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Morenci Safe Production Standard	Standard # 1.2	
Ventilation Natural and Artificial	OHSAS 18001:2007	4.4.6
	Revision #	03
	Revision Date	06/11/2013
	Effective Date	05/30/2012
	Document Owner	Industrial Hygiene
Approvals:		
<i>Senior VP Morenci Operations: 10/28/2011</i>	<i>Safety Steering Committee: 10/28/2011</i>	

1.0 PURPOSE:

The purpose of this standard is to provide guidelines for ventilation systems designed to ensure an adequate supply of fresh air is available to supply and maintain indoor and work place air quality.

2.0 SCOPE:

- 2.1. This standard manages Morenci Operations ventilation program in order to meet MSHA and OSHA occupational health and safety (OH&S) requirements.
- 2.2. This standard applies to:
 - a. Morenci Operations facilities, equipment and working places under the control of Freeport McMoRan.
 - b. Employees and other individuals (including temporary employees and contractor personnel), company's visitors, or any other person(s) who work and/or are present in the workplace.

3.0 TERMS, DEFINITIONS AND ABBREVIATIONS

- 3.1 **Clean air** – Air of such purity that it will not cause harm or discomfort to an individual if it is inhaled for extended periods of time.
- 3.2 **Dilution** – Airflow designed to dilute contaminants to acceptable levels.
- 3.3 **Dust collector** – A device or combination of devices for separating dust from the air handled by an exhaust ventilation system.
- 3.4 **Exhaust ventilation system** – A system for removing contaminated air from a space, comprising two or more of the following elements (a) enclosure or hood, (b) duct work, (c) dust collecting equipment, (d) exhauster, and (e) discharge stack.
- 3.5 **Confined Space** – These spaces may include underground vaults, chutes, feeders, tanks, storage bins, crushers, vessels, silos and other similar areas. A confined space is an area with limited means of ingress/egress, large enough to enter that is not designed for continuous occupancy. For a detailed definition of non permit and permit required confined spaces refer to Morenci Operations Confined Space Policy.
- 3.6 **Mechanical** – Air movement caused by a fan or other air-moving device.
- 3.7 **Natural** – Air movement caused by wind, temperature difference or other non-mechanical factors
- 3.8 **Ventilation** – Circulating fresh air to replace contaminated air.

4.0 RESPONSIBILITIES:

- 4.1 Area Manager: will provide resources for employees to comply with this procedure. Resources include information, training, time, money and equipment.
- 4.2 Health and Safety Manager: will ensure Morenci has its own Standard to regulate ventilation and review the standard as needed.

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- a. Provide resources for the effective implementation of this standard.
 - b. Ensure the standard is implemented throughout the property.
- 4.3 Supervisor and/or person responsible for the work: will ensure that their employees or contractors working under them understand and follow this standard. Employees will be provided with the equipment necessary to complete all work in compliance with this standard.
 - a. Allocate resources for the effective implementation of this standard in area of responsibility
 - b. Ensure this standard is implemented. This includes:
 - (1) Ensuring that a baseline and follow-up ventilation surveys are undertaken and the results recorded. Special attention shall be made for:
 - Areas where flammable gases may be present.
 - Areas where toxic fumes may be present.
 - Areas where work processing generates heat, dust or fumes.
 - Areas where welding, grinding, painting, lining and vehicle maintenance is carried out.
 - (2) Generating, communicating and updating required Standard Operating Procedures (SOPs), as required.
 - (3) Regularly inspecting and maintaining all ventilation equipment.
- 4.4 Industrial Hygiene Department
 - a. Provide OH&S advice for Morenci Operations employees and Contractor Companies to ensure that they meet their responsibilities and accountabilities relevant to the implementation of this standard. The industrial hygiene department must assist site management with completing risk assessments/surveys of areas determined to be high risk.
- 4.5 Employees
 - a. Ensure that ventilation is adequate where task(s) is being performed. When ventilation concerns exist they are to be reported to the employees supervisor.
 - b. Report any defect ventilation system immediately to their immediate supervisor and/or relevant party.
 - c. Follow the requirements of this standard and those prescribed within division procedures.
- 4.6 Technical Training Department: will provide or make available annual training for all employees who might reasonably be affected by this procedure. In general training should be included within confined space and hot work training courses.

5.0 STANDARDS OF PERFORMANCE

- 5.1. Risk assessments/surveys to identify potential ventilation concerns shall be carried out within areas of concern. Such areas may include, but are not limited to:
 - i. Maintenance facilities, i.e. welding, painting, etc.
 - ii. Operational areas with exposures to chemicals, dust, etc.
 - iii. Laboratory furnaces, ventilation hoods, extraction systems, etc.
 - iv. Confined Spaces
 - v. Enclosed mobile equipment exposed to high levels of dust, chemicals or gases
 - vi. In operational and/or maintenance areas where mobile equipment are used indoors
 - vii. Underground workings, tunnels and or shafts

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Action plans, evaluations and follow up shall be developed as needed from preventative maintenance (PM) programs, periodic inspections and as a result of risk assessments/surveys.

- 5.2. Office buildings designed and provided with ventilation systems for circulation of air shall be monitored and maintained to original system capacities.
 - a. Schematic diagrams shall be retained and kept updated by the plant engineering department.
 - b. A Periodic inspections program shall be in place to ensure ventilation defects are identified and corrected.
- 5.3. Ventilation design criteria shall ensure at a minimum that the following is considered:
 - a. Motors, fans and duct work that extract flammable vapor/gases shall be explosion proof.
 - b. Motors, fans and duct work that extract corrosive dust and gases shall be constructed of material capable of withstanding the corrosive effects.
 - c. The design capacity of the ventilation system shall be such that is capable of meeting the demands produced by the source of the hazardous substances the ventilation system is intended for.
 - d. Ventilation design criteria shall meet the requirements of NIOSH and OSHA occupational exposure requirements.
 - e. All exhaust systems shall be provided with suitable dust collectors.
- 5.4. Extraction systems for hazardous contaminants shall be designed so that, in the event of failure, they give adequate warning to the operator or other employees in the area.
- 5.5. Adequate natural and/or artificial ventilation shall be provided for hot work conducted in the workplace. Each area is responsible for maintaining the following:
 1. Generating, communicating and updating required Work Instructions and/or Standard Operating Procedures (SOP's), as required.
 2. Regular inspections and maintenance of all ventilation equipment.
 3. Ensuring that employees within their area of responsibility are trained in the use of ventilation systems and have an awareness of the need to work in properly ventilated areas.
 4. Ensuring that air quality monitoring to further evaluate the effectiveness of ventilation system is carried out when inadequate ventilation is known or suspected, a new process is initiated which could affect air quality or if a potential overexposure exists.
 5. Documents and records relevant to this program.
- 5.6. Ventilation – General Requirements:

Adequate ventilation, in addition to the use of personal protective equipment (if needed) shall be provided and used for Hot Work. Pure Oxygen shall never be used for ventilation. Mechanical ventilation is required when any of the following conditions are present:

 1. Space is less than 10,000 cubic feet per welder
 2. Ceiling height in space is less than sixteen feet
 3. In confined spaces where welding space contains partitions or other structural barriers which may obstruct cross ventilation.
 4. Whenever the following materials are identified as other than trace constituents in welding, brazing, or cutting operations, and unless breathing zone sampling under the most adverse conditions has established that the level of hazardous constituents is below the allowable limits specified by OSHA
 - Lead, Beryllium, Zinc, mercury, Cadmium, Chromium fluorine compounds and cleaning compounds

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- 5.6.1 Mechanical ventilation shall be provided at a minimum rate of 2,000 cubic feet per minute per welder, except where local exhaust hoods, booths, or airline respirators are provided. Natural ventilation is considered sufficient for welding or cutting where restrictions 1-4 are not present.
- 5.6.2 Employees performing such hot work operations as indicated in section 4, in open well naturally ventilated locations, shall be protected by filter type respirators.

Refer to Appendix 8.1 for additional ventilation guidelines in Confined Spaces

- 5.7 General mechanical ventilation shall be of sufficient capacity and so arranged as to produce the number of air changes necessary to maintain welding fumes, smoke and other hazardous gases within safe limits.
- 5.8 Contaminated air exhausted from a working space shall be discharged into the open air or otherwise clear of the source of intake air.

6.0 REFERENCE DOCUMENTS

- 6.1 American Welding Society (AWS). Health and Safety Fact Sheets Number 1 and Number 11. Retrieved August 18, 2011 from <http://www.aws.org/technical/facts/>
- 6.2 Mine Safety and Health Administration (MSHA). 30CFR Part 56.5001 Exposure limits for airborne contaminants, 30CFR Part 56.5002, 56.5005, 56.15007.
- 6.3 Occupational Safety and Health Administration (OSHA). Technical Training Manual Chapter 3: Ventilation. Retrieved August 18, 2011 from http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_3.html
- 6.4 Occupational Safety and Health Administration (OSHA). 29CFR Part 1910.94 Ventilation.
- 6.5 Morenci Safe Production Standard 2.6 – Confined Space Policy

7.0 RECORDS

Name of the Document	Responsible for Control	Records Retention
Original Document of this Standard	Health and Safety Department	Permanent

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Training Records Associated with this Standard	Division/Area or Technical Training Department	Duration of employment + 10 years
SOP/Work Instructions related to this Standard	Division/Area	Permanent
Periodic Inspection Records	Division/Area	Duration of inspection program + 10 years

8.0 APPENDICES

- 8.1 Confined Space Ventilation Requirements
- 8.2 Selection Criteria for General and Local Exhaust Ventilation

9.0 REVIEW AND CHANGE

All changes, modifications and/or revisions must be documented on the table below:

Description of Changes to this Document
<i>Section 6 – Reference Documents – Included 6.5 Morenci Safe Production Standard 2.6 – Confined Space Policy because Confined Space Ventilation requirements are discussed in Appendix 8.1. This change is for traceability purposes and does not affect the procedure/process. The change does not require review/re-approval. – S. Elias 03/29/2012</i>
<i>Section 7.0 - Records– Changed "Training Certificates" to "Records for area training on this standard". – S. Elias 06/08/2012</i>
<i>Section 7.0 – Updated records table – S. Elias 06/11/2013</i>

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APPENDIX 8.1 – VENTILATION REQUIREMENTS FOR CONFINED SPACES

REQUIRED ACTIONS DURING HOT WORK IN A CONFINED SPACE

Adequate ventilation must be provided to prevent accumulation of toxic fumes or possible oxygen deficiency. This includes not only the welder, but also helpers and other personnel in the immediate vicinity. All make-up air that is drawn into the area of operation must be clean and breathable. All welding and cutting operations carried on in confined spaces shall be adequately ventilated to prevent the accumulation of toxic materials or possible oxygen deficiency. All air replacing that is withdrawn from the space shall be clean and respirable.

When performing hot work in permit required confined spaces, the following precautions shall be taken:

- I. When mechanical ventilation is required it must be maintained throughout the duration of the entry and atmospheric monitoring provided to ensure fumes and gases do not exceed safe exposure limits.
- II. Gas cylinders and welding machines shall be left outside the space.
- III. Heavy portable equipment mounted on wheels shall be securely blocked.
- IV. Whenever an employee must enter a confined space through a small opening (an opening in which extraction would be hindered due to its configuration and size) or manhole, safe access shall be provided and a means shall be provided to quickly remove them in the event of an emergency.
- V. An attendant with the requisite training and knowledge of Morenci Operations preplanned rescue procedure shall be stationed outside to observe the welder at all times. They must be capable of putting rescue operations into effect.
- VI. When arc welding is suspended for any substantial length of time, all electrodes shall be removed from the holders, and the holders located so that accidental contact cannot occur. The machine shall be disconnected from the power source.
- VII. To prevent accidental gas leakage, torch valves shall be closed and the fuel-gas and oxygen supply to the torch shut off outside the confined area whenever the torch is not to be used for a substantial period of time. Where practicable, the torch and hose shall also be removed from the confined space.

Three factors in arc and gas welding govern the amount of contamination to which welders may be exposed. These factors are:

1. Dimensions of space where welding is to be done (ceiling height is especially important)
2. Rate of welding
3. Possible evolution of hazardous fumes, gases, or dust according to metals involved.

Specific metals/chemicals are known to have low threshold limits and are extremely dangerous in moderate to high volumes. The use of local exhaust ventilation or supplied air respiratory protection is required when hot work is performed in a confined space where there is a potential for exposure to:

- a. Fluorine compounds (fluxes and rod coatings)
- b. Zinc
- c. Lead
- d. Cadmium
- e. Chromium
- f. Mercury

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Page 6 of 8

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When beryllium is present, the use of both local exhaust and a supplied-air respirator is required.
All entry into confined spaces for **any purpose**, including welding and cutting, must be done in compliance with the Morenci Branch Confined Space Policy.

APPENDIX 8.2 - SELECTION CRITERIA FOR GENERAL AND LOCAL EXHAUST SYSTEMS

General exhaust ventilation (dilution ventilation) is appropriate when:

- Emission sources contain materials of relatively low hazard. (The degree of hazard is related to toxicity, dose rate, and individual susceptibility);
- Emission sources are primarily vapors or gases, or small, respirable-size aerosols (those not likely to settle);
- Emissions occur uniformly;
- Emissions are widely dispersed;
- Moderate climatic conditions prevail;
- Heat is to be removed from the space by flushing it with outside air;
- Concentrations of vapors are to be reduced in an enclosure; and
- Portable or mobile emission sources are to be controlled.

Local exhaust ventilating is appropriate when:

- Emission sources contain materials of relatively high hazard;
- Emitted materials are primarily larger-diameter particulates (likely to settle);
- Emissions vary over time;
- Emission sources consist of point sources;
- Employees work in the immediate vicinity of the emission source;
- The plant is located in a severe climate; and
- Minimizing air turnover is necessary.

Recirculation Criteria:

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Page **7** of **8**

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- Protection of employees must be the primary design consideration.
- The system should remove as much of the contaminant as can economically be separated from exhaust air.
- The system should not be designed simply to achieve PEL levels of exposure.
- The system should never allow recirculation to significantly increase existing exposures.
- Recirculation should not be used if a carcinogen is present.
- The system should have fail-safe features, e.g., warning devices on critical parts, back-up systems.
- Cleaning and filtering devices that ensure continuous and reliable collection of the contaminant should be used.
- The system should provide a by-pass or auxiliary exhaust system for use during system failure.
- The system should include feedback devices that monitor system performance, e.g., static pressure taps, particulate counters, amperage monitors.
- The system should be designed not to re-circulate air during equipment malfunction.
- The employer should train employees in the use and operation of the system.