
 - l) Emergency response throughout transport

2. The written agreement must specify the designated responsibilities extended to any subcontractor(s) used by the producer, distributor, transporter or the operation for transportation-related activities.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAGEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	---	---

Code of Practice 5.2.2: Cyanide transporters are required to implement appropriate emergency response plans and capabilities and employ adequate measures for cyanide management.

Audit criteria:

1. Verify that the operation’s contract with the cyanide transporter(s) requires the transporter(s) be certified under international or industry standards.
2. Confirm that the cyanide transporter(s) certified under international or industry standards.
3. Ensure that the operation has chain of custody records identifying all elements of the supply chain (producer, transporter(s), interim storage facilities) that handle the cyanide brought to its site.

5.3. HANDLING AND STORAGE

Principle: Protect workers and the environment during cyanide handling and storage.

Code of Practice 5.3.1: Design and construct unloading, storage and mixing facilities consistent with sound, accepted engineering practices, quality control/quality assurance procedures, spill prevention and spill containment measures.

Audit criteria:

1. Ensure that the facilities for unloading, storing and mixing cyanide been designed and constructed in accordance with cyanide producers’ guidelines, applicable jurisdictional rules and/or other sound and accepted engineering practices for these facilities.
- 2(a). Confirm that the unloading and storage areas for liquid and solid cyanide are located away from people and surface waters.
- 2(b). If not compliant with 2(a), confirm that the operation evaluated the potential for releases to surface water and/or human exposure, and implemented precautions to minimize these potentials.
3. Verify that liquid cyanide is unloaded on a surface that can minimize seepage to the subsurface.
4. Confirm that the cyanide unloading area is designed and constructed to contain, recover or allow remediation of any leakage from the tanker truck.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

5. Confirm that there is a system or mechanism in place to prevent the overfilling of cyanide storage tanks, such as a level indicator and high-level alarm.
6. Ensure that the cyanide mixing and storage tanks located on a concrete or other surface that can prevent seepage to the subsurface.
7. Ensure that there are secondary containments for cyanide storage and mixing tanks constructed of materials that provide a competent barrier to leakage.
8. Ensure that is cyanide stored:
 - a) With adequate ventilation to prevent the build-up of hydrogen cyanide gas.
 - b) Under a roof, off the ground or with other measures to minimize the potential for contact of solid cyanide with water.
 - c) In a secure area where public access is prohibited, such as within the fenced boundary of the plant or within a separate fenced and locked area.
 - d) Separately from incompatible materials such as acids, strong oxidizers and explosives and apart from foods, animal feeds and tobacco products with berms, bunds, walls or other appropriate barriers that will prevent mixing.

Code of Practice 5.3.2: Operate unloading, storage and mixing facilities using inspections, preventive maintenance and contingency plans to prevent or contain releases and control and respond to worker exposures.

Audit criteria:

1. There must be procedures in place and implemented to:
 - a) Prevent empty cyanide containers from being used for any purpose other than holding cyanide.
 - b) Rinse empty cyanide drums, plastic bags and liners with water three times and add the rinse water to the Cyanidation process or otherwise dispose of it in an environmentally sound manner.
 - c) Crush empty cyanide drums prior to disposal in a landfill and burn empty wooden crates in an environmentally sound manner.
 - d) Clean any cyanide residue from the outside of cyanide containers that are returned to the vendor and securely close them for shipment.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

2. The operation has to develop and implement plans or procedures to prevent exposure and releases during cyanide unloading and mixing activities; including but not limited to:
 - a) Operation of all valves and couplings for unloading liquid cyanide and mixing solid or liquid cyanide;
 - b) Handling cyanide containers without rupturing or puncturing;
 - c) Limiting the height of stacking of cyanide containers;
 - d) Timely cleanup of any spills of cyanide during mixing;
 - e) Providing for safe unloading of liquid cyanide and manual mixing of solid cyanide by requiring appropriate personal protective equipment and having a second individual observe from a safe area, or remote observation by video.

5.4. OPERATIONS

Principle: Manage cyanide process solutions and waste streams to protect human health and the environment.

Code of Practice 5.4.1: Implement management and operating systems designed to protect human health and the environment including contingency planning and inspection and preventive maintenance procedures. (GGMC)

Audit criteria:

1. Written management and operating plans or procedures must be developed for cyanide facilities including unloading, mixing and storage facilities, leach plants, heap leach operations, tailings impoundments, and cyanide treatment, regeneration and disposal systems.
2. Ensure that the operation has plans or procedures that identify the assumptions and parameters on which the facility design was based and any applicable regulatory requirements necessary to prevent or control cyanide releases and exposures consistent with applicable requirements, including but not limited to:
 - freeboard required for safe pond and impoundment operation;
 - the cyanide concentrations in tailings on which the facility's wildlife protection measures were based

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

3. Ensure that the operation has plans or procedures that describe the standard practices necessary for the safe and environmentally sound operation of the facility including the specific measures needed for compliance with the Code, including but not limited to inspections and preventive maintenance activities.
4. Ensure that the operation has a system in place to indicate when changes in a site's processes or operating practices may increase the potential for the release of cyanide and to incorporate the necessary release prevention measures.
5. Verify that the operation has cyanide management contingency procedures for situations including but not limited to:
 - when there is an upset in a facility's water balance,
 - when inspections and monitoring identify a deviation from design or standard operating procedures, and
 - when a temporary closure or cessation of operations may be necessary.
6. Confirm that there cyanide facilities are inspected with an established frequency sufficient to assure and document that they are functioning within design parameters.
7. Ensure that the operation inspects the following at unloading, storage, mixing and process areas, as applicable to the site:
 - a) Tanks holding cyanide solutions for structural integrity and signs of corrosion and leakage
 - b) Secondary containments for their integrity, the presence of fluids and their available capacity, and to ensure that any drains are closed and, if necessary, locked, to prevent accidental releases to the environment
 - c) Leak detection and collection systems at leach pads and ponds, as required in the design documents
 - d) Pipelines, pumps and valves for deterioration and leakage
 - e) Ponds and impoundments for the parameters identified in their design documents as critical to their containment of cyanide and solutions and maintenance of the water balance, such as available freeboard and integrity of surface water diversions.
8. Verify that inspections are documented, information includes but is not limited to: the date of the inspection, the name of the inspector, any observed deficiencies, the nature and date of corrective actions documented. Ensure that records are retained.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

9. Ensure that preventive maintenance programs are implemented to verify that equipment and devices function as necessary for safe cyanide management. Ensure that preventive maintenance activities are documented.
10. Ensure that the operation has the necessary emergency power resources to operate pumps and other equipment to prevent unintentional releases and exposure in the event its primary source of power is interrupted.
11. Verify that the back-up power generating equipment maintained and tested.
12. Verify that the back-up power generating equipment has sufficient drain time been incorporated into the water balance to allow acquisition, installation, and activation of such equipment.

Code of Practice 5.4.2: Introduce management and operating systems to minimize cyanide use, thereby limiting concentrations of cyanide in mill tailings.

Audit criteria:

1. The operation must have installed systems to determine appropriate cyanide addition rates in the mill and evaluate and adjust addition rates as necessary when ore types or processing practices change cyanide requirements.
2. Verify that the operation has evaluated and implemented control strategies for cyanide additions.

Code of Practice 5.4.3: Implement a comprehensive water management program to protect against unintentional releases.

Audit criteria:

1. The operation must develop a comprehensive, probabilistic water balance.
2. Verify that the water balance considers the following in a reasonable manner and as appropriate for the facilities and environment:
 - a) The rates at which solutions are applied to leach pads and tailings that are deposited into tailings storage facilities

<p>MINING (AMENDMENT) REGULATIONS 2005</p>	<p>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

- b) A design storm duration and storm return interval that provides a sufficient degree of probability that overtopping of the pond or impoundment can be prevented during the operational life of the facility
 - c) The quality of existing precipitation and evaporation data in representing actual site conditions
 - d) The amount of precipitation entering a pond or impoundment resulting from surface run-on from the up-gradient watershed, including adjustments as necessary to account for differences in elevation and for infiltration of the runoff into the ground
 - e) The effects of potential freezing and thawing conditions on the accumulation of precipitation within the facility and the up-gradient watershed
 - f) Solution losses in addition to evaporation, such as the capacity of decant, drainage and recycling systems, allowable seepage to the subsurface, and allowable discharges to surface water
 - g) The effects of potential power outages or pump and other equipment failures on the drain-down from a leach pad or the emergency removal of water from a facility
 - h) Where solution is discharged to surface waters, the capacity and on-line availability of necessary treatment, destruction or regeneration systems
 - i) Other aspects of facility design that can affect the water balance, such as the assumed phreatic surface in a tailings storage facility
3. Verify that operating procedures incorporate inspection and monitoring activities to implement the water balance and prevent overtopping of ponds and impoundments, and unplanned discharge of cyanide solutions to the environment.
 4. Verify that ponds and impoundments are designed and operated with adequate freeboard above the maximum design storage capacity determined to be necessary from water balance calculations.
 5. Confirm that the operation measures precipitation, and compares the results to design assumptions and that revision of operating practices when necessary.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Code of Practice 5.4.4: Implement measures to protect birds, other wildlife and livestock from adverse effects of cyanide process solutions.

Audit criteria:

1. Verify that the operation has implemented control measures (i.e., fencing, filling in collection ditches with gravel, and covering or netting solution in ponds and impoundments) to restrict access by wildlife and livestock to all open waters where WAD cyanide exceeds 50 mg/l.
2. The operation must demonstrate that the cyanide concentration in open water in TSFs, leach facilities and solution ponds does not exceed 50 mg/l WAD cyanide.
3. Verify that maintaining a WAD cyanide concentration of 50 mg/l or less in open water is effective in preventing significant wildlife mortality?
4. Verify that the operation applies leach solutions in a manner designed to avoid significant ponding on the heap surface and limit overspray of solution off the heap liner.

Code of Practice 5.4.5: Implement measures to protect fish and wildlife from direct and indirect discharges of cyanide process solutions to surface water.

Audit criteria:

1. Verify that the operation does not have a direct discharge to surface water. In cases where there is a discharge, verify that said discharge is it no greater than 0.5 mg/l WAD cyanide.
2. Verify that the concentration of free cyanide downstream of any established mixing zone is 0.022 mg/l or lower. Validate how this has been determined, i.e. that the method used is accepted by industry standards.
3. Verify that the operation does not have an indirect discharge to surface water. In cases where there is a discharge, verify that said discharge does not result in a concentration of free cyanide in excess of 0.022 mg/l downstream of any established mixing zone.
4. If indirect discharges from the operation have caused cyanide concentrations in surface water to rise above levels protective of a designated beneficial use for aquatic life, confirm that the operation engaged in remedial activity to prevent further degradation and restore beneficial use. Operations should cease until restoration is completed.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Code of Practice 5.4.6: Implement measures designed to manage seepage from cyanide facilities to protect the beneficial uses of ground water.

Audit criteria:

1. The operation must implement specific water management or other measures to manage seepage to protect the beneficial use(s) of ground water beneath and/or immediately down gradient of the operation.
2. Verify that WAD cyanide concentrations (or other species of cyanide for which there is a numerical standard established by the applicable jurisdiction) in groundwater are at compliance points below or down gradient of the facility at or below levels that are protective of identified beneficial uses of the groundwater.
3. Verify that the potential impacts to worker health and the beneficial uses of ground water been evaluated and have measures been implemented as necessary to address them, for all cases where the operation uses mill tailings as underground backfill.
4. In cases where seepage from the operation has caused cyanide concentrations of ground water to rise above levels protective of beneficial use, verify that the operation has engaged in remedial activity to prevent further degradation and restore beneficial use.

Code of Practice 5.4.7: Provide spill prevention or containment measures for process tanks and pipelines.

Audit criteria:

1. Verify that spill prevention or containment measures are provided for all cyanide unloading, storage, mixing and process solution tanks.
2. Ensure that there are secondary containments for cyanide unloading, storage, mixing and process tanks sized to hold a volume greater than that of the largest tank within the containment and any piping draining back to the tank, and with additional capacity for the design storm event.
3. Verify that there are procedures implemented to prevent discharge to the environment of any cyanide solution or cyanide-contaminated water that is collected in a secondary containment area.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

4. Ensure that procedures for remediation of any contaminated soil such that adverse impacts on surface or ground water are prevented are in place and implemented, for cyanide process tanks without secondary containment.
5. Verify that there are spill prevention or containment measures implemented for all cyanide process solution pipelines to collect leaks and prevent releases to the environment.
6. Verify that areas where cyanide pipelines present a risk to surface water have been evaluated for special protection needs.
7. Verify that cyanide tanks and pipelines constructed of materials compatible with cyanide and high pH conditions.

Code of Practice 5.4.8: Implement quality control/quality assurance procedures to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications.

Audit criteria:

1. Ensure quality control and quality assurance programs is implemented during construction of all new cyanide facilities and modifications to existing facilities, including cyanide unloading, storage, mixing facilities and other cyanide facilities.
2. Verify that quality control and quality assurance programs address the suitability of materials and adequacy of soil compaction for earthworks such as tank foundations and earthen liners, the installation of synthetic membrane liners used in ponds and leach pads, and for construction of cyanide storage and process tanks.
3. Confirm that quality control and quality assurance records for cyanide facilities are retained.
4. Verify that certified personnel have reviewed cyanide facility construction and provided documentation that the facility has been built as proposed and approved.
5. Where there is no available quality control and quality assurance documentation or as-built certification for cyanide facility construction, verify that an appropriately certified person has inspected those elements of the facility involving cyanide and issued a report concluding that its continued operation within established parameters will protect against cyanide exposures and releases.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Code of Practice 5.4.9: Implement monitoring programs to evaluate the effects of cyanide use on wildlife, surface and ground water quality.

Audit criteria:

1. Ensure that the operation developed written standard operating procedures for monitoring activities.
2. Verify that sampling and analytical protocols were developed by certified personnel?
3. Verify that procedures specify how and where samples should be taken, sample preservation techniques, chain of custody procedures, shipping instructions, and cyanide species to be analysed.
4. Confirm that sampling conditions (e.g., weather, livestock/wildlife activity, anthropogenic influences, etc.) and procedures are documented.
5. Verify that the operation monitors for cyanide in discharges of process water to surface water and in surface and ground water down gradient of the site.
6. Ensure that the operation inspects for and records wildlife mortalities related to contact with and ingestion of cyanide solutions.
7. Verify that monitoring is conducted at frequencies adequate to characterize the medium being monitored and to identify changes in a timely manner.

5.5. DECOMMISSIONING

Principle: Protect communities and the environment from cyanide through development and implementation of decommissioning plans for cyanide facilities.

Code of Practice 5.5.1: Plan and implement procedures for effective decommissioning of cyanide facilities to protect human health, wildlife and livestock.

Audit criteria:

1. Verify that the operation has developed and implemented procedures to decommission cyanide facilities at the cessation of operations.
2. Ensure that the decommissioning plan includes an implementation schedule for decommissioning activities.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

3. Confirm that the operation reviews its decommissioning procedures for cyanide facilities during the life of the operation and revises them as needed.

Code of Practice 5.5.2: Establish an assurance mechanism capable of fully funding cyanide related decommissioning activities.

Audit criteria:

1. Confirm that the operation has developed an estimate of and made budgetary provisions for the cost to fully fund third party implementation of the cyanide-related decommissioning measures as identified in its site decommissioning or closure plan.
2. Verify that the operation reviews and updates the cost estimate at least every five years and when revisions to the plan are made that effect cyanide-related decommissioning activities.
3. Verify that the operation has established a financial mechanism approved by the applicable jurisdiction to cover the estimated costs for cyanide-related decommissioning activities as identified in its decommissioning and closure strategy.
4. If the applicable jurisdiction does not require financial guarantees, confirm that the operation established a mechanism other than self-insurance or self-guarantee to cover estimated costs for the cyanide-related decommissioning activities as identified in its decommissioning and closure strategy.
5. If the operation has established self-insurance or self-guarantee as a financial assurance mechanism, Verify that the operation has provided a statement by a chartered financial auditor that it possess sufficient financial strength to fulfill this obligation as demonstrated by an accepted financial evaluation methodology.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

5.6. WORKER SAFETY

Principle: Protect workers' health and safety from exposure to cyanide.

Code of Practice 5.6.1: Identify potential cyanide exposure scenarios and take measures as necessary to eliminate, reduce and control them.

Audit criteria:

1. Ensure that the operation has developed and implemented procedures describing how cyanide-related tasks (such as unloading, mixing, plant operations, entry into confined spaces, and equipment decontamination prior to maintenance) should be conducted to minimize worker exposure.
2. Verify that the procedures require, where necessary, the use of personal protective equipment and address pre-work inspections.
3. Verify that the operation has implemented systems to review proposed process and operational changes and modifications for their potential impacts on worker health and safety, and incorporate the necessary worker protection measures.
4. Confirm that the operation solicits and actively considers worker input in developing and evaluating health and safety procedures.

Code of Practice 5.6.2: Operate and monitor cyanide facilities to protect worker health and safety and periodically evaluate the effectiveness of health and safety measures.

Audit criteria:

1. Verify that the operation complies with the industry approved pH level for limiting the evolution of hydrogen cyanide gas during mixing and production activities.
2. Where the potential exists for significant cyanide exposure, confirm that the operation uses ambient or personal monitoring devices to confirm that controls are adequate to limit worker exposure to hydrogen cyanide gas and sodium, calcium or potassium cyanide dust to 10 parts per million on an instantaneous basis and 4.7 parts per million continuously over an 8-hour period, as cyanide.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

3. Confirm that the operation identified areas and activities where workers may be exposed to cyanide in excess of 10 parts per million on an instantaneous basis and 4.7 parts per million continuously over an 8-hour period and require use of personal protective equipment in these areas or when performing these activities.
4. Verify that hydrogen cyanide monitoring equipment is maintained, tested and calibrated as directed by the manufacturer, and that maintenance records retained.
5. Confirm that warning signs have been placed where cyanide is used, advising workers that cyanide is present, and that smoking, open flames, and eating and drinking are not allowed, and that, if necessary, suitable personal protective equipment must be worn.
6. Verify that emergency showers, low-pressure eye wash stations and dry powder or non-acidic sodium bi-carbonate fire extinguishers are located at strategic points throughout the operation and are maintained, inspected and tested as per manufacturer's directions.
7. Verify that unloading, storage, mixing and process tanks, and piping containing cyanide are clearly identified to alert workers of their contents, and is the direction of cyanide flow in pipes designated.
8. Confirm that MSDS, first aid procedures or other informational materials on cyanide safety in the language of the workforce are readily available and accessible in areas where cyanide is managed.
9. Verify that procedures in place and implemented to investigate and evaluate cyanide exposure incidents to determine if the operation's programs and procedures to protect worker health and safety, and to respond to cyanide exposures, are adequate or need revising.

Code of Practice 5.6.3: Develop and implement emergency response plans and procedures to respond to worker exposure to cyanide.

Audit criteria:

1. Ensure that the operation has water, oxygen, a resuscitator, antidote kits and a radio, telephone, alarm system or other means of communication or emergency notification readily available for use at cyanide unloading, storage and mixing locations and elsewhere in the plant.
2. Verify that the operation inspects its first aid equipment regularly (as per manufacturer's directions) to ensure that it is in working condition and readily accessible when needed.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

3. Verify that materials such as cyanide antidotes stored and/or tested as directed by their manufacturer(s) and replaced on a schedule to ensure that they will be effective when needed.
4. Verify that the operation has developed (documented) and implemented specific emergency response plans or procedures to respond to cyanide exposures.
5. Confirm that the operation has its own on-site capability to provide first aid or medical assistance to workers exposed to cyanide.
6. Ensure that the operation has developed and implemented procedures to transport workers exposed to cyanide to locally available qualified off site medical facilities.
7. Verify that the operation has made formal arrangements with local hospitals, clinics, etc., so that these providers are aware of the potential need to treat patients for cyanide exposure.
8. Verify that the medical facilities have adequate, qualified staff, equipment and expertise to respond to cyanide exposures.
8. Verify that emergency drills are conducted periodically to test response procedures for various cyanide exposure scenarios, and that lessons learned from the drills are incorporated into response planning.

5.7. EMERGENCY RESPONSE

Principle: Protect communities and the environment through the development of emergency response strategies and capabilities.

Code of Practice 5.7.1: Prepare detailed emergency response plans for potential cyanide releases.

Audit criteria:

1. Verify that the operation has developed and implemented an Emergency Response Plan (ERP) to address potential accidental releases of cyanide.
2. Verify that the ERP considers the appropriate potential cyanide failure scenarios for its site-specific environmental and operating circumstances, including the following, as applicable:
 - a) Catastrophic release of hydrogen cyanide from storage or process facilities

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

- b) Transportation accidents
 - c) Releases during unloading and mixing
 - d) Releases during fires and explosions
 - e) Pipe, valve and tank ruptures
 - f) Overtopping of ponds and impoundments
 - g) Power outages and pump failures
 - h) Uncontrolled seepage
 - i) Failure of cyanide treatment, destruction or recovery systems
 - j) Failure of tailings impoundments, heap leach facilities and other cyanide facilities
3. Confirm that planning for response to transportation-related emergencies considers transportation route(s), physical and chemical form of the cyanide, method of transport (e.g., rail, truck), the condition of the road or railway, and the design of the transport vehicle (e.g., single or double walled, top or bottom unloading).
 4. Verify that the ERP describes specific response actions (as appropriate for the anticipated emergency situations) such as clearing site personnel and potentially affected communities from the area of exposure, use of cyanide antidotes and first aid measures for cyanide exposure, control of releases at their source, and containment, assessment, mitigation and future prevention of releases.

Code of Practice 5.7.2: Involve site personnel and stakeholders in the planning process.

Audit criteria:

1. Confirm that the operation has involved its workforce and stakeholders, including potentially affected communities, in the cyanide emergency response planning process.
2. Verify that the operation has made potentially affected communities aware of the nature of their risks associated with accidental cyanide releases, and consulted with them directly or through community representatives regarding appropriate communications and response actions.
3. Confirm that the operation has involved local response agencies such as external first responders and medical facilities in the cyanide emergency planning and response process.
4. Verify that the operation engages in consultation with stakeholders to keep the ERP current.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Code of Practice 5.7.3: Designate appropriate personnel and commit necessary equipment and resources for emergency response.

Audit criteria:

1. Verify that the cyanide-related elements of the ERP:
 - a) Designate primary and alternate emergency response coordinators who have explicit authority to commit the resources necessary to implement the ERP;
 - b) Identify Emergency Response Teams;
 - c) Require appropriate training for emergency responders;
 - d) Include call-out procedures and 24-hour contact information for the coordinators and response team members;
 - e) Specify the duties and responsibilities of the coordinators and team members;
 - f) List emergency response equipment, including personal protection gear, available along transportation routes and/or on-site;
 - g) Include procedures to inspect emergency response equipment to ensure its availability;
 - h) Describe the role of outside responders, medical facilities and communities in the emergency response procedures.
2. Confirm that the operation has confirmed that external entities included in the ERP are aware of their involvement and are included as necessary in drills and implementation exercises.

Code of Practice 5.7.4: Develop procedures for internal and external emergency notification and reporting.

Audit criteria:

1. Verify that the ERP includes procedures and contact information for notifying management, regulatory agencies, outside response providers and medical facilities of the cyanide emergency.
2. Verify that the ERP includes procedures and contact information for notifying potentially affected communities of the cyanide related incident and any necessary response measures, and for communication with the media.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Code of Practice 5.7.5: Incorporate into response plans and remediation measures monitoring elements that account for the additional hazards of using cyanide treatment chemicals.

Audit criteria:

1. Confirm that the ERP describes specific remediation measures as appropriate for likely cyanide release scenarios, such as:
 - a) Recovery or neutralization of solutions or solids;
 - b) Decontamination of soils or other contaminated media;
 - c) Management and/or disposal of spill clean-up debris;
 - d) Provision of an alternate drinking water supply.
2. Verify that the ERP prohibits the use of chemicals such as sodium hypochlorite, ferrous sulfate and hydrogen peroxide to treat cyanide that has been released into surface water.
3. Confirm that the ERP addresses the potential need for environmental monitoring to identify the extent and effects of a cyanide release, and include sampling methodologies, parameters and, where practical, possible sampling locations.

Code of Practice 5.7.6: Periodically evaluate response procedures and capabilities and revise them as needed.

Audit criteria:

1. Verify that the operation reviews and evaluates the cyanide related elements of its ERP for adequacy on an annual or more frequent basis.
2. Confirm that cyanide emergency drills are conducted periodically as part of the ERP evaluation process.
3. Verify that provisions are in place to evaluate and revise the ERP after any cyanide related emergency requiring its implementation.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

5.8. TRAINING

Principle: Train workers and emergency response personnel to manage cyanide in a safe and environmentally protective manner.

Code of Practice 5.8.1: Train workers to understand the hazards associated with cyanide use.

Audit criteria:

1. Verify that the operation trains all personnel who may encounter cyanide in cyanide hazard recognition.
2. Confirm that cyanide hazard recognition refresher training periodically conducted, at least on a quarterly basis.
3. Verify that cyanide training records retained.

Code of Practice 5.8.2: Train appropriate personnel to operate the facility according to systems and procedures that protect human health, the community and the environment.

Audit criteria:

1. Verify that the operation trains workers to perform their tasks, including unloading, mixing, production and maintenance, with minimum risk to worker health and safety and in a manner that prevents unplanned cyanide releases.
2. Confirm that the training elements necessary for each job involving cyanide management is clearly identified in training materials.
3. Confirm that appropriately qualified personnel provide task training related to cyanide management activities.
4. Confirm that employees are trained prior to working with cyanide.
5. Verify that refresher training on cyanide management is provided to ensure that employees continue to perform their jobs in a safe and environmentally protective manner.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

6. Verify that the operation evaluates the effectiveness of cyanide training by testing, observation or other means.
7. Verify that records are retained throughout an individual's employment documenting the training they receive? Do the records include the names of the employee and the trainer, the date of training, the topics covered, and if the employee demonstrated an understanding of the training materials.

Code of Practice 5.8.3: **Train appropriate workers and personnel to respond to worker exposures and environmental releases of cyanide.**

Audit criteria:

1. Verify that all cyanide unloading, mixing, production and maintenance personnel are trained in the procedures to be followed if cyanide is released.
2. Confirm that site cyanide response personnel, including unloading, mixing, production and maintenance workers, are trained in decontamination and first aid procedures.
3. Confirm that site cyanide response personnel, including unloading, mixing, production and maintenance workers, take part in routine drills to test and improve their response skills.
4. Verify that Emergency Response Coordinators and members of the Emergency Response Team trained in the procedures included in the Emergency Response Plan regarding cyanide, including the use of necessary response equipment.
5. Verify that the operation familiarises off-site Emergency Responders, such as community members, local responders and medical providers, with those elements of the ERP related to cyanide.
6. Ensure that refresher training for response to cyanide exposures and releases regularly conducted.
7. Verify that simulated cyanide emergency drills are periodically conducted for training purposes.
8. Verify that simulated cyanide emergency drills cover both worker exposures and environmental releases.
9. Confirm that cyanide emergency drills are evaluated from a training perspective to determine if personnel have the requisite knowledge and skills for effective response.
10. Verify that training procedures are revised when deficiencies are identified.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAGEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	---	---

11. Verify that records retained documents the cyanide training, including the names of the employee and the trainer, the date of training, the topics covered, and assessment of the employee's demonstrated understanding of the training materials.

5.9. DIALOGUE

Principle: Engage in public consultation and disclosure.

Code of Practice 5.9.1: Provide stakeholders the opportunity to communicate issues of concern.

Audit criteria:

1. Verify that the operation provides opportunities for stakeholders to communicate issues of concern regarding said operation's management of cyanide.

Code of Practice 5.9.2: Initiate dialogue describing cyanide management procedures and responsibly address identified concerns.

Audit criteria:

1. Verify that there are opportunities for the operation to interact with stakeholders and provide them with information regarding cyanide management practices and procedures.

Code of Practice 5.9.3: Make appropriate operational and environmental information regarding cyanide available to stakeholders.

Audit criteria:

1. Confirm that the operation has developed written descriptions of how activities are conducted and how cyanide is managed.
2. Verify that these descriptions are available to communities and other stakeholders.
3. Verify that the operation disseminated information on cyanide in an understandable format in areas where a significant percentage of the local population is illiterate.

MINING (AMENDMENT) REGULATIONS 2005	ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE	Version: 3.0 Revision Date: 2019-04-23
--	---	---

3. Verify that the operation makes information on the following confirmed cyanide release or exposure incidents publicly available:
- a) Cyanide exposure resulting in hospitalization or fatality;
 - b) Cyanide releases off the mine site requiring response or remediation;
 - c) Cyanide releases on or off the mine site resulting in significant adverse effects to health or the environment;
 - d) Cyanide releases on or off the mine site requiring reporting under applicable regulations;
 - e) Releases that are or that cause applicable limits for cyanide to be exceeded.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

6.0 General Information and Health Issues

Synonyms include formonitrile. Aqueous solutions are referred to as hydrocyanic acid and prussic acid.

- Persons whose clothing or skin is contaminated with cyanide-containing solutions can secondarily contaminate response personnel by direct contact or through off-gassing vapor.
- Hydrogen cyanide is a colorless or pale-blue liquid at room temperature. It is very volatile, readily producing flammable and toxic concentrations at room temperature. Hydrogen cyanide gas mixes well with air, and explosive mixtures are easily formed.
- Hydrogen cyanide has a distinctive bitter almond odor, but some individuals cannot detect it and consequently, it may not provide adequate warning of hazardous concentrations.
- Hydrogen cyanide is absorbed well by inhalation and can produce death within minutes. Substantial absorption can occur through intact skin if vapor concentration is high or with direct contact with solutions, especially at high ambient temperatures and relative humidity. Exposure by any route may cause systemic effects.

Description

At temperatures below 78 °F, hydrogen cyanide is a colorless or pale-blue liquid (hydrocyanic acid); at higher temperatures, it is a colorless gas. Hydrogen cyanide is very volatile, producing potentially lethal concentrations at room temperature. The vapor is flammable and potentially explosive. Hydrogen cyanide has a faint, bitter almond odor and a bitter, burning taste. It is soluble in water and is often used as a 96% aqueous solution (NIOSH 2005).

Routes of Exposure

Inhalation

Hydrogen cyanide is readily absorbed from the lungs; symptoms of poisoning begin within seconds to minutes. The odor of hydrogen cyanide is detectable at 2-10 ppm (OSHA PEL = 10 ppm), but does not provide adequate warning of hazardous concentrations. Perception of the odor is a genetic

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

trait (20-40% of the general population cannot detect hydrogen cyanide); also, rapid olfactory fatigue can occur. Hydrogen cyanide is lighter than air (HSDB 2007).

Children exposed to the same levels of hydrogen cyanide as adults may receive larger doses because they have greater lung surface area: body weight ratios and increased minute volumes: weight ratios.

Skin/Eye Contact

Exposure to hydrogen cyanide can cause skin and eye irritation. More importantly, skin or eye absorption is rapid and contributes to systemic poisoning. After skin exposure, onset of symptoms may be immediate or delayed for 30-60 minutes. Most cases of toxicity from dermal exposure have been from industrial accidents involving partial immersion in liquid cyanide or cyanide solutions or from contact with molten cyanide salts, resulting in large surface-area burns (ATSDR 2006).

Children are more vulnerable to toxicants absorbed through the skin because of their relatively larger surface area: body weight ratio.

Ingestion

Ingestion of hydrogen cyanide solutions or cyanide salts can be rapidly fatal (ATSDR 2006). Treatment of ingested cyanide salts is similar to treatment of oral hydrogen cyanide poisoning because cyanide salts form hydrogen cyanide in acidic conditions.

Sources/Uses

Hydrogen cyanide is manufactured by oxidation of ammonia- methane mixtures under controlled conditions and by the catalytic decomposition of formamide. It may be generated by treating cyanide salts with acid, and it is a combustion by-product of nitrogen-containing materials such as wool, silk, and plastics. It is also produced by enzymatic hydrolysis of nitriles and related chemicals. Hydrogen cyanide gas is a by-product of coke-oven and blast-furnace operations (ATSDR 2006; Hartung 1994).

Hydrogen cyanide is used in fumigating; electroplating; mining; and in producing synthetic fibers, plastics, dyes, and pesticides. It also is used as an intermediate in chemical syntheses (Hartung 1994). Hydrogen cyanide may also be found in cigarette smoke (ATSDR 2006; HSDB 2007).

Standards and Guidelines

OSHA PEL (permissible exposure limit) (ceiling) = 10 ppm (skin) (averaged over 15 minutes) (OSHA 1999)

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

EPA AEGL-1 (Acute Exposure Guideline Level-1) = 2.5 ppm (10-minute) to 1 ppm (8-hour) (EPA 2007).

Physical Properties

Description: Colorless gas or colorless or pale-blue liquid

Warning properties: Almond odor; inadequate warning because rapid olfactory fatigue can occur and 20-40% of the general population cannot smell hydrogen cyanide.

Molecular weight: 27.03 daltons

Boiling point (760 mm Hg): 78 F (25.6 °C)

Freezing point: 8 F (-13.4 °C)

Specific gravity (liquid): 0.69 (water = 1)

Vapor pressure: 630 mm Hg at 68 °F (20 °C)

Gas density: 0.94 (air = 1)

Water solubility: Miscible with water

Flammability: Flammable at temperatures >0 °F (-18 °C)

Flammable range: 5.6-40% (concentration in air) (ATSDR 2006)

Incompatibilities

Hydrogen cyanide reacts with amines, oxidizers, acids, sodium hydroxide, calcium hydroxide, sodium carbonate, caustic substances, and ammonia. Hydrogen cyanide may polymerize at 122-140 °F (NIOSH 2005).

Health Effects

- Hydrogen cyanide is highly toxic by all routes of exposure and may cause abrupt onset of profound CNS, cardiovascular, and respiratory effects, leading to death within minutes.
- Exposure to lower concentrations of hydrogen cyanide may produce eye irritation, headache, confusion, nausea, and vomiting followed in some cases by coma and death.
- Hydrogen cyanide acts as a cellular asphyxiant. By binding to mitochondrial cytochrome oxidase, it prevents the utilization of oxygen in cellular metabolism. The CNS and myocardium are particularly sensitive to the toxic effects of cyanide.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Acute Exposure

In humans, cyanide combines with the ferric ion in mitochondrial cytochrome oxidase, preventing electron transport in the cytochrome system and bringing oxidative phosphorylation and ATP production to a halt. The inhibition of oxidative metabolism puts increased demands on anaerobic glycolysis, which results in lactic acid production and may produce severe acid-base imbalance. The CNS is particularly sensitive to the toxic effects of cyanide, and exposure to hydrogen cyanide generally produces symptoms within a short period of time (ATSDR 2006).

Children do not always respond to chemicals in the same manner as adults. Different protocols for managing their care may be needed.

CNS

CNS signs and symptoms usually develop rapidly. Initial symptoms are nonspecific and include excitement, dizziness, nausea, vomiting, headache, and weakness. As poisoning progresses, drowsiness, tetanic spasm, lockjaw, convulsions, hallucinations, loss of consciousness, and coma may occur (ATSDR 2006).

Cardiovascular

Abnormal heartbeat can occur in cases of severe poisoning. Slow heartbeat, intractable low blood pressure, and death may result. High blood pressure and a rapid heartbeat may be early, transient findings (ATSDR 2006).

Respiratory

After systemic poisoning begins, victims may complain of shortness of breath and chest tightness. Pulmonary findings may include rapid breathing and increased depth of respirations. As poisoning progresses, respirations become slow and gasping; a bluish skin color may or may not be present. Accumulation of fluid in the lungs may develop (ATSDR 2006).

Children may be more vulnerable to gas exposure because of relatively increased minute ventilation per kg and failure to recognize the need to promptly evacuate an area when exposed.

Metabolic

An anion-gap, metabolic acidosis occurs in severe poisoning from increased blood levels of lactic acid (ATSDR 2006).

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Because of their higher metabolic rates, children may be more vulnerable to toxicants interfering with basic metabolism.

Dermal

Dermal contact with hydrogen cyanide can cause skin irritation (HSDB 2007).

Dermal absorption can occur, leading to systemic toxicity. Absorption occurs more readily at high ambient temperature and relative humidity (ATSDR 2006).

Because of their relatively larger surface area:body weight ratio, children are more vulnerable to toxicants absorbed through the skin.

Ocular/Ophthalmic

When splashed in the eye, hydrogen cyanide can cause eye irritation and swelling. Eye contact with cyanide salts has produced systemic symptoms in experimental animals (ATSDR 2006).

Potential Sequelae

Survivors of severe exposure may suffer brain damage. Cases of neurologic sequelae such as personality changes, memory deficits, disturbances in voluntary muscle movements, and the appearance of involuntary movements (i.e., extrapyramidal syndromes) have been reported (ATSDR 2006).

Chronic Exposure

Chronically exposed workers may complain of headache, eye irritation, easy fatigue, chest discomfort, palpitations, loss of appetite, and nosebleeds (ATSDR 2006).

Chronic exposure may be more serious for children because of their potential longer life span.

Carcinogenicity

Hydrogen cyanide has not been classified for carcinogenic effects (IARC 2007; IRIS 2007; NTP 2005), and no carcinogenic effects have been reported for hydrogen cyanide.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAGEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	---	---

Reproductive and Developmental Effects

No hydrogen cyanide-induced developmental effects have been reported in humans or in animals at exposure levels that were not maternally toxic (ATSDR 2006). Mild reproductive effects of sodium cyanide have been reported in rats and mice administered the substance orally for 13 weeks (ATSDR 2006). Increased levels of thiocyanate in the umbilical cords of fetuses whose mothers smoked compared to those whose mothers were non-smokers suggests that thiocyanate, and possibly also cyanide, can cross the placenta. No data were located pertaining to hydrogen cyanide in breast milk (ATSDR 2006).

Prehospital Management

- A victim exposed to hydrogen cyanide gas could secondarily contaminate a rescuer attempting resuscitation without a respiratory barrier. Victims whose clothing or skin is contaminated with hydrogen cyanide liquid or solution can secondarily contaminate response personnel by direct contact or through off-gassing vapor. Avoid dermal contact with cyanide-contaminated victims or with gastric contents of victims who may have ingested cyanide-containing materials.
- Hydrogen cyanide poisoning is marked by abrupt onset of profound toxic effects that may include syncope, seizures, coma, gasping respirations, and cardiovascular collapse, causing death within minutes. These effects can occur from all routes of exposure.
- Victims exposed to hydrogen cyanide require supportive care and rapid administration of specific antidotes.

Hot Zone

Rescuers should be trained and appropriately attired before entering the Hot Zone. If the proper equipment is not available, or if rescuers have not been trained in its use, assistance should be obtained from a local or regional HAZMAT team or other properly equipped response organization.

Rescuer Protection

Hydrogen cyanide is a highly toxic systemic poison that is absorbed well by inhalation and through the skin.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is recommended in response situations that involve exposure to potentially unsafe levels of hydrogen cyanide (HSDB 2007).

Skin Protection: Chemical-protective clothing against hydrogen cyanide is recommended because both hydrogen cyanide vapor and liquid can be absorbed through the skin to produce systemic toxicity.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

ABC Reminders

Quickly establish a patent airway, ensure adequate respiration and pulse. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible.

Victim Removal

If victims can walk, lead them out of the Hot Zone to the Decontamination Zone. Victims who are unable to walk may be removed on backboards or gurneys; if these are not available, carefully carry or drag victims to safety.

Victims with chemically-induced acute disorders may suffer from anxiety, especially children who may be separated from a parent or other adult.

Decontamination Zone

Patients exposed only to hydrogen cyanide gas who have no eye irritation do not need decontamination. They may be transferred immediately to the Support Zone. Other patients will require decontamination as described below.

Rescuer Protection

If exposure levels are determined to be safe, decontamination may be conducted by personnel wearing a lower level of protection than that worn in the Hot Zone (described above). **However, do not attempt resuscitation without a respiratory barrier.**

ABC Reminders

Quickly establish a patent airway, ensure adequate respiration and pulse. Stabilize the cervical spine with a collar and a backboard if trauma is suspected. Administer supplemental oxygen as required. Assist ventilation with a bag-valve-mask device if necessary.

Basic Decontamination

Speed is critical. For symptomatic victims, provide treatment with 100% oxygen and specific antidotes as needed. Treatment should be given simultaneously with decontamination procedures. (For treatment, see *ABC Reminders, Advanced Treatment, and Antidotes* below).

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Victims who are able may assist with their own decontamination. Quickly remove and double-bag contaminated clothing and personal belongings.

Flush exposed skin and hair with copious amounts of water for at least 20 minutes. Wash with soap and rinse thoroughly with water. Use caution to avoid hypothermia when decontaminating victims, particularly children or the elderly. Use blankets or warmers as needed.

Flush exposed or irritated eyes with plain water or saline for 5 minutes. Remove contact lenses if easily removable without additional trauma to the eye. Continue eye irrigation during other basic care or transport (HSDB 2007). If pain or injury is evident, continue irrigation while transferring to the Support Zone.

In cases of ingestion, **do not induce emesis. If the victim is symptomatic, immediately institute emergency life support measures including the use of a cyanide antidote (see Antidotes below).**

Provide reassurance to chemically-contaminated victims during decontamination, particularly children who may suffer separation anxiety if separation from a parent occurs.

Transfer to Support Zone

As soon as basic decontamination is complete, move the victim to the Support Zone.

Support Zone

Be certain that victims have been decontaminated properly (see *Decontamination Zone* above). Victims who have undergone decontamination pose no serious risks of secondary contamination to rescuers. In such cases, Support Zone personnel require no specialized protective gear.

ABC Reminders

Quickly establish a patent airway, ensure adequate respiration and pulse. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible. Administer supplemental oxygen as required and establish intravenous access if necessary. Place on a cardiac monitor.

Patients who rapidly regain consciousness and who have no other signs or symptoms may not require antidotal treatment. Those who remain comatose or develop shock should be treated promptly with the antidotes in the cyanide antidote kit (see Antidotes below).

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Additional Decontamination

Continue irrigating exposed skin and eyes, as appropriate.

In cases of ingestion, **do not induce emesis. If the patient is symptomatic, immediately institute emergency life support measures, including the use of a cyanide antidote (see *Antidotes* below).**

Advanced Treatment

In cases of respiratory compromise, secure airway and support respiration according to advanced life support (ALS) protocols.

Patients who are in shock or have seizures should be treated according to ALS protocols. These patients or those who have arrhythmias may be seriously acidotic; consider giving, under medical supervision, 1 mEq/kg intravenous sodium bicarbonate (HSDB 2007).

Antidotes

When possible, treatment with cyanide antidotes should be given under medical supervision to unconscious victims who have known or strongly suspected cyanide poisoning. There are currently two cyanide antidotal kits approved by the U.S. Food and Drug Administration (FDA). Use either the standard cyanide antidotal kit that includes amyl nitrite perles and intravenous infusions of sodium nitrite and sodium thiosulfate or the recently approved cyanokit that employs intravenous infusion of hydroxocobalamin (FDA 2006; HSDB 2007).

Use of the standard cyanide antidotal kit includes the following: Amyl nitrite perles should be broken onto a gauze pad and held under the nose, over the Ambu-valve intake, or placed under the lip of the face mask. Inhale for 30 seconds every minute and use a new perle every 3 minutes if sodium nitrite infusions will be delayed (HSDB 2007). If the patient has not responded to oxygen and amyl nitrite treatment, infuse sodium nitrite intravenously as soon as possible. The usual adult dose is 10 mL of a 3% solution (300 mg) infused over **absolutely no less than 5 minutes**; the average pediatric dose is 0.12-0.33 mL/kg body weight up to 10 mL infused as above. Monitor blood pressure during sodium nitrite administration, and slow the rate of infusion if hypotension develops (HSDB 2007). Next, infuse sodium thiosulfate intravenously. The usual adult dose is 50 mL of a 25% solution (12.5 g) infused over 10-20 minutes; the average pediatric dose is 1.65 mL/kg of a 25% solution. Repeat one-half of the initial dose 30 minutes later if there is an inadequate clinical response (HSDB 2007).

Use of the Cyanokit includes the following: Infuse hydroxocobalamin (5 g) intravenously over 15 minutes. Depending on the severity of poisoning and the clinical response, a second dose of 5 g may

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

be administered over 15 minutes to 2 hours (based on patient condition). The recommended diluent is 0.9% sodium chloride. Some drugs are incompatible with hydroxocobalamin, in which case, a separate intravenous line may be necessary (Drugs.com 2007).

Transport to Medical Facility

Only decontaminated patients or patients not requiring decontamination should be transported to a medical facility. Body bags are not recommended.

Report to the base station and the receiving medical facility the condition of the patient, treatment given, and estimated time of arrival at the medical facility.

If a cyanide-containing solution has been ingested, prepare the ambulance in case the victim vomits. Have ready several towels and open plastic bags to quickly clean up and isolate vomitus.

Multi-Casualty Triage

Consult with the base station physician or the regional poison control center for advice regarding triage of multiple victims.

Patients with evidence of significant hydrogen cyanide exposure, and all patients with oral exposure to hydrogen cyanide and those with potentially hazardous dermal exposure, should be transported to a medical facility for evaluation.

Patients who have only brief inhalation exposure and mild or transient symptoms may be discharged from the scene after their names, addresses, and telephone numbers are recorded. They should be advised to seek medical care promptly if symptoms develop or recur (see *Patient Information Sheet* below).

Emergency Department Management

- Hospital/Health Centre personnel in an enclosed area can be secondarily contaminated by vapor off-gassing from heavily soaked clothing or skin, or from vomitus. Avoid dermal contact with cyanide-contaminated patients or with gastric contents of patients who may have ingested cyanide-containing materials. Patients do not pose secondary contamination risks after contaminated clothing is removed and the skin is washed.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

- Hydrogen cyanide poisoning is marked by abrupt onset of profound health effects that may include syncope, seizures, coma, gasping respirations, and cardiovascular collapse, causing death within minutes.
- Patients exposed to hydrogen cyanide can survive with supportive care and rapid administration of specific antidotes.

Decontamination Area

Previously decontaminated patients and patients exposed only to hydrogen cyanide gas and have no skin or eye irritation may be transferred immediately to the Critical Care Area. Other patients require decontamination as described below.

ED personnel should don butyl rubber gloves and aprons before treating patients who have been exposed to hydrogen cyanide liquid or solutions. Hydrogen cyanide readily penetrates most rubbers and barrier fabrics or creams, but butyl rubber provides good skin protection for a short period of time.

Be aware that use of protective equipment by the provider may cause anxiety, particularly in children, resulting in decreased compliance with further management efforts.

Because of their relatively larger surface area:body weight ratio, children are more vulnerable to toxicants absorbed through the skin.

ABC Reminders

Evaluate and support airway, breathing, and circulation according to ALS protocols.

Patients who are comatose, hypotensive, or have seizures or cardiac dysrhythmias should be treated in the conventional manner. If not previously administered, give sodium bicarbonate intravenously to these patients (HSDB 2007). Further bicarbonate therapy should be guided by ABG measurements.

Basic Decontamination

Patients who are able may assist with their own decontamination. Remove and double-bag contaminated clothing and personal belongings.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
--	---	---

Speed is critical. If the patient is symptomatic, immediately institute emergency life support measures, including the use of a cyanide antidote kit (see Antidotes in the Prehospital Management section above).

If the patient’s clothing is wet with hydrogen cyanide solution, quickly remove contaminated clothing while flushing exposed skin and hair with plain water for 2-3 minutes (preferably under a shower), then wash twice with mild soap (HSDB 2007). Use caution to avoid hypothermia when decontaminating victims, particularly children or the elderly. Use blankets or warmers as needed.

Irrigate exposed eyes for at least 5 minutes. Remove contact lenses if easily removable without additional trauma to the eye. Continue irrigation while transporting the patient to the Critical Care Area.

In cases of ingestion, **do not induce emesis**. If the victim is alert, asymptomatic, and has a gag reflex, consider administering a slurry of activated charcoal at a dose of 1 g/kg (infant, child, and adult dose) (HSDB 2007). Because cyanide absorption from the gut is rapid, the effectiveness of activated charcoal will depend on how quickly after ingestion it can be administered. Consider gastric lavage if the patient is conscious and it can be performed shortly after ingestion. Isolate gastric washings and vomitus; they may off-gas hydrogen cyanide (HSDB 2007).

Critical Care Area

Be certain that appropriate decontamination has been carried out (see *Decontamination Area* above).

ABC Reminders

Evaluate and support airway, breathing, and circulation as in *ABC Reminders* above under *Decontamination Zone*. Establish intravenous access in seriously ill patients if this has not been done previously. Continuously monitor cardiac rhythm.

Patients who are in shock or have seizures should be treated according to ALS protocols. These patients or those who have dysrhythmias may be seriously acidotic; consider giving 1 mEq/kg intravenous sodium bicarbonate (HSDB 2007).

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
--	---	---

Inhalation Exposure

Inhalation is the primary route of exposure to hydrogen cyanide. Refer to *Antidotes and Other Treatments* below for appropriate clinical treatment of systemic effects.

Skin Exposure

If the skin contacted hydrogen cyanide liquid or cyanide solutions, chemical burns may occur; treat as thermal burns. Watch for signs or symptoms of systemic toxicity, which may be delayed in onset for up to 1 hour.

Eye Exposure

Continue irrigation for at least 15 minutes. Test visual acuity. Examine the eyes for corneal damage and treat appropriately. Immediately consult an ophthalmologist for patients who have corneal injuries.

Ingestion Exposure

Do not induce emesis. If the victim is symptomatic, immediately institute emergency life support measures including the use of a cyanide antidote kit (see *Antidotes in the Prehospital Management section above*). If the victim is alert, asymptomatic, has a gag reflex, and it has not been done previously, consider performing gastric lavage.

Vomitus or gastric washings should be isolated (e.g., by attaching the lavage tube to isolated wall suction or another closed container).

Antidotes and Other Treatments

Patients who have signs or symptoms of significant systemic toxicity should be evaluated for antidotal treatment. There are currently two cyanide antidotal kits approved by the U.S. FDA. Use either the cyanide antidotal kit that includes amyl nitrite perles and intravenous infusions of sodium nitrite and sodium thiosulfate or the recently approved cyanokit that employs intravenous infusion of hydroxocobalamin (FDA 2006; HSDB 2007). For instructions on use of cyanide antidotal kits, see *Antidotes* in the Prehospital Management section above.

The efficacy of hyperbaric oxygen in cyanide poisoning is unproven. It has been reported to be useful in severe cases of smoke inhalation combined with exposure to hydrogen cyanide and carbon monoxide (HSDB 2007).

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Laboratory Tests

The diagnosis of acute cyanide toxicity is primarily a clinical one (based on rapid onset of CNS toxicity and cardiorespiratory collapse). Specific tests for the presence of cyanide in blood and urine may be useful in confirming exposure, but have limited usefulness in acute treatment decisions. Routine laboratory studies for all exposed patients include CBC, blood glucose, and electrolyte determinations. Additional studies for patients exposed to hydrogen cyanide include ECG monitoring, determinations of serum lactate and urinary thiocyanate, chest radiography, and pulse oximetry (or ABG measurements) (Hall and Rumack 1998). Some pulse oximeters may give spurious results in the presence of hemoglobin species other than oxyhemoglobin and deoxyhemoglobin.

In severe poisonings, venous blood is oxygenated and has a bright red color. Elevated venous PO₂ and venous percent O₂ saturation occurs, narrowing the gap between arterial and central venous PO₂ or percent O₂ saturation (Hall and Rumack 1998).

After treatment with nitrites, serum methemoglobin levels may be monitored. Whole blood cyanide tests generally require several hours and cannot be used to guide emergency treatment. However, blood cyanide levels may be useful in documenting exposure (Hall and Rumack 1998; Kruszyna et al. 1993).

MRI studies may be useful in identifying the location and extent of brain injury in patients with cyanide-induced Parkinsonian syndrome.

Disposition and Follow-up

Consider hospitalizing patients who have histories of significant exposure and are symptomatic. Whenever infusions from a cyanide antidote kit are used, the patient should be admitted to the intensive care unit (Hall and Rumack 1998).

Delayed Effects

Patients who have ingested hydrogen cyanide solutions or patients who have direct skin or eye contact should be observed in the Emergency Department for at least 4 to 6 hours (Hall and Rumack 1998).

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Patient Release

Patients who remain asymptomatic 4 to 6 hours after exposure may be discharged with instructions to seek medical care promptly if symptoms develop (see the *Hydrogen Cyanide Patient Information Sheet* below).

Follow-up

Obtain the name of the patient’s primary care physician so that the hospital can send a copy of the ED visit to the patient’s doctor.

Survivors of a serious exposure should be evaluated for ischemic damage to the brain and heart. Patients who have serious systemic cyanide poisoning may be at risk for CNS sequelae including Parkinsonian-like syndromes; they should be monitored for several weeks to months (Hall and Rumack 1998).

Patients who have corneal injuries should be reexamined within 24 hours.

Reporting

If a work-related incident has occurred, you may be legally required to file a report; contact your state or local health department.

Other persons may still be at risk in the setting where this incident occurred. If the incident occurred in the workplace, discussing it with company personnel may prevent future incidents. If a public health risk exists, notify your state or local health department or other public agency. When appropriate, inform patients that they may request an evaluation of their workplace from OSHA or NIOSH. See Appendices III and IV for a list of agencies that may be of assistance.

Patient Information Sheet

This handout provides information and follow-up instructions for persons who have been exposed to hydrogen cyanide.

What is hydrogen cyanide?

At room temperature, hydrogen cyanide is a volatile, colorless-to-blue liquid (also called hydrocyanic acid). It rapidly becomes a gas that can produce death in minutes if breathed. Hydrogen cyanide is used in making fibers, plastics, dyes, pesticides, and other chemicals, and as a fumigant to kill rats. It is also used in electroplating metals and in developing photographic film. Low cyanide levels can be measured in cigarette smoke.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

What immediate health effects can be caused by exposure to hydrogen cyanide?

Breathing small amounts of hydrogen cyanide may cause headache, dizziness, weakness, nausea, and vomiting. Larger amounts may cause gasping, irregular heartbeats, seizures, fainting, and even rapid death. Generally, the more serious the exposure, the more severe the symptoms. Similar symptoms may be produced when solutions of hydrogen cyanide are ingested or come in contact with the skin.

Can hydrogen cyanide poisoning be treated?

The treatment for cyanide poisoning includes breathing pure oxygen, and in the case of serious symptoms, treatment with specific cyanide antidotes. Persons with serious symptoms will need to be hospitalized.

Are any future health effects likely to occur?

A single small exposure from which a person recovers quickly is not likely to cause delayed or long-term effects. After a serious exposure, a patient may have brain or heart damage.

What tests can be done if a person has been exposed to hydrogen cyanide?

Specific tests for the presence of cyanide in blood and urine may be useful in confirming exposure, but have limited usefulness in acute treatment decisions. If a severe exposure has occurred, blood and urine analyses and other tests may show whether the brain or heart has been injured. Testing is not needed in every case.

Where can more information about hydrogen cyanide be found?

More information about hydrogen cyanide can be obtained from your regional poison control center; your state, county, or local health department; the Agency for Toxic Substances and Disease Registry (ATSDR); your doctor; or a clinic in your area that specializes in occupational and environmental health. If the exposure happened at work, you may wish to discuss it with your employer, the Occupational Safety and Health Administration (OSHA), or the National Institute for Occupational Safety and Health (NIOSH). Ask the person who gave you this form for help in locating these telephone numbers.

Follow-up Instructions

Keep this page and take it with you to your next appointment. Follow only the instructions checked below.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

Call your doctor or the Emergency Department if you develop any unusual signs or symptoms within the next 24 hours, especially:

- difficulty breathing, shortness of breath, or chest pain
- confusion or fainting
- increased pain or a discharge from your eyes
- increased redness, pain, or a pus-like discharge in the area of a skin burn

No follow-up appointment is necessary unless you develop any of the symptoms listed above.

Call for an appointment with Dr. _____ in the practice of _____.

When you call for your appointment, please say that you were treated in the Emergency Department at _____ Hospital/Heal Centre by _____ and were advised to be seen again in ____ days.

Return to the Emergency Department/Clinic on ____ (date) at ____ AM/PM for a follow-up examination.

Do not perform vigorous physical activities for 1 to 2 days.

You may resume everyday activities including driving and operating machinery.

Do not return to work for ____ days.

You may return to work on a limited basis. See instructions below.

Avoid exposure to cigarette smoke for 72 hours; smoke may worsen the condition of your lungs

Avoid drinking alcoholic beverages for at least 24 hours; alcohol may worsen injury to your stomach or have other effects.

Avoid taking the following medications: _____

You may continue taking the following medication(s) that your doctor(s) prescribed for you:

Other instructions: _____

- Provide the Emergency Department/Hospital/Health Centre with the name and the number of your primary care physician so that the ED can send him or her a record of your emergency department visit.
- You or your physician can get more information on the chemical by contacting: _____ or _____, or by checking out the following Internet Web sites: _____;_____.

MINING (AMENDMENT) REGULATIONS 2005	ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE	Version: 3.0 Revision Date: 2019-04-23
--	---	---

Signature of patient _____ Date _____

Signature of physician _____ Date _____

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

7.0 References

- AIHA. 1994. Emergency response planning guidelines: Hydrogen cyanide. Fairfax, VA: American Industrial Hygiene Association.
- ATSDR. 2006. Toxicological profile for cyanide (update). U.S. Department of Health and Human Services. Agency for Toxic Substances and Disease Registry.
- Drugs.com. 2007. Drug information online: Cyanokit injection. <http://www.drugs.com/pro/cyanokit.html>. October 11, 2007.
- EPA. 2007. Hydrogen cyanide results. Acute Exposure Guideline Levels (AEGs). U.S. Environmental Protection Agency. <http://www.epa.gov/opptintr/aegl/pubs/results6.htm>. January 12, 2007.
- FDA. 2006. FDA news: FDA approves drug to treat cyanide poisoning. U.S. Food and Drug Administration. <http://www.fda.gov/bbs/topics/NEWS/2006/NEW01531.html>. October 11, 2007.
- Hall AH, Rumack BH. 1998. Cyanide and related compounds. In: Haddad LM, Winchester JF, eds. Clinical management of poisoning and drug overdose. 2nd ed. Philadelphia, PA: W.B. Saunders Company, 899-905.
- Hartung R. 1994. Cyanides and nitriles. In: Clayton GD, Clayton FE, ed. Patty's industrial hygiene and toxicology. New York, NY: John Wiley & Sons, Inc., 3119-3127.
- HSDB. 2007. Hydrogen cyanide. Hazardous Substances Data Bank. National Library of Medicine. <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>. October 11, 2007.
- IARC. 2007. International Agency for Research on Cancer. <http://monographs.iarc.fr/ENG/Classification/Listagentsalphorder.pdf>. October 11, 2007.
- IRIS. 2007. Hydrogen cyanide. Integrated Risk Information System. U.S. Environmental Protection Agency. <http://www.epa.gov/iris/subst/0060.htm>. October 11, 2007.

<p style="text-align: center;">MINING (AMENDMENT) REGULATIONS 2005</p>	<p style="text-align: center;">ENVIRONMENTAL MANAEMENT CODES OF PRACTICE USE OF CYANIDE</p>	<p>Version: 3.0 Revision Date: 2019-04-23</p>
---	--	---

- Kruszyna R, Kruszyna HG, Smith RP. 1993. A spectrophotometric method for estimating methemoglobin concentration in the presence of cyanide. Am J Emerg Med 11(6):642-643.
- NIOSH. 2005. Hydrogen cyanide. NIOSH pocket guide to chemical hazards. National Institute for Occupational Safety and Health. <http://www.cdc.gov/niosh/npg/npgdo333.html>. October 11, 2007.
- NTP. 2005. Report on carcinogens. 11th ed. National Toxicological Program. National Institute of Environmental Health Sciences. <http://ntp.niehs.nih.gov/ntpweb/index.cfm?objectid=035E5806-F735-FE81-FF769DFE5509AFoA>. October 11, 2007.
- OSHA. 1999. Hydrogen cyanide. U.S. Department of Labor. Occupational Safety and Health Administration. Code of Federal Regulations. 29 CFR 1910.1000. TableZ-1. Part Z, Toxic and Hazardous Substances. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARD S&p_id=9992. October 11, 2007.
- The Official Gazette 19th March, 2005, Legal Supplement –B (No.3 of 2005), 19th March, 2005
- Mining Environmental Management Codes of Practice- Mercury, August 2010.
- International Cyanide Management Code, International Cyanide Management Institute, 2009