HZL Standards

Industrial Hygiene Framework Standard

	Issued by	Approved by
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Acknowledgement The management acknowledges the contributions of the following individuals from Hindustan Zinc Limited for being a part of the Zone / location workgroup and for their assistance in finalizing this standard on Industrial Hygiene Program.

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DOCUMENT ISSUE

The Industrial Hygiene Framework Standard (IHFS) Manual is issued by the Corporate Safety Council on behalf of Hindustan Zinc Limited management and forms a part of the HZL Integrated Management System.

Name: Chairman, Corporate SRP Sub Committee

Signed: .....

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Abbreviations

- ABIH - American Board of Industrial Hygiene
- ALARA - As Low As Reasonably Achievable
- BOHS - British Occupational Hygiene Society
- CAS - Chemical Abstract Service
- CSC - Corporate Safety Council
- CSRP - Corporate Standards, Rules and Procedure Subcommittee
- DGMS - Directorate General of Mines Safety
- EHS - Environment, Health and Safety
- EMF - Electromagnetic Field
- HIRA - Hazard Identification Risk Analysis
- HAV - Hand Arm Vibration
- HSE - Health, Safety and Environment
- HZL - Hindustan Zinc Limited
- IH - Industrial hygiene
- IHFS - Industrial Hygiene Framework Standard
- JSA - Job Safety Analysis
- LEV - Local Exhaust Ventilation
- LFOH - Licensed Fellow of Occupational Hygiene
- MSDS - Material Safety Data Sheets
- NIOSH - National Institure for Occupational Safety and Health
- OSHA - Occupational Safety and health Administration
- PBZ - Personal Breathing Zone
- PPE - Personal Protective Equipment
- QLEA - Qualitative Exposure Assessment
- QNEA - Quantitative Exposure Assessment
- RPE - Respiratory Protective Equipment

- SEG - Similar Exposure Group
- SOP - Standard Operating Procedure
- WBV - Whole-Body Vibration

Table of Contents

1. Introduction

Industrial hygiene (IH) is the practice of controlling employee exposure from potentially harmful agents in the workplace. It is the science of anticipating, recognizing, evaluating, and controlling workplace conditions that may cause employee injury or illness.

An effective IH program protects employees from exposure to agents with immediate, acute health effects, as well as those causing chronic effects. This is achieved by eliminating or limiting to the lowest practicable levels of exposures to chemical, physical and biological agents that could lead to adverse human health effects. To successfully manage IH concerns, the Hindustan Zinc Limited (HZL) team needs to develop and implement appropriate programs and procedures as described in this manual.

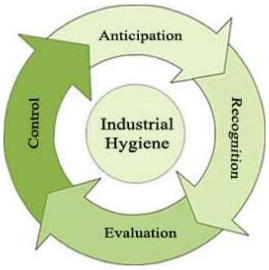


Figure 1: Industrial Hygiene Steps

This main framework standard assists Environmental Health and Safety (EHS) coordinators and Managers to recognize, evaluate and control occupational risks; to reduce the risk to the health of individuals working on, or visiting the sites. The guidance provided in this manual helps ensure compliance with requirements imposed by regulatory agencies, HZL's EHS policy and best practices.

Additional standards included as an addendum to this framework standard include:

- Lead standard
- Respiratory protective equipment standard
- Hearing Protection Program standard
- Heat Stress standard

1.1. Applicability

This framework standard applies to all HZL mines and smelters and its stakeholders, including employees, supervisors, managers, contractors, consultants and visitors.

All work activities involving the risk of occupational exposure to chemical agents (such as metal fumes for lead, cadmium, arsenic, acids like sulfuric acid etc.), physical agents (such noise, heat stress, radiation etc.) as and biological agents are covered in this Industrial Hygiene Program (IHP).

Exemptions to compliance with IHP include:

- Chemical agents: Commercially available chemical cleaning agents and office supplies in less than 250 ml quantity.
- Physical Agents (Radiation): Smoke detectors, static eliminators, tritium fire exit signage; commercial microwave units; and Class 1 and Class 2 lasers (including laser pointers and printers).
- Contractors who are engaged in activities with no potential for chemical, physical and biological agents.

2. Scope

This standard applies to all HZL business units and operations, including admin/corporate offices; through all development phases and construction, operation to closure and, where applicable, for post closure management. National regulations shall be used in conjunction with this standard.

3. Management Responsibilities

Line management has the responsibility to implement this standard.

4. Definitions

Factory Manager/ Mines Manager/ Project Head - A person who is legally notified and authorized by the Occupier to discharge his duties.

Certification - a verification process, which documents that a person has the necessary training, skill, competency, experience and the ability to perform designated roles and tasks.

Operator - any person who directly or indirectly is involved with the process, with a likely exposure potential to physical, chemical and/or biological agents.

Visitor - any third-party person who has not been inducted under HZL's safety policy. Such person may be a subject matter expert/consultant/ OEM/Supplier from another organization.

Risk Assessment - The formal process of identifying, assessing and evaluating the safety, health and environmental risks that may be associated with a hazard. For example: Hazard Identification Risk Analysis (HIRA), Job Safety Analysis (JSA), etc.

5. People (Roles and Responsibilities)

5.1. Subject Matter Expert (SME) - Industrial Hygiene (IH)

Assign at least one competent person to implement the relevant elements of the IHFS. **The SME-IH's primary responsibility is to provide or arrange the provision the training relevant to the needs of the site.**

5.1.1. Qualification and experience of SME - IH:

Degree in industrial hygiene, occupational safety, science or related field and a minimum of 5 years of experience in occupational hygiene, safety or related field. Practical experience in industrial hygiene including exposure assessment under guidance of (a) Certified Industrial Hygienist (CIH)

from American Board of Industrial Hygiene (ABIH) or (b) Licensed Fellow of Occupational Hygiene (LFOH) from British Occupational Hygiene Society (BOHS) or (c) Industrial Hygienist with internationally recognized equivalent certification. However, when practical experience is used towards required qualification, SME - IH must pass a written and practical examination offered by CIH or LFOH.

5.1.2. **Responsibilities SME-IH**:

Implementation and facilitation of all elements of this standard including hazard characterization, Qualitative Exposure Assessment (QLEA), Quantitative Exposure Assessment (QNEA), training on occupational hygiene program elements, exposure monitoring results communication, record retention, self-audit and advising in all matter related to industrial hygiene.

5.2. Site Leadership / Mine Manager

5.2.1. **Ensure relevant elements of the IHFS (e.g., exposure controls, safe work practices, use of personal protective equipment) are implemented at the site.**

5.2.2. Assign at least one competent person to implement the relevant elements of the IHFS. The SME-IH's primary responsibility is to provide or arrange the provision of the training relevant to the needs of the site.

5.2.3. Through application of the Hierarchy of Control principle, ensure effective risk-based controls are implanted and maintained.

5.2.4. Ensure work-practices to reduce exposure to chemical, physical and biological agents are implemented.

5.2.5. Ensure Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE) are used as advised by SME-IH or Safety Officer.

5.3. Supervisor/Head of Department/ Mine Foreman

5.3.1. Provide onsite training on basic hazard recognition, evaluation and controls.

5.3.2. **Ensure all stakeholders including HZL employees and contractors are implementing work practices to reduce potential occupational health risk. Refer Standard 2 (lead standard) and Standard 5 (heat stress standards**).

5.3.3. **Ensure PPE and RPE are used as advised by SME-IH or Safety Officer**. Refer Standard 3 (Respiratory Protective Program).

5.3.4. **Report to the site leader and the SME-IH any change in process, equipment, area, new chemical requiring a review of the IHFS**.

5.4. Engineering and Maintenance

5.4.1. Assist in designing engineering and process controls to reduce exposures.

5.4.2. **Maintain and verify effectiveness of engineering controls by conducting preventive maintenance and appropriate measurements on Local Exhaust Ventilation (LEV) systems and dust collectors**. Refer appendix 5 for details of ventilation and validation of the LEV systems.

5.5. Occupational Physician

5.5.1. **Determine the need, frequency and content of medical surveillance based on results of the risk assessment and the monitoring results. Follow national (Indian Factories Act, DGMS) or international (Occupational Safety and health Administration (OSHA)) on the frequency and content of medical surveillance whichever is more stringent. Refer Vedanta's Technical standard TS 12 guidelines for details on Occupational Health Surveillance and Occupational Health Management.**

5.5.2. **Notify the SME-IH of any potential occupational illness to enable the SME-IH to assess actual workplace exposure to assist in determining if the condition is work related. Refer Vedanta's internal management standard MS 11 for Incident Reporting, Classification and Investigation.**

5.6. Stakeholders including employees and contractors:

5.6.1. **Follow work-practices aimed at reducing potential occupational exposures to chemical, physical and biological agents.**

5.6.2. **Use PPE and RPE as required in the relevant procedures.**

5.6.3. **Report to supervisor or manager any unsafe working condition or work practices which may results to occupational exposures.**

6. PROCEDURES:

Risk Assessment: The process of occupational health risk assessment includes; hazard identification and characterization, QLEA and QNEA.

6.1. Hazard Identification and Characterization:

6.1.1. **As a first step towards hazard identification, maintain an inventory of chemicals including gases and particulates being used except for chemicals that are used in laboratories and meet the definition of laboratory scale (e.g., less than 250 ml). Also, include chemicals and gases which are by-products.**

6.1.2. Include in the inventory, department/location in which the chemical is used, and where it is stored and approximate chemical consumption per month or year.

6.1.3. **For chemical composition (e.g., concentrate, dross, ore), include ingredients, % of ingredient and, if feasible, Chemical Abstract Service (CAS) number for each ingredient**.

6.1.4. Maintain inventory of physical agents in individual sites.

6.1.5. **Conduct or facilitate hazard characterization for each of the chemicals and by-products**.

6.1.6. Hazard characterization includes, for example, (a) **acute and chronic health effects and exposure limits** (b) **chemicals and by-products that poses carcinogen, reproductive and mutagen health hazards**.

6.1.7. **Safety Officer shall develop hazard characterization in consultation with SME-IH.**

6.1.8. Communicate potential hazards from the inventories to all affected stake-holders; including employees and contractors.

6.1.9. Hazard assessments conducted at HZL sites are available at centralized HZL server.

6.2. Qualitative Exposure Assessment

The second step of the risk assessment process involves conducting the qualitative exposure assessment (QLEA). This is conducted to estimate the exposures through a walkthrough survey, discussion with process experts and discussions with maintenance team and employees. The details such as frequency and duration of exposure, controls provided to mitigate exposures and inherent hazard of the agent of concern is considered during the QLEA. The steps followed during the QLEA is included below.

6.21 **Prepare an inventory of Similar Exposure Groups (SEGs) consisting of all routine, as well as non-routine activities (for example: FEL operator, Slag tappers, Mine mate, Laboratory Chemist etc.)**

6.22 **Conduct or arrange for conducting QLEA for all SEGs with routine activities and non-routine activities**.

6.23 Include in QLEA, all operations, utilities, laboratories and all other ancillary activities with little or no apparent occupational health risk (e.g., oxygen plant).

6.24 Consider all hazard-specific factors across the lifecycle of the process (i.e. material receipt through to disposal), including agent, process and task factors.

6.25 **Consider inhalation, skin absorption and ingestion risk while conducting the risk assessment**.

6.26 **Identify potential high risk activates with exposure potentials above the national or internationally recognized exposure limits. Recommend exposure controls for such activities. Provide or upgrade respiratory protection (as an interim control) for the high-risk activities until exposure is confirmed below exposure limits by means of exposure controls and exposure monitoring.**

6.27 Develop an exposure monitoring plan based on the QLEA.

6.28 **Update QLEA whenever a process change occurs or at least every two years. Update the exposure monitoring plan, if needed based on revised QLEA.**

6.29 **Respiratory protection will not be considered under any circumstances while determining the degree of potential health risk in the QLEA**.

6.210 QLEA shall be conducted by the SME-IH or a qualified consultant.

6.3. Quantitative Exposure Assessment

The final step of the risk assessment process involves conducting the quantitative exposure assessment (QNEA). This is conducted to confirm and quantify the exposures through personal monitoring, based on the monitoring plan developed during the QLEA.

6.3.1. Conduct QNEA based on the exposure monitoring plan developed from QLEA.

6.3.2. Conduct personal air sampling for one or more of the following reasons:

6.3.2.1. Compliance with government regulations (For example: Indian Factories Act and Directorate General of Mines Safety);

6.3.2.2. As a result of the QLEA ranking

6.3.2.3. At the specific request of or following complaints from operators, customers, residents or others;

6.3.2.4. To help the design or evaluation of control measures;

6.3.2.5. To support ongoing or continuous monitoring at regular intervals.

6.3.2.6. When occupational illness is identified by an occupational physician

6.3.3. Ensure exposure monitoring is representative, reproducible and reliable.

6.3.4. **Ensure exposure monitoring is representative of the exposures or worst-case scenarios. In order for representative exposure monitoring, conduct monitoring**:

6.3.4.1. During multiple shifts if a single shift monitoring is not representative of potential exposure,

6.3.4.2. During entire task (e.g., ladle cleaning, housekeeping, fabrication, launder cleaning etc.),

6.3.4.3. During other exposure potential activities (e.g., Quality control sample collection).

6.3.5. **For reproducible exposure monitoring, collect adequate number of samples (e.g., 6 or 3 samples for each SEG)** recognizing exposure variability and to enable effective comparison with established exposure limits.

6.3.6. For reliable exposure monitoring, ensure:

6.3.6.1. Sampling and analytical methods are approved by NIOSH, OSHA or equivalent.

6.3.6.2. Quality assurance is maintained (e.g., calibration of sampling equipment before and after sampling, collection of blank samples)

6.3.6.3. An American Industrial Hygiene Association (AIHA) or equivalent laboratory is used for sample analysis.

6.3.7. **Area air sampling may be conducted to quantify spread of contaminants to non-process areas. However, results of area air sampling are not to be compared with the personal exposure results**.

6.3.8. Ensure calibrated equipment is use and maintain a detailed record of sampling; such as calibration data, sampling duration, working conditions at the time of sampling.

6.3.9. ***Conduct Personal Breathing Zone (PBZ) monitoring*** to determine potential inhalation exposure. Area air monitoring is not preferred to determine personal exposure.

6.3.10. Conduct monitoring for physical agents such as **noise and vibration using direct reading instruments.**

6.3.11. **Compare the results of the exposure monitoring with the lowest (most protective) of Occupational Exposure Limits (OEL) from, (a) Exposure limits detailed in Indian Factories Act (Schedule II), Directorate General of Mines Safety (DGMS) or the (b) ACGIH Threshold Limit Values (TLV).**

6.3.12. **Electromagnetic fields (EMF) are likely be generated at the furnace areas,** which may require protection devices for employees. Conduct measurements for EMFs and compare the measured values with the ACGIH TLVs, as they are more protective.

6.3.13. Conduct additional exposure monitoring for **physical agents such as noise, heat stress and vibration**. Noise and heat stress monitoring are included in and other requirements are included in HZL Standards, 4 and 5 attached to this standard. ***Conduct vibration monitoring based on the outcome of QLEA and compare the measured value with ACGIH limit of 0.4 m/s^2.***

6.3.14. When **personal exposure results exceed 50% of exposure Limit**:

6.3.14.1. Report the exposure monitoring results to SME-IH and the occupational physician

6.3.14.2. Protect affected employees with respiratory protection

6.3.14.3. Develop action plan to implement exposure controls and

6.3.14.4. Provide or upgrade suitable PPE until the exposure is confirmed below exposure limits by means of exposure controls.

6.4. Repeat exposure monitoring based on the results of previous exposure monitoring and finding of QLEA once every 2 years or sooner as needed. Suggested frequency based on EN 689 **based on the previous exposure monitoring is as follows:**

Exposure as % of OEL	How often monitoring needs to be done?
<=25%	Every 64 weeks
25%-50%	Every 32 weeks
>50%	Every 16 weeks

6.5. Extended Shift Adjustment

The American Conference for Governmental Industrial Hygienists (ACGIH) refers to the **Brief and Scala model** for adjusting its Threshold Limit Values (TLVs) for extended work shifts.

The **Brief and Scala** method is regarded as the most conservative model and considers the impact of the number of increased hours worked and the recovery time between exposure periods. No consideration of the agent's activity in the body is made. Using either the daily or weekly equation detailed below, a reduction factor is determined, and then applied to the TWA exposure standard.

The Brief and Scala model reduces the TLV according to a reduction factor calculated by the following formula:

Daily exposure

$$RF = \frac{8}{h} * \frac{24-h}{16}$$

Where: RF = reduction factor

h= hours worked per shift

Note that 24-h represents the exposure free hours per day

7. Risk Management and Risk Control Plans:

7.1. Develop and implement a formal plan to control exposure risks (**Risk Control Plan (RCP**)) in the following circumstances:

- Any qualitative risk assessment indicating a moderate or high risk and/or quantitative assessments (monitoring) that indicate exposures exceeding 50% of the exposure limit.
- Where respiratory protection is worn as the primary means of exposure protection.

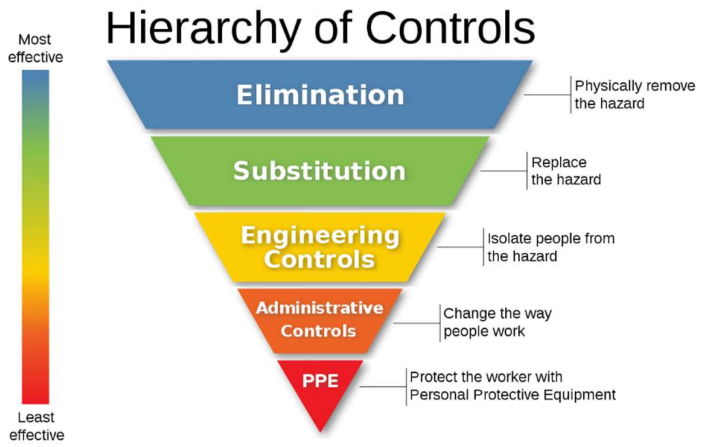
7.2. RCPs are not required in the following circumstances:

- **During non-routine cleaning and maintenance tasks**
- **When entering an unknown atmosphere with a supplied air respirator**
- **During one-time tasks that are not anticipated to be repeated**

7.3. Review and update RCP, as appropriate, at least annually.

7.4. For Biological Agents, implement exposure controls based on hazard characterization.

7.5. Follow the Hierarchy of Controls while developing RCP. Select effective controls in the following order based on risk-based decision making



8. Process and Engineering Control Verification

8.1. Prepare an inventory of all exposure controls for verification.

8.2. Conduct verification of the effectiveness of engineering controls; at least annually. Refer Appendix 4 for ventilation validation details.

8.3. Conduct verification in accordance with the instructions from the exposure control manufacturer.

8.4. Testing parameters for verification include, filter integrity test on dust collectors; face, capture and duct velocity measurements on LEV systems.

8.5. Ensure calibrated instruments are used for verification. Determine acceptability criteria for exposure controls.

8.6. **Track to completion any deficiency identified during verification. Depending on potential occupation health risk, provide alternate work practice control or respiratory protection until the identified deficiencies are corrected**.

8.7. Discontinue using a process or engineering controls which is defective and when potential health risk is not controlled with alternate exposure control measures.

9. Local Exhaust Ventilation (LEV)

9.1. Ensure competent professionals design and maintain LEVs, dust collectors and scrubbers.

9.2. Conduct LEV effectiveness determination by:

- **Conducting capture, face and duct velocity measurements with an annually calibrated thermo-anemometer or similar devise.**
- Measuring pressure drop across filtering device

9.3. **Ensure capture. Face and duct velocity meet requirements of local regulations or ACGIH Industrial Ventilation Manual. For most vapors and particulates, ACGIH capture velocity guidelines are 0.5 meters/second (m/s) and 1 to 2 m/s, respectively**.

9.4 Conduct LEV effectiveness determination at least annually.

10. Biological Agents and SARS

10.1. Potential exposures to biological agents, other than Legionella, are unlikely at HZL sites. Legionella pneumophila bacteria are widely distributed in water systems. Exposure to Legionella has potential of causing Legionnaires' disease. The sources of Legionella include locations where water I sprayed or accumulated including, for example, cooling towers.

10.2. Conduct initial and annual assessment for presence of Legionella. Legionella prevention and control measures including using a biocide in water and prevent accumulation of water, among other exposure controls.

10.3. Implement program for identification and control of Severe Acute Respiratory Syndrome (SARS) virus infections. Follow the governmental guidelines including testing, tracing, social distancing and use of face covering.

11. Occupational Hygiene Hazard and Risk Communication

11.1. **Prior to assigning a stakeholder (including employee or contractor) in a work area and annually thereafter, conduct training that assures all employees and contractors at risk of occupational exposure to hazardous agents understand the hazards, risks and controls. Include in training element**:

- Health hazards, workplace control measures and emergency response actions for hazardous agents (chemical, physical and biological) to which they may be potentially exposed.
- Hazard-specific training as determined by risk assessments (e.g., Specific PPEs to be used during the task).

11.2. Make available Safety Data Sheets (SDSs) for all hazardous chemicals onsite.

11.3. Notify affected employees and contractors of the QLEA and QNEA assessment results, within 15 days of completion of QLEA and receiving final report on QNEA.

11.4. Include in the notification the results, interpretation of results and action; HZL and employees need to take, if any, to reduce exposures.

12. Medical evaluation

12.1. **The purpose of medical evaluation is to identify an onset of an occupational illness, to determine if occupational illness is work-related or not and to take corrective measures to reduce occupational health risk**.

12.2. **Determine the need, frequency and content of medical surveillance based on results of QLEA and QNEA.**

12.3. **Communicate exposure monitoring results to the site Occupational Physician. Based on regulatory requirement or at the discretion of the Occupational Physician, conduct substance specific medical surveillance on HZL stakeholders with chemical and physical agents above the exposure limits, to determine an onset of occupational illness, if any.**

12.4. **Communicate any abnormal medical conditions to the SME-IH to determine if an illness is work-related or not and to take appropriate actions to reduce health risk**.

12.5. Refer Standard 2 for Lead related medical surveillance requirements.

13. Record Keeping and Confidentiality

13.1. **Maintain the following records electronically in the HZL server for a minimum of forty years**. Refer Vedanta's Technical standard TS 12.

13.2. The contents of the records include:

- **QLEA and QNEA reports including QLEA and QNEA process, sampling and monitoring results and, interpretation of sampling results.**
- Written annual sampling plans, PPE program and Management of Change Procedures
- **Written Risk Control Plans**
- Training records
- Exposure control verification

13.3. **List of employees whose routine 8-hour exposure to noise exceed regulatory action levels of 85 dBA. This would assist in defining population for audiometric examinations**.

13.4. Maintain confidentiality of employee exposure and medical surveillance data. Provide access of the exposure and medical surveillance data to only the affected employees. Keep hard copy of the records in lock and key with limited access. Provide password protection for electronic record keeping of the above referred data.

14. Self-Audit and Key Performance Indicator

14.1. Evaluate IHP effectiveness annually by conducting internal audit. The SME-IH and Head of the Department will participate in the program evaluation.

14.2. Track any deficiency identified in the audit to completion. (Refer to Appendix 2, Self-Audit Checklist).

14.3. Evaluate exposure monitoring results and complete the following KPI

Key Performance Indicator			
Total Number of Employees			
Number of employees Exposed to Chemical Agents			
<50% of Exposure Limit	**>50%<10% of Exposure Limits**	**> Exposure Limits**	**No data available***

Total of orange and red		
* Exposed but measurements not taken		

15. Management Systems

15.1. **Support Resources**

Location head /Unit head / CSC/ Corporate EHS/ S&FS is available to assist with implementation of this standard.

15.2. **Audit Requirements**

Each location shall audit compliance with this standard as part of its Safety audit program.

15.3. **Standard Renewal Process**

This standard shall be reviewed and revised as necessary and, at a minimum, not later than three years from the date of the last revision.

15.4. **Deviation Process**

Deviations from this standard must be authorized by the CSC. Deviations must be documented and documentation must indicate causes of deviation. Deviation authorization must be renewed periodically and no less frequently than every three years.

15.5. **Training and Communication Requirements**

Each unit must be familiar with this standard to carry out its responsibilities. Training is the responsibility of each Zone / location.

15.6. **Contact**

In the event that interpretation or clarification is needed, questions shall be directed to the Safety & Fire Services Head and Zone/ Corporate SRP Subcommittee.

Appendix 1: Terminologies used

1. **Acute Effect** – A change that occurs in the body within a relatively short time (minutes, hours, days) following exposure to a substance.
2. **Acute Exposure** – A single exposure to a hazardous agent.
3. **Additive Effects** – **The health effects of a mixture which are equal to the sum of the effects of the components of the mixture**.
4. **Administrative Controls** – A category of hazard control that uses administrative/ management involvement in order to minimize employee exposure to the hazard. Some examples are: job enrichment job rotation work/rest schedules work rates periods of adjustment.
5. **American Conference of Governmental Industrial Hygienists (ACGIH) – An organization of industrial hygiene professionals that develops occupational health and safety programs. ACGIH develops and publishes recommended occupational exposure limits for hundreds of chemical substances and physical agents (see Threshold Limit Value).**
6. **Area Sampling** – Collection and analysis of representative samples of air in general work areas in order to determine the concentrations of any contaminants that are present.
7. **Biological Agent** – Any living organism (for example, virus or bacteria) that affects the body, a part of the body, or any of its functions. The effects may be beneficial or harmful.
8. **Biological Monitoring** – The use of medical tests (for example, blood, urine, exhaled air) to determine whether a person has been or is being exposed to a substance.
9. **Breathing Zone – The area surrounding the employee's head. The make-up of air in this area is thought to be representative of the air that is actually breathed in by the employee**.
10. **Carcinogen** – A chemical, physical or biological agent that can cause cancer in humans or animals.
11. **Chemical Agent** – A chemical substance that affects the body, a part of the body, or any of its functions. The effects may be beneficial or harmful.
12. **Chronic Effect – A change that occurs in the body over a relatively long time (weeks, months, years) following repeated exposure or a single over-exposure to a substance. Chronic Exposure – Repeated exposure to a hazardous agent**.
13. **Controls** – Measures designed to eliminate or reduce hazards or hazardous exposures. Examples include: engineering controls, administrative controls, personal protective equipment. Hazards can be controlled at the source, along the path to the employee, or at the employee.
14. **Occupational Exposure Limit (OEL)/Threshold Limit Values**: – The airborne concentrations of a biological, chemical, or physical agent to which it is believed nearly all operators may be exposed without experiencing any harmful effects.
    - **Time Weighted Average (TWA)** - The time weighted average concentration or levels of a chemical or biological agent for an 8-hour day or a 40- hour week to which it is believed nearly all operators may be exposed, day after day, without experiencing harmful effects.
    - **Short-Term Exposure Limit (STEL)** - The maximum airborne concentration of a chemical, biological or physical agent to which operators may be exposed from time to time, provided that the **exposure is for not more than 15 minutes**, **is not more often than four times in a work day**, and at **least 60 minutes have elapsed from the time of the last exposure**.
    - Ceiling Limit - **The maximum exposure to an airborne concentration of a chemical, biological or physical agent that is not to be exceeded for any length of time.**

15. **Industrial Hygiene – A science that deals with the anticipation, recognition, evaluation, and control of hazards in the workplace. These hazards may cause sickness, harm to employee health, discomfort, and inefficient performance on the job. Also known as occupational hygiene**.
16. **Localized** – Restricted to one spot or area in the body and not spread throughout it. Compare with systemic.
17. **Material Safety Data Sheet (MSDS)** – A form that contains detailed information about the possible health and safety hazards of a product and how to safely store, use and handle the product.
18. **Medical Surveillance** – The systematic approach to monitoring health changes in operators to identify and determine which effects may be work-related.
19. **Occupational Illness** – A harmful condition or sickness that results from exposure in the workplace to a biological, chemical, or physical agent or an ergonomic hazard.
20. **Parts Per Million (PPM)** – **Parts of gas or vapor per million parts of air by volume at room temperature**. For example, 1 cubic centimeter of gas in 1 million cubic centimeters of air has a concentration of 1 PPM.
21. **Personal Monitoring – A technique used to determine an individual's personal exposure to a chemical, physical or biological agent. This is done by means of a sampling device worn on the employee's body (e.g., personal monitor). The monitoring of hazardous chemicals is done at the breathing zone; the monitoring of noise is done at the ears.**
22. **Physical Agent** – A source of energy (for example, noise, radiation, vibration, heat) that affects the body, a part of the body, or any of its functions. The effects may be beneficial or harmful.
23. **Radiation** – The energy transmitted by waves through space or some medium. There are two types of radiation: Ionizing (for example, X-Rays or radiation from a radioactive device), and non-ionizing Radiation (for example, infra-red radiation, ultraviolet radiation).
24. **Reproductive Hazards** – Any material that can affect the **development of sperm and egg cells**. This can lead to an inability to have children, birth defects and other harmful changes.
25. **Similar Exposure Groups:** Group of people who have similar exposure potential
26. **Sensitizer** – A substance which on first exposure causes little or no reaction in humans or test animals. However, on repeated exposure, it may cause a marked response not necessarily limited to the contact site. Skin sensitization (for example, to a metal such as nickel) is the most common form of sensitization in the workplace. Respiratory sensitization to a few chemicals (for example, isocyanates) is also known to occur.
27. **Synergistic Effects – The health effects of two or more substances or agents that are greater than the sum of their separate effects.**
28. **Systemic –** Spread throughout the body; affecting one or more body parts or systems. Compare with localized.
29. Teratogen – An agent that causes birth defects by harming the unborn child.
30. **Toxic Substance** – Any substance that can cause acute or chronic effects to a person or is suspected to cause disease or injury under certain conditions

Appendix 2: Self-Audit Checklist

Evaluation Item	Confirmation criteria	Yes/No	Action Item
Is written program in place?	**Review written program, ensure it is site specific**		
Is program annually updated?	**Discuss with process colleagues, any process changes, hazard assessment and is IHFS updated**.		
Chemical agent inventory and hazard characterization done? Updated?	**Review this item, identify at least 3 chemicals from site visit and confirm inventory and hazard characterization for these chemicals.**		
Physical agent inventory and Hazard characterization done? Updated?	Review this item, identify at least 3 physical agents from site visit and confirm inventory and hazard characterization is done		
Biological Agent inventory and hazard characterization done? Updated?	Review this item, identify at least 2 Biological agents from site visit and confirm inventory and hazard characterization is done		
List of SEGs in place and covers all activities with exposure potential? QRA done? Comprehensive?	**Review SEGs based on site visits and review QLEA.**		
Annual exposure monitoring in place?			
QNEA conducted as per monitoring plan			
Is QNEA representative, reproducible, reliable?	Review reports, sampling duration, calibration data, laboratory analyzing samples, result interpretation		
Hazard Control Plan in place? Updated annually?			
Inventory of exposure controls for verification is in place? All exposure controls listed?			
Verification done at least annually?			
Deficiencies identified during verification tracked to completion?			
Training conducted?	Review training topics, trainers qualifications, interview colleagues and contractors to determine training effectiveness		

Medical surveillance conducted initially and periodically?			
Are exposure monitoring results communicated to physician, are medical surveillance findings indicative of an onset of illness communicated to site occupational hygienist (without name of colleague)			

Name/Title of Program Evaluators

Evaluation Date

Evaluation decision: Acceptable/Not Acceptable

Signature

HZL Standards

Lead Program

Abbreviations

- ACGIH - American Conference of Governmental Industrial Hygienists
- AIHA - American Industrial Hygiene Association
- APF - Assigned protection factor.
- APR - Air-purifying respirator.
- BLL - Blood Lead Level
- CSC - Corporate Safety Council
- CSRP - Corporate Standards, Rules and Procedure Subcommittee
- EHS - Environment, Health and Safety
- HEPA - High efficiency particulate air.
- HZL - Hindustan Zinc Limited
- IFA - Indian Factories Act
- NIOSH - National Institute for Occupational Safety and Health
- OEL - Occupational Exposure Limit
- OSHA - Occupational Safety and Health Administration
- PAPR - Powered air-purifying respirator
- PEL - Permissible Exposure Limit
- PLE - Permissible Limit of Exposure
- PPE - Personal protective equipment
- SME - IH - Subject Matter Expert - Industrial Hygienist
- TLV - Threshold Limit Value
- TWA - Time-weighted average.

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7. Introduction

This **Lead Management Program provides guidance on recognizing health hazards of lead, determining the potential lead exposures and, more importantly, controlling lead exposures through routes of inhalation and ingestion**.

Lead poisoning including poisoning by any preparation or compound of lead is a notifiable disease under Indian Factories Act (IFA), The Third Schedule (SECTIONS 89 and 90) List of Notifiable Diseases.

Lead overexposure may result in damage to the blood-producing systems, kidneys, gastrointestinal system, nervous system and reproductive system. Therefore, adherence to protective measures is important for the protection of all stakeholders. Hindustan Zinc Limited (HZL) Lead Program outlines the roles and responsibilities of managers, supervisors and workers and defines the protective measures to be taken during different types of work.

Lead exposure potential exists in zinc/lead smelting activities. Studies in metal mining have identified lead exposures among mining and milling employees also.

7.1. Purpose

The lead management program is aimed at (a) reducing potential health effects from lead exposure to all HZL stake holders, (b) to ensure compliance with regulatory requirements, and (c) to implement best management practices to reduce potential lead exposures.

8. Scope

This standard applies to all HZL business units and operations where lead containing materials are used or processed.

9. Management Responsibilities

Line management has the responsibility to implement this standard.

10. Definitions

Factory Manager/ Mines Manager - A person who is legally notified and authorized by the Occupier to discharge his duties.

Operator - any person who directly or indirectly is involved with the process, with a likely exposure potential to physical, chemical or biological agents.

Visitor - any third-party person who has not been inducted under HZL's safety policy. Such person may be a subject matter expert/consultant/ OEM/Supplier from another organization.

Risk Assessment - The formal process of identifying, assessing and evaluating the safety, health and environmental risks that may be associated with a hazard. For example: Hazard Identification Risk Analysis, Job Safety Analysis etc.

11. People (Roles and Responsibilities)

Lead Management Program is a multidisciplinary program and requires the contribution from all levels of professionals at HZL

Establish a team to implement the program, in consultation with the employees. Ensure the composition and size of the program team is proportional to the size of the company and the number of employees exposed to lead.

The composition of the team may include:

- Site leadership / Mine Manager;
- Subject Matter Expert - Industrial Hygienist (SME-IH);
- Site Safety Officer
- Lead Employee/Worker;
- Occupational Physician / Industrial Nurse.

11.1. Site Leadership / Mine Manager

- Ultimately responsible to comply with all elements of this Program.
- Ensures all affected employees are educated on the hazards of lead exposure and the contents of this standard.
- Ensures adequate controls, including personal protective equipment is made available and used to protect employees and contractors from lead over-exposures;
- Designate a competent person to recognize and communicate lead health hazards, to assist in conducting exposure assessments and to facilitate implementation of lead exposure control measures.

11.2. Subject Matter Expert - Industrial Hygienist (SME-IH)

- Provide guidance to all stakeholders on lead exposures and control measures.
- Oversee project-specific lead programs; inspections of work activities involving potential lead exposure.
- Initiate Lead identification/assessment techniques and monitoring lead exposure
- Review this standard annually.
- Determine when enough current or historical air monitoring is available to de-regulate a regulated

area.

- Coordinate with occupational physicians for need for biological monitoring and medical removal of the affected employee from the work area.

11.3. Site Safety Officer

- Assist SME-IH by providing necessary data to make decisions on control procedures and protective equipment;
- Provide onsite training on basic hazard recognition, evaluation and controls.
- **Ensure all stakeholders; including HZL employees and contractors are implementing work practices to reduce potential occupational health risk.**
- Ensure adequate records (monitoring results, employee concerns, medical removal and re-entry) are maintained in a dedicated server.

11.4. Lead Employee/Worker

- **Use assigned personal protective equipment, follow good personal hygiene practices and adhere to all work practices established for each specific job**. Refer Standard 3 for usage and maintenance of Respiratory Protection Devices.

11.5. Occupational Physician

- **Determine the need and frequency for lead specific health surveillance based on (a) regulatory requirements and (b) lead exposures in various job classifications.**
- **Review results of medical surveillance and determine the need for additional medical surveillance and action items needed to address lead exposure concerns, if any.**
- Ensure every employee / contractor employed in a lead processes are medically examined initially during preplacement in the lead processing areas. Indian Factories Act (IFA) requires medical examinations from a Certifying Surgeon within 15 days of the first employment (e.g., determination of Aminolaevulinic Acid (ALA) in urine, haemoglobin content
- Administer biological monitoring for lead and communicate results to affected personnel.
- **Retain records for all employees undergoing medical examinations (such as those arising from health monitoring and surveillance) for up to 40 years in a secure and confidential manner**. Refer Vedanta's Technical Standard TS 12;
- Notify SME-IH and the affected persons when biological monitoring results exceed defined levels and or when a work-related occupational illness is identified;
- Communicate to the site leadership for the need for medical removal of the affected employee from the area.

7. Exposure Standards and Exposure Assessment

6.1. Initial Determination of Lead Exposure

- **If percentage of lead in ore or intermediate materials are not known, determine the percentage of elemental lead and or lead compounds such as lead sulphide. For the purpose of this determination, use an independent laboratory which is accredited by National Accreditation Board for testing and Calibration Laboratories (NABL))**.
- Based on initial indication of the lead and lead exposure potential, prepare a list of all activities with potential for similar lead exposure, also known as Similar Exposure Groups (SEGs).

6.2. Exposure Standards

Airborne Exposure Limits

The IFA has set the Permissible Limit of Exposure (PLE) for lead (inorganic dusts and fumes as Pb) at 0.15 milligrams per cubic meter of air (0.15 mg/m^3) as an eight-hour time-weighted average (TWA).

The American Conference of Governmental Industrial Hygienists (ACGIH) has established the most protective exposure limit (Threshold Limit Value for lead of 0.05 mg/m^3) for the eight-hour shift.

The US Occupational Safety Health and Administration has established an Action Level of 0.030 mg/m^3.

Vedanta standard requires comparison of the personal exposure with the most protective exposure limits. Refer Vedanta's Technical standard TS 12. **Therefore, airborne exposure limits applicable at HZL will be 0.05 mg/m^3 and Action Level of 0.03 mg/m^3**.

Biological Monitoring Limits also known as Biological Exposure Indices (BEIs)

The IFA mandates periodic medical examination (including biological monitoring) of every employee (as per IFA-CHAPTER IV-A PROVISIONS RELATING TO HAZARDOUS PROCESSES, Under 41-C) and State Rules. ;

OSHA requires biological monitoring including or Blood Lead Level (BLL) determination of those job classifications with employee exposure above the Action for more than 30 days per year.

ACGIH established BEI for lead is 20 ug/dL. Current HZL standard requires medical removal of females employees with BLL at or above 15 µg/dL and for male employees with BLL at or above 35 µg/dL from the work area (Refer Vedanta's internal standard). The medical removal requirements from HZL is the most restrictive of the global standards.

6.3. Qualitative Exposure Assessment

Conduct QLEA for all SEGs to estimate lead exposure potential. This is accomplished by collecting all hazard information, by conducting a walkthrough of all areas, discussion with process experts and discussions with maintenance team and employees.

Prepare an exposure monitoring plan based on QLEA. The monitoring plan is to be updated based on the findings of the QLEA report, employee concerns, change in the exposure limits and change in process or procedures. Refer Standard 1 (Industrial Hygiene Framework standard) for the detailed process for conducting the QLEA.

6.4. Quantitative Exposure Assessment

Conduct Personal Breathing Zone (PBZ) monitoring for SEG employees from the monitoring plan. The SME-IH or the qualified consultant conducts personal exposure monitoring to determine the employee exposure to airborne lead. **Ensure professionals conducting the exposure monitoring are qualified and experienced. The qualifications include a degree in Industrial Hygiene or related field and or certification from British Occupational Hygiene Society (BOHS) for exposure monitoring or equivalent**.

The procedure for conducting the personal exposure monitoring is as follows:

- Collect air samples in the breathing zone of employees in accordance with the NIOSH Method number 7082.
- Ensure air monitoring is representative of each task that will be conducted (i.e., monitoring conducted while setting up the work area cannot be used to represent exposures during hot work).
- Ensure all lead samples are analysed by an American Industrial Hygiene Association accredited laboratory.
- Repeat monitoring based on the results of baseline monitoring and findings of QLEA.
- Repeat the air sampling annually if the employee exposure is between the 50 % - 100 % of the Action Level; after implementation of required controls.
- Repeat the air sampling semi-annually if the employee exposure exceeds the Action Level, till employee exposure is confirmed below exposure limits by means of engineering and process controls.
- Refer to HZL standard on Industrial Hygiene Program for additional requirements on exposure monitoring.

8. Controlling Exposure

7.1. Lead compliance plan

Develop a written lead compliance plan for any SEGs where lead exposure exceeds the lead Action Level. Review the compliance plans at least annually. Include in compliance plan hierarchy of controls with implementation timelines to reduce lead exposures below the Action Level.

7.2. **Interim Personal Protective Equipment.**

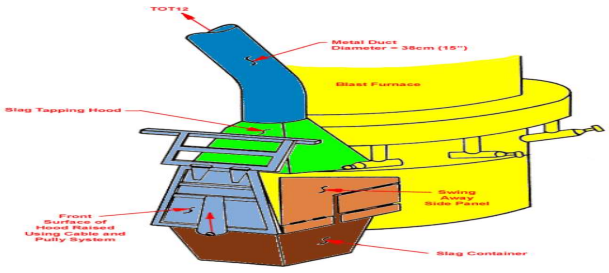
- **Ensure employees and contractors are protected with Personal Protective Equipment at all times where there is potential exposure to lead containing materials including the initial exposure assessment phase. The minimum level of personal protective equipment will be specified by the SME-IH. Refer section 8 of this standard for respiratory protection and HZL Standard 2 (Respiratory Protection Program) for details on the respirator's usage, maintenance, and disposal.**

7.3. **Hierarchy of Exposure Controls Engineering Controls**

Implement the hierarchy of exposure controls as explained in HZL Industrial Hygiene Standard. when lead exposure exceeds Action Level.

1. Elimination
2. Substitution
3. **Process controls and engineering controls**
4. Administrative controls and work practices
5. PPE.

The following image depicts and example of engineering control.



The most common engineering controls include:

- **Install Local Exhaust Ventilation (LEV) systems to control lead exposure**.
- **Vacuum work surfaces with a High Efficiency Particulate Air (HEPA) vacuum as needed during the work shift and at the end of the day to remove lead particulates likely to accumulate on the surfaces**.
- Enclosed cabins for earth moving equipment operators.

Verify effectiveness of engineering controls such as LEV by means of face, capture and duct velocity measurements. Refer to HZL standard on Industrial Hygiene Program for additional information. The following image depicts LEV verification.

7.4. **Administrative and Work practice Controls**

- **Perform daily clean-up of work area and equipment to prevent leaded particulate accumulations**;
- **Mist the debris with water prior to clean-up to minimize leaded dust generation**;
- Keep all surfaces as free as practicable from leaded dust accumulation and contamination;
- **Restricted Access Areas with lead exposures above Action Level**: Post warning signs at all Regulated Areas.

  The signs may read as follows:

  WARNING
  LEAD WORK AREA
  POISON
  NO SMOKING OR EATING

- Provide a change area at the boundary of the Regulated Area for the purpose of entry and exit from the Regulated Area for any purpose except emergencies;

7.5. **Personal hygiene**

- Do not wear coveralls contaminated with lead outside of the regulated area;
- Always use gloves and eye protection;
- **Refrain from smoking and consuming tobacco products at all times when working in the areas containing lead**;
- **Decontaminate protective clothing before exiting the Regulated Area for any purpose by the following methods:**
  a) **Removal of outer protective clothing**
  b) **Use of a HEPA-filtered vacuum**
- Keep street clothes and work clothes separate. Provide a change room where street clothes are removed, and work clothes are worn while going in to regulated areas. While leaving the area, remove potentially contaminated work clothes with street clothes, take a shower or thoroughly wash potentially contaminated body parts such as hands and feet.
- Ensure contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the change-room which prevents dispersion of lead outside the

container. Provide appropriate warning label indicating lead hazard on containers.

- **Conduct a surface wipe sampling for lead in the areas which may pose lead ingestion potential**. Such areas include, for example, canteen.

9. Respiratory Protection

Ensure while working with lead, respirators are used under the following conditions:

- **When TWA lead exposure exceeds the Action Level**.
- When engineering or administrative controls do not reduce exposure below the Action Level;
- As interim protection during exposure assessments or during installation of controls.
- **Conduct respiratory fit testing and medical surveillance before administering respiratory protection.**

Employees already in the HZL Respiratory Protection program will continue to use the provided respirator while working with lead, even when the above conditions don't apply, provided:

- **They have HEPA filter cartridges**;
- **The respirator use does not increase other hazards and**
- **All aspects of the HZL Respiratory Protection Standard attached to this standard are followed**

10. Medical Surveillance

Conduct medical surveillance before being employed and potential lead exposure area. After employment, conduct medical surveillance for all employees exposed on any day to airborne lead concentrations at or above the Action Level initially and every six thereafter. The standards to be used for blood levels are included in Section 6.2 of this standard.

Conduct periodical blood lead monitoring as follows:

1. Every 3 months during the 1st year of employment
2. After 1st year, annually for male and every 3 months for females
3. Every month if employed blood level exceeds 20 ug/dL.

Blood lead level sampling and analysis provided shall have an accuracy (to a confidence level of 95 percent) within plus or minus 15 percent or 6 ug/100 ml, whichever is greater, and shall be conducted by a laboratory licensed by an authorized agency.

Please refer to OSHA standard 29CFR1910.25 for additional guidance on biological monitoring. This guidance is to be used as best practice and not as requirements.

Ensure medical surveillance program meets the requirements of IFA (as per IFA-CHAPTER IV-A PROVISIONS RELATING TO HAZARDOUS PROCESSES, under 41-C, provide for medical examination of every worker) and as per under model rules part II.

Pregnant Female Policy

Current HZL policy is to restrict females form lead exposure areas when pregnancy is known.
Encourage female employees to report confidentially to HZL designated physician when they are known to be pregnant.
The HZL physician will follow additional steps as needed.

11. Training and Information

- Ensure all employees and contractors with lead exposure potential are trained on health hazards of lead, safe work practices to be followed and safe use of respiratory protection. Provide this training before a person is assigned to work in the lead area and annually thereafter.

12. Recordkeeping and Notification

12.1. Exposure Monitoring Records

Notify the results of biological monitoring and employee exposure monitoring within 30 working days after the receipt of the results to the affected employees only. Refer to HZL Standard Industrial Hygiene Program for the notification requirements.

Retain monitoring and medical surveillance records for a minimum of forty years. Refer Vedanta's Technical standard TS 12.

12.2. Medical Removal

Retain records of all employees removed from current job status due to elevated BLLs.

The records will include at a minimum: employee name; date of removal and return to job status; explanation of how the removal was accomplished; and reason for removal. Retain the records for at least the duration of the employee's employment.

12.3. Training Records

Ensure training records are kept at least until the next refresher is completed. Records will include: date of training; employee name; and a description or outline of training content.

12.4. Negative Exposure Assessment Information

Retain any objective data used to determine exemptions from initial monitoring or any other data used to show negative exposure assessments for at least thirty years.

13. Management Systems

13.1. **Support Resources**

Location head /Unit head / CSC/ Corporate EHS/ S&FS is available to assist with implementation of this standard.

13.2. **Audit Requirements**

Each location shall audit compliance with this standard as part of its Safety audit program.

13.3. **Standard Renewal Process**

This standard shall be reviewed and revised as necessary and, at a minimum, not later than three years from the date of the last revision.

13.4. **Deviation Process**

Deviations from this standard must be authorized by the CSC. Deviations must be documented and documentation must indicate causes of deviation. Deviation authorization must be renewed periodically and no less frequently than every three years.

13.5. **Contact**

In the event that interpretation or clarification is needed, questions shall be directed to the Safety & Fire Services Head and Zone/ Corporate SRP Subcommittee.

14. References

- **THE FACTORIES ACT, 1948**
- **OSHA Lead Standard**
- **OSHA Respiratory Protection Standard**
- **Vendata's Technical standard TS 12**
- **Vedanta's Management Standard MS 11**
- **IFC General EHS Guidelines - Occupational Health and Safety**

15. Appendices

- Appendix 1- Terminologies used
- Appendix 3 – Lead Compliance Checklist

Appendix 1: Terminologies used

31. **Administrative Controls**: A category of hazard control that uses administrative / management involvement in order to minimize employee exposure to the hazard. Some examples are: job enrichment job rotation work/rest schedules work rates periods of adjustment.
32. **Controls**: Measures designed to eliminate or reduce hazards or hazardous exposures. Examples include: engineering controls, administrative controls, personal protective equipment. Hazards can be controlled at the source, along the path to the employee, or at the employee.
33. **Time Weighted Average**: The time weighted average concentration or levels of a chemical or biological agent for an 8-hour day or a 40-hour week to which it is believed nearly all operators may be exposed, day after day, without experiencing harmful effects.
34. **Medical Surveillance**: The systematic approach to monitoring health changes in operators to identify and determine which effects may be work-related.
35. **OEL**: An occupational exposure limit is an upper limit on the acceptable concentration of a hazardous substance in workplace air for a particular material or class of materials.

APPENDIX 2 – COMPLIANCE CHECKLIST
LEAD EXPOSURE CONTROL STANDARD

ROLES AND RESPONSIBILITIES (SECTION 5)

1. Has the facility designated a facility competent person for lead?

EXPOSURE STANDARDS AND MONITORING (SECTION 6)

2. Does the facility conduct proper initial determinations of lead exposures?
3. Does the facility conduct proper initial and periodic exposure monitoring when negative exposure assessments have not been developed?

CONTROLLING EXPOSURE (SECTION 7)

4. Are lead compliance plans completed for large lead jobs conducted by HZL employees or contractors?
5. Are interim protection requirements followed for jobs involving lead?
6. Are engineering and work practice controls such as local exhaust ventilation, HEPA equipped tools, wet methods, etc. used or considered for lead jobs?
7. Are proper signs posted for restricted areas where lead work is being performed?

RESPIRATORY PROTECTION (SECTION 8)

8. Are proper respirators worn for lead jobs based on exposure assessments?

PERSONAL PROTECTIVE EQUIPMENT (SECTION 9)

9. Is proper PPE used for lead jobs (cloth coveralls, head covers, foot covers, gloves and eye / face protection)?
10. Are decontamination procedures communicated for leather boots or leather protective equipment?
11. Is clean protective clothing provided ?
12. Are commercial laundry services notified of the presence of lead contamination?

HYGIENE FACILITIES AND PRACTICES (SECTION 10)

13. Are change rooms provided when feasible (if not are containers or some other means of storing personal clothing provided)?
14. Is protective clothing HEPA vacuumed and removed at the entrance to the regulated area?
15. Are shower facilities available and are employees required to shower at the end of their shifts when working in lead regulated areas?
16. Is contaminated clothing stored in appropriate labeled containers?

MEDICAL SURVEILLANCE (SECTION 12)

17. Is initial biological monitoring, consisting of tests for blood lead and zinc protoporphyrin levels, made available to employees performing work covered under the lead standard who have been or will be exposed to lead above the 50% of PLE on any day?

18. Is continuing biological monitoring made available to employees covered by the lead standards who are, or will be, exposed at or above the 50% of PLE for thirty or more days per year.

TRAINING (SECTION 13)

19. Are employees who may be exposed above the 50% of PLE on any given day given training on lead hazards?

HZL Standards

Respiratory Protection Standard

Abbreviations

- **CSRP –** Corporate Standards, Rules and Procedure Subcommittee
- **HZL –** Hindustan Zinc Limited
- **HSE –** Health, Safety and Environment
- **EOHS –** Environment Occupational Health & Safety
- **SOP –** Standard Operating Procedure
- **ANSI –** American National Standards Institute
- **NIOSH –** National institute for Occupational Safety and Health
- **OSHA –** Occupational Safety and Health Administration
- **PPE –** Personal Protective Equipment
- **RPE –** Respiratory Protective Equipment
- **SAR –** Supplied - Air Respirator
- **SCBA –** Self Contained Breathing Apparatus

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Appendix – 1	SCBA Inspection Checklist	
Appendix - 2	RPE Program audit checklist	

1. Purpose

The purpose of the Respiratory Protection Program (RPP) is:

- **To ensure that all HZL employees and stakeholders are protected from potential harmful exposures to air contaminants (dusts, mists, smoke, vapors or gases) prescribed in this program and are provided with Respiratory Protective Equipment (RPE) that is appropriate to the risks involved in their tasks**.

2. Scope

- This standard applies to all HZL business units. It is applicable to all stakeholders including HZL employees and contractors.

- This RPE program applies to all operations including process, manufacturing, ware house, utilities, maintenance, gardening, laboratories and offices at HZL site.

3. References

Indian Standards **IS 9623.2008- Recommendations for the selection, use and maintenance of respiratory protective devices**

4. Management Responsibilities

The employer or the occupier are responsible for the implementation of an effective Respiratory Protection Program.

5. Definitions

Air-purifying respirator – means a respirator with an air-purifying filter, cartridge or canister that removes specific air contaminants by passing air through the air-purifying element.

Self-contained Breathing Apparatus (SCBA) – means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

Canister or cartridge – means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

Assigned protection factor (APF) means the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program as specified by this section.

Atmosphere-supplying respirator means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

Powered air-purifying respirator (PAPR) means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Qualitative fit test (QLFT) means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent**.**

Supplied-air respirator (SAR) or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

6. People (Roles and Responsibilities)

6.1. Program Administrator

The site safety officer will function as RPE program Administrator.

Implement or facilitate all elements of RPP including hazard assessment, respirator selection, training, respirator fit testing, medical surveillance, record keeping and annual update of RPP.

6.2. Supervisor/Head of Department

Ensure (a) colleagues and contractors are using respirator, (b) appropriate respirators and accessories are available (c) respirators are maintained, stored, cleaned and decontaminated (d) respirators and accessories inventory is maintained.

Report to Program Administrator any change in process, equipment, area, new chemical requiring review of RPP.

6.3. Employees and Contractors:

Use RPE as prescribed in this program and as communicated in RPE training.

Inspect RPE before every use to ensure damaged RPE is not used.

Clean, decontaminate and store RPE as prescribed in this program and communicated in the training.

Ensure all RPE parts are functional and inform supervisor if RPE is damaged or no longer fits well.

7. PROCEDURES:

Respirators are to be used when (a) it is not feasible to reduce exposures below exposure limits by means of process and engineering controls (b) controls are being implemented (c) certain maintenance and repair operations and (d) emergency situations.

7.1. Hazard Assessment:

Conduct hazard assessment for each of the activities and operations with potential exposures to

chemical agents.
Conduct hazard Assessment for RPE which consists of Qualitative Exposure Assessment (QLEA) and Quantitative Exposure Assessment (QNEA). Refer to HZL Industrial Hygiene Program for additional information on hazard assessment.

7.2. **Selection and use of RPE**

Select RPE based on exposure monitoring results and protection factor provided by the respirator. **Use a respiratory protection factor to determine potential exposure with the use of a respirator only when all elements of this RPP, including respirator fit testing, medical surveillance and cleaning and decontamination, are implemented**. Use the following protection factors for various type of respirators. The protection factors how much exposure is reduced with the use of a respirator. For example, quarter mask, with a protection factor of 5 reduces exposure by 5 times.

Type of respirator	Quarter mask	Half mask	Full facepiece	Loose-fitting facepiece
1. Air-Purifying Respirator	5	10	50	.....
2. Powered Air-Purifying Respirator (PAPR)	.....	50	1,000	25

Select National Institute for Occupational Safety and Health (NIOSH, USA) or equivalent agency certified respirator.
Perform positive and negative pressure seal check every time before using a respirator. Positive and negative pressure check is done by blowing the air out by keeping exhalation valve of respirator closed and inhaling air with inhalation valve closed as illustrated in the following pictures. Tighten the respirator straps or replace the respirator is a leak is sensed during the check.

Do not use tight-fitting face-piece respirators if a respirator user has any condition, such as facial scars, facial hair or missing dentures that would prevent a proper seal.
Before and after each use of a respirator, inspect respirator for damaged parts including ***face-piece, headbands, valves, filter holders and filters****. Repair or replace damaged part prior to use in accordance with the manufacturer's instruction. Ensure cartridge use for respirator is suitable for organic vapor, acid* ***gases*****, specific gases and particulates**.

Disposable Dust Mask: Do not use disposable dust mask for protection against chemical agents and protection against exposures above exposure limits

Half Face Air Purifying Respirators: Do not use half-face or full - face air purifying respirator with organic vapors/acid gas for protection against (a) odorless substances, (b) acutely toxic substances and in case of a spill or an emergency situation where concentrations are likely to be above Immediately Dangerous to Life or Health (IDLH) Concentrations.

Cartridge Replacement: For High Efficiency Particulate Air Filter (HEPA) filter respirator, replace the cartridge when breathing resistance is felt. For organic and acid gas cartridges, replace the cartridges based on expected concentrations and other factors as per the guidance from the following link: OSHA e-tools Respiratory Change schedule .

Self-Contained Breathing Apparatus (SCBA): Ensure SCBA procedures are implemented for use of SCBA in case of an emergency and or respond to an IDLH concentration situation.

Air Line Respirator and Breathing Air Quality:

- Ensure airline coupling diameter is such that the airline can never be connected to air supply other than breathing air (e.g., nitrogen supply). Ensure all breathing air supply line and other gas supply lines are conspicuously labelled. Ensure an airline is equipped with an air pressure-regulating device.
- Use air compressor dedicated for airline respirator. Alternatively, use oil-free compressor for breathing air supply. Ensure compressor is located in an area to avoid entry of potentially contaminated air into the compressor.
- Ensure, if an Oil-lubricated compressor is used, it is equipped with a high temperature alarm, and/or the airline equipped with a carbon monoxide alarm. Provide visual or audible alarms to indicate compressor failure or overheating. Conduct breathing air testing before being used and annually thereafter. Confirm with an approved testing agency to make sure the air supplied meets the specifications of Grade D air.

Select RPE considering the following factors:

- The chemical and physical properties of the contaminant;
- The toxicity and concentration of the hazardous material and the amount of oxygen present;
- Nature and extent of the hazard, work rate, area to be covered, mobility, work requirement and conditions as well as the limitations and characteristics of the available respirators;
- Availability of a suitable selection of sizes;
- Specifications of the RPE to ensure proper level of protection is provided

8. Medical evaluation:

8.1. **The site occupational physician will determine the need for RPE specific medical evaluation in consultation with the Program Administrator and administer the medical evaluation as appropriate.**

8.2. The purpose of medical evaluation is to make sure a respirator user is medical fit (e.g., sound lung function, no pre-existing medical condition such as asthma) to wear a respirator.

8.3. The site occupational physician may perform an initial medical evaluation to determine if the employee can use a respirator or not.

8.4. The requirement for additional medical examination (e.g., pulmonary function test) would be decided based

upon the responses of the employee for the initial medical evaluation (e.g., medical questionnaire review).

8.5. For workers above 45 years of age and who are carrying out strenuous work with SCBA, detailed annual medical examination including, Pulmonary Function Test, are recommended.

9. Respirator Fit Testing

9.1. **Conduct qualitative respirator fit testing on all tight-fitting respirator users prior to a colleague is assigned to use a respirator and thereafter at least once every 2 years or whenever there is any change in the user's facial characteristics is identified.**

9.2. **The fit testing is required for all tight-fitting face piece respirators including Self Contain Breathing Air Apparatus (SCBA) positive pressure respirator**.

Conduct Quantitative Respirator fit testing for respirator used for highly toxic substances (e.g., lead) overexposures. QNFT is also recommended when a fit factor of more than 100 and more than 500 is needed for half face and full-face respirators, respectively.

9.3. Refer to this link for details on qualitative and quantitative respirator fit testing https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.134AppA

10. Training:

10.1. The Program Administrator in collaboration with the EHS department will conduct, or arrange to conduct the training with the following elements:

- An explanation of the hazards presents at the site and the requirement of RPE;
- Applicable government regulations and facility policy and procedures;
- Specific jobs, work practices and areas that require RPE;
- Proper means to select, inspect and wear RPE;
- Proper means to maintain, decontaminate and store RPE;
- Identify and report any loss or defects of RPE;
- **Factors affecting the protection provided, such as interference by other protective equipment, working conditions, inadequate fit, damage or infrequent maintenance**.
- **Limitations and capabilities of various types of RPE; and**
- Administration of the facility RPE program, emphasizing the specific responsibilities and duties of management, supervisors and RPE users.

10.2. Include in the training demonstration of **respirator use, care and maintenance.**

10.3. Conduct the respirator users training annually and maintain records of the training including the training content, name of instructors and qualifications of the instructors.

11. Maintenance, Inspection and storage of RPE:

11.1. **Inspect respirator before and after every use for damage and leaks**.

11.2. **Inspect SCBAs at least once every month.** Appendix 1 can be used for SCBA inspection.

11.3. **Repair or replace damaged RPE immediately after noticing the damage. Repairs to respirators and pressure regulators shall only be carried out by the equipment manufacturer's authorized agent or by personnel who are trained and certified by the equipment manufacturer as qualified**.

11.4. Store respirator in a non-contaminated area such as employee locker. Use a pouch or similar bag as illustrated in figure below for respirator storage when in use. Do not leave a respirator in a contaminated area.

12. Record Keeping

- **Maintain all respirator fit testing, medical surveillance and training records as per HZL Industrial Hygiene Program Standard.**

13. Program Evaluation and Audit

13.1. Conduct RPE program audit at least annually using the audit checklist provided in Appendix 2.

13.2. Track any gaps identified during the audit with completion dates.

14. Key Performance Indicators:

14.1. Number of employees using respirators and progress towards elimination of respirator use

14.2. Number of findings in the audit conducted.

15. Management Systems

15.1. **Support Resources**

Location head /Unit head / CSC/ Corporate EOHS/ S&FS is available to assist with implementation of this standard

15.2. Standard Renewal Process

Ensure this standard is reviewed and revised as necessary and, at a minimum, not later than three years from the date of the last revision.

15.3. Deviation Process

Deviations from this standard must be authorized by the CSC after consultation with the APEX. Deviations must be documented and documentation must indicate causes of deviation with safety plan. Deviation authorization must be renewed periodically and no less frequently than every three years.

15.4. Training and Communication Requirements

Each Zone or location must be familiar with this standard to carry out its responsibilities. Training is the responsibility of each Zone / location.

15.5. Contact

In the event that interpretation or clarification is needed, questions are directed to the Safety & Fire Services Head and Zone/ Corporate SRP Subcommittee.

Appendix 1: Sample SCBA Inspection Check list

Self-Contained Breathing Apparatus Inspection Checklist

SCBA Makeand Model	Today's Date

Cylinder SerialNumber	

- **Instructions:**
  1. This checklist shall be used for an Open Circuit Self-Contained Breathing Apparatus (SCBA) only
  2. Units that are soiled or contaminated shall be cleaned prior to inspection
     Definitions:
     - **"Soiled" - Soil is easily transferred from one surface to another "Contaminated" - Presenceofavisualorodorousforeignsubstance**
  3. Place an X in the appropriate box (P)ass or (F)ail

Face piece					
	P	F		P	F
Overallassembly:freefromdeterioration, dirt and damage			Lens: free from cracks, crazing, thermal, or other damage		
Head net and harness anchors: present, functional and undamaged			Exhalationvalve:functionalandundamaged		
Regulator connection: functional and Undamaged			Speaking diaphragm: functional and undamaged		
RubberComponents:freefromdeformation, wear, damage, and cracks			Lens Frame Retainer: present and correctly installed		

Back plate and Harness Assembly					
	P	F		P	F
HarnessandBack frameassemblies:freefrom cuts, tears and damage			CylinderRetentionSystem:functionaland undamaged		
Fastening assemblies: operate properly			Straps: extend fully		

Cylinder					
	P	F		P	F
Hydrostatic test: current			Threads: serviceable		
Gauge: functional and undamaged			Valve hand wheel: undamaged		
Cylinder: cracks, dents, or damage			Burst disc outlet: clear		
Compositecylinder:cuts,gouges,ordamage			Cylinder pressure: full		

Construction (Circle) Life Date	Last Hydro Date	Hydro Retest Req.	Hydro Due Date	Service Life(yrs.)	End of
Steel orAluminum		5 years		Indefinite	
Hoop wrappedAlum.		3 years		15 Years	
Fiberglass wrapped		3 years		15 Years	
Kevlar wrapped		3 years		15 Years	
Carbon Fiberwrapped		5 years		15 Years	

Hoses					
	P	F		P	F
Free of cuts, abrasion, or damage			Connections tight		
External fittings: functional and undamaged			Couplingnippleseal;presentandundamaged		

Pressure RetentionTest		
Procedure: Close all valves, open cylinder valve fully then close.	P	F
No audible pressure loss, or visual loss of greater than 100 psi in 10 seconds		

End of Service Time Indicator(ESTI)					
	P	F		P	F
Mount secure and debris free			Fitting: functional and undamaged		
Proper activation pressure					

Regulator Assembly					
	P	F		P	F
Control: functional and undamaged			Pressure relief device: undamaged		
Housing: undamaged					
No unusual noises while operating			Normal and bypass modes functional		

Remote Pressure Gauge / Remote Console					
				P	F
Undamaged			Remotegaugeandcylinderpressurewithin 5%		

Personal Alert Safety System(PASS)					
	P	F		P	F
Excessive wear or damage			Battery covers secure		
Functions properly			Low battery warning not present		

Other Components					
	P	F		P	F
Heads Up Display(HUD): functional and Undamaged			Voice amp serviceable		
Rapid Intervention Connection/Universal Air Connection(RIC/UAC)storable and serviceable					

COMMENTS:	
Inspected by:	**Signature:**

Appendix 2: Self-audit/Program Evaluation Checklist

Evaluation Item	Confirmation criteria	Yes/No	Action Item
Is written program is in place?	Review written program, ensure it is site specific		
Detailed hazard assessment conducted, and PPE selected based on hazard assessment?	***Review Hazard Assessment for 6 activities and ensure it is complete.***		
Are approved PPE selected?	Review manufacturer details and inspect PPE for certification label.		
Are NIIOSH or equivalent agency certified PPE used	Confirm on respirator approval detail. Obtain cartridge details and ensure cartridge is designed for chemicals used		
Is medical evaluation for PPE conducted	Interview company occupational physician and determine if medical evaluation is conducted		
Is robust PPE storage, inspection, maintenance, cleaning, disinfection and decontamination program is in place?	Randomly pickup 6 PPE from site and determine compliance with this element		
Is PPE training conducted?	Review training records. Interview 3 employees and contractors. Have them explain how to use PPE.		
Are record related to PPE maintained?	Review PPE records.		
Detailed hazard assessment conducted, and respirator selected based on hazard assessment?	Review exposure assessment and monitoring results. For exposures above OEL, and considering respirator protection factor, review if employees are assign respirator.		

Are NIIOSH or equivalent agency certified respirator used and respirators are suitable for chemical agents	Confirm on respirator approval detail. Obtain cartridge details and ensure cartridge is designed for chemicals used		
Are respirators used to provide protection?	In a walkthrough, review how respirators are used, check for facial hair (for tight fitting respirators).		
Is robust cleaning and decontamination procedure is in place?			
Are respirator stored non-Contaminated area	Determine based on walkthrough		
Is respirator training conducted initially and annually thereafter?	Review training records. Interview 3 employees and contractors. Have them explain how fit check is done, and confirm other elements of training		
Is respirator fit testing conducted?	Review fit test record.		
Is medical surveillance for respirator users conducted and written documentation to confirm medical clearance available?	Discuss with occupational physician on content of **medical** surveillance and have him provide written records of respirator user's medical clearance (not specific medical surveillance results)		

Name/Title of Program Evaluators

Evaluation Date

Evaluation decision: Acceptable/Not Acceptable

Signature

HZL Standards

Hearing Conservation Program

Abbreviations

- ACGIH - American Conference of Governmental Industrial Hygienists
- CSC - Corporate Safety Council
- CSRP - Corporate Standards, Rules and Procedure Subcommittee
- dB - decibel
- DGMS - Directorate General of Mines Safety
- EHS - Environment, Health and Safety
- HCP - Hearing Conservation Program
- HPD - Hearing Protection Devices
- HZL - Hindustan Zinc Limited
- IFA - Indian Factories Act
- NID - Noise Induced Deafness
- NIOSH - National Institute for Occupational Safety and Health
- NRR - Noise Reduction Rating
- OSHA - Occupational Safety and Health Administration
- PLE - Permissible Limit of Exposure
- PPE - Personal Protective Equipment
- SEG - Similar Exposure Group
- SPL - Sound Pressure Level
- STS - Standard Threshold Shift
- TWA - Time Weighted Average

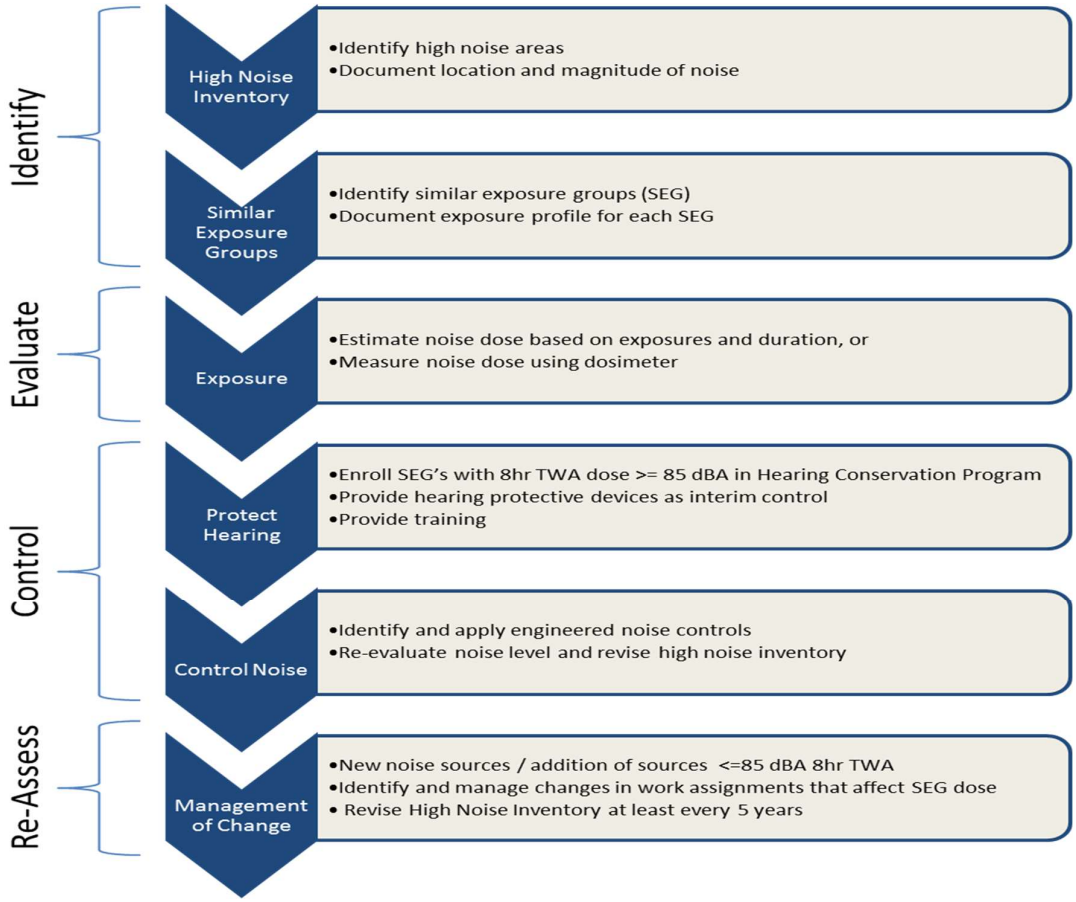
Table of Contents

1. Introduction

The primary goal of an occupational HCP is the prevention (or at a minimum; limitation) of permanent hearing loss associated with exposure to occupational noise or to other environmental factors in the workplace that may interact with noise, such as ototoxic industrial chemicals or vibration. Other goals may be formulated in addition to this primary goal, such as compliance with governmental regulations, reduction of employee stress and absenteeism, reduction of accidents due to workplace noise levels, and reduction of the facility's liability to employee compensation claims for occupational hearing loss.

1.1. Purpose

The purpose of this document is to establish the requirements to minimize the risk of permanent hearing impairment from exposure to hazardous levels of occupational noise.



Noise Evaluation Criteria

Indian Regulation of noise in mining is covered in the Directorate General of Mines Safety (DGMS) Tech circular 18/1975. The guidelines prescribe that for an unprotected ear a noise level of 90 dB(A) in a shift of 8 hours is permissible. The "Warning Limit" as per DGMS however is fixed at 85 dB(A).

Allowable Exposure Duration for Noise			
5 dB Exchange Rate (Indian Factories Act (IFA) - Model Factories Rule)		**3 dB Exchange Rate (ACGIH)**	
L_{TWA} (dBA)	Allowable Exposure Duration	L_{TWA} (dBA)	Allowable Exposure Duration
85	8 hr	85	8 hr
90	4 hr	88	4 hr
95	2 hr	91	2 hr
100	1 hr	94	1 hr
105	30 min	97	30 min
110	15 min	100	15 min
115	7.5 min	103	7.5 min
120	3.75 min	106	3.75 min

Noise exposure limits applicable to HZL is 85 dBA as an eight-hour TWA limits at 3 dB exchange rate. For regulatory compliance applicable noise exposure limit is 85 dBA at 5 dB exchange rate.

2. Scope

This standard applies to all HZL business units (smelters and mines) and operations through all development phases and construction, operation to closure and, where applicable, for post closure management. National regulations shall be used in conjunction with this standard.

3. Management Responsibilities

Line management has the responsibility to implement this standard.

4. Definitions

Factory Manager/ Mines Manager/ Project Head - A person who is legally notified and authorized by the Occupier to discharge his duties.

Operator - any person who directly or indirectly is involved with the process, with a likely exposure potential to physical, chemical or biological agents.

Visitor - any third-party person who has not been inducted under HZL's safety policy. Such person may be a subject matter expert/consultant/ OEM/Supplier from another organization.

Risk Assessment - The formal process of identifying, assessing and evaluating the safety, health and environmental risks that may be associated with a hazard. For example: Hazard Identification Risk Analysis, Job Safety Analysis etc.

5. People (Roles and Responsibilities)

Hearing conservation is a multidisciplinary field and requires the contribution of both; professionals and nonprofessionals. The HCP administrator can be assigned with the responsibility and authority for ensuring that the HCP in that facility functions successfully.

The top management can set up a team to implement the HCP, in consultation with the employees. The composition and size of the HCP team is be proportionate to the size of the unit and the number of employees likely to be exposed to excessive noise.

The HCP team may comprise the following:

- HCP administrator
- Safety and health personnel;
- Noise monitoring officer;
- Noise control officer;
- Occupational hygiene officer;
- Industrial hygienist;
- Employees' representative; and
- Occupational Physician

5.1. HCP administrator

HCP Administrator could be the Site Safety Officer.

The HCP administrator coordinates all aspects of the programme and possess knowledge on:

- **Individual elements of the HCP**
- **Relevant provisions of the Indian Factories Act (IFA), the respective state rules and the DGMS guidelines**
- International standards and guidelines such as OSHA and the American Conference of Governmental Industrial Hygienists (ACGIH)
- Effects of noise on hearing
- Purpose and selection of hearing protectors
- Purpose of audiometric examinations

The role of the HCP administrator involves:

- Coordinating the HCP;
- Monitoring its progress;
- Assessing its performance;
- Evaluating its effectiveness;
- Reviewing the HCP at regular intervals;
- Ensuring that the set objectives are met;
- Arranging meetings or discussions to promote collaboration of efforts between management and team members; and
- Fostering exchange of information between management and team members on the progress of the programme.

5.2. Site Leadership/Mine Manager

5.2.1. The management provides noise control measures to ensure employees are not exposed to excessive noise (greater than 85 dBA Time Weighted Average (TWA) exposure).
5.2.2. Assign at least one competent person to implement the relevant elements of the HCP. This person can also be the Safety Officer or the site Industrial Hygienist. Ensure the individuals who are advising on noise control are suitably qualified, whether in-house personnel or service providers.
5.2.3. Allocate appropriate resources and as far as it is reasonably practicable, implement the noise control plan put up by the competent person.
5.2.4. Ensure effective risk-based controls are implanted and maintained, through application of the Hierarchy of Control principle.
5.2.5. **Ensure Hearing Protection Devices (HPDs) are used as advised by the HCP administrator**.
5.2.6. Ensure that the noise control plan is reviewed at least once every three years or until such time when the noise is reduced to an acceptable level and the noise hazard is eliminated.

5.3. Supervisor/Head of Department/Mine Foreman

5.3.1. Provide onsite training on basic hazard recognition, evaluation and controls.
5.3.2. Ensure all stakeholders including HZL employees and contractors are implementing work practices to reduce potential occupational health risk.
5.3.3. Ensure HPDs are used as advised by the HCP administrator.
5.3.4. Report to the site leader and the HCP administrator any change in process, equipment, area, new chemical requiring a review of the HCP.
5.3.5. Adopting a prescribed schedule for monitoring noise exposure levels and other risks, including ensuring that the equipment and personnel training are appropriate for the task.
5.3.6. Ensuring the correct use of hearing protectors through onsite inspection.

5.4. Engineering and Maintenance

5.4.1. Ensure that all noise control systems or devices are well-maintained, for e.g., a machine enclosure is kept closed, its seals are in good condition and replaced when they have worn out.
5.4.2. Assist the management with considerations provided to the noise emission levels during the selection and procurement of new machines. Selecting quieter machines at the initial stage can help to save costs, compared to installation of noise control measures.
5.4.3. Set targets for minimising daily peak noise exposure levels in the workplace and developing strategies to achieve them.

5.5. Occupational Physician

5.5.1. **Determine the need and frequency for audiometric examinations based on results of the risk assessment and the monitoring results.**
5.5.2. **Review results of audiometric evaluations, with associated follow-up for any significant hearing change detected.**

5.5.3. **Retain records for all employees undergoing audiometric examinations.**

5.5.4. **Ensure employees who are likely to be exposed to excessive noise undergo pre-placement and periodic audiometric examinations**

5.6. Stakeholders including employees and contractors:

5.6.1. **Follow work-practices aimed at reducing potential occupational exposures to noise.**

5.6.2. Use HPDs as required in the relevant procedures. Ensure the ear cup of the ear muffs covers the ear lobes completely when wearing ear muffs.

5.6.3. Report to supervisor or manager regarding any unsafe working condition or work practices which may results to occupational noise exposures.

5.6.4. Follow proper use and care of the hearing protectors to maintain the effectiveness of the hearing protectors.

6. Identification of Noise Hazard and Evaluation of Noise Risk:

6.1. Qualitative Approach:

- Conduct initial noise assessment to identify areas and job classification with noise exposure potential. Use Noise hazard identification checklist from Appendix 2 for this purpose.

- Conduct a walkthrough of all areas and activities with similar noise exposure potential called Similar Exposure Groups (SEG) and identify SEGs requiring area noise monitoring.

The factors considered in determining SEGs for noise monitoring include:

- Noise is louder than busy city traffic.
- People have to raise their voice to talk to someone at one meter (3 feet) away.
- At the end of work shift, people have to increase the volume of their radio or TV to a level too loud for others.
- After working for a few years at that workplace, employees find it difficult to communicate in a crowd or party situation where there are other sounds or many voices.
- Employee complaints about the high noise levels.

6.2. Quantitative approach: Area Noise Monitoring (ANM)

- **Conduct ANM with a Sound Level Meter (SLM) meeting the following specifications. A noise dosimeter used for personal noise exposure monitoring can also be used instead of SLM**.
  - Type 1 or Type 2 sound level meter. The Type of SLM indicates the degree of precision. Type 1 and Type 2 sound level meters are more precise.
  - Calibrate SLM with a factory calibrated acoustic calibrator before and after ANM. The calibration process includes inserting SLM microphone in the calibrator, turning the calibrator on and reading the sound level on SLM. If the SLM is not within the calibration limits (+- 0.5 dB) compared to reference level in the acoustic calibrator (normally 114 dBA) then the results are invalid.
  - Refer to additional calibration instruction on instruction on SLM manual.

- Conduct ANM in A-weighing Scale (Represent sound heard by normal ear)
- Conduct ANM in "Slow" Response (The response rate is the time period over which the instrument averages the sound level before displaying it on the readout)
- **Hold microphone at ear level of the operator, allow the sound level meter to stabilize for and record sound levels.**
- Record for each SEG sound level and approximate duration of the exposure.

6.3. **Personal Noise Monitoring (Personal Noise Dosimetry)**

- **Include all SEGs in Personal Noise Monitoring Program (PNM) with noise exposure duration of 30 minutes or more at sound levels of 85 dBA or more. Include SEGS in PNM if peak noise level is 115 dBA**.
- Ensure a competent person, either from HZL, or a qualified service provider conducts PNM. The qualifications include degree in industrial hygiene, 2 to 5 years of experience in noise monitoring and or a professional who has completed W503 course on Noise Measurements from BOHS.
- **Set the noise dosimeter criteria at 5 dB Exchange Rate for compliance with DGMS/IFA and 3 dB Exchange Rate for ACGIH noise exposure limit comparison**.
- Calibrate noise dosimeter before and after measurements
- Ensure acoustic calibrator is calibrated annually by a competent agency and obtain calibration certificate.
- Conduct PNM as per the instruction provided in the noise dosimeter manual
- Observe the operator work practices, working conditions, factors potentially contributing to the noise exposures, at least once every hour and record in sampling data sheet.

Based on the noise dosimetry/Area Noise monitoring results:

- Develop High Noise Area Inventory for those areas TWA noise exposure above 85 dBA.
- **Prepare and display conspicuously noise map on the site floor plan indicating the high noise areas**.
- Include the following details in high noise inventory, location description, sound pressure level, and approximate noise exposure duration.

7. Noise Control Measures:

Prepare a list of SEGs with 8-hour TWA noise exposure above 85 dBA. Take the following actions for the employees in SEG with the TWA noise exposure above 85 dBA.

- Provide and ensure use of suitable and efficient personal ear protection also known as Hearing Protection Devices (HPDs).

- **Designate hearing protection zone with signs, informing that HPDs must be worn**.
- Implement feasible engineering controls such as acoustic enclosure, administrative controls such as job rotation to reduce TWA noise exposure below 85 dBA.
- Implement feasible administrative controls, such as job rotation, to reduce TWA noise exposures below 85 dBA.
- Refer to the following link on noise prevention and control details.

https://www.cdc.gov/niosh/docs/79-117/

7.1. **Principles of noise exposure controls**:

The principles of noise controls include, controlling noise:

- At the source.
- Along the path.
- At the receiver.

- **Noise Control at the Source**

  Noise control at the source is an engineering remedy. Vibration control or isolation, damping or lagging of vibrating surfaces, proper balancing and maintenance of machinery can reduce noise. Mufflers or silencers can control noise generated by turbulent fluid flow.

- **Noise Control along the Path**

  The control of noise along the path of transmission involves the modification of the paths by which noise travels through the air to the employees. Complete or partial enclosure of the source using an acoustical shield or barrier wall between the source and the receiver, or by increasing the distance provides a barrier for reducing noise exposure. Doubling the distance from a noise sources reduces noise exposure by four-fold.

- **Noise Control at the Receiver**

  Noise control at the receiver can be achieved by the use of hearing protectors, by use of personal enclosure or application of administrative controls such as job rotation.

7.2. **Noise Control Plan**:

- Develop noise control plans with a list of feasible engineering controls and completion dates for implementing engineering controls for areas and SEGs with 8-hour TWA noise exposure above 85 dBA.

Consider the following points when developing the noise control plan:

- **Noise control measures for new and existing processes, machinery, and equipment**.
- **Advise the management to specify low noise output of the processes, machinery and equipment as a condition of purchase alongside production-related specifications**.
- **Suggested alternative ways of production without generating excessive noise**.
- **Replacing of the noisy parts with quieter alternatives**.

Ensure the site leadership endorses the control plan

8. Types of Hearing Protectors and Noise Reduction Rating

The commonly used hearing protectors are **earmuffs and earplugs**. Consider the following factors when selecting hearing protectors.

8.1. Noise Exposure Level of the Employees

Select HPDs based on their ability to reduce noise at the ear below the warning level.

8.2. Degree of Attenuation Required

- Hearing protection is considered adequate when hearing protection is able to reduce the noise level at the ear between 5 and 10 dB(A) below the exposure limit for noise. When selecting hearing protectors, select HPD providing a higher Noise Reduction Rating (NRR), which is the expected to mitigate higher exposure to the ears, when worn properly.
- **The NRR on the HPD label is based on laboratory experimental fit and the printed NRR overestimate the protection provided by an HPD.**
- For effective noise reduction rating, subtract 7 dB from the NRR when noise is measured on the A-weighting filter (dBA). Divide the result by 2. This step is known as "derating" or Effective Noise Reduction Rating. Use de-rated noise reduction rating in determining TWA noise exposure with the use of HPDs to the ears.
- Implement engineering and administrative controls immediately if the TWA noise exposure with the use of HPD and **effective NRR is above 85 dBA inside HPD near the ears**. Also, review audiometric examination results to identify if Noise Induced Hearing Loss (NIHL) has occurred. Notify immediately to the site leadership if NIHL has occurred to take appropriate actions to reduce noise exposure

8.3. Comfort and Fit to the User

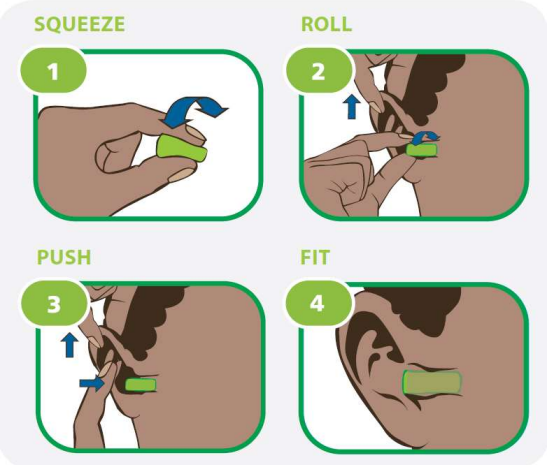
Individual fitting of the hearing protectors is necessary to ensure optimum performance.

8.4. Suitability for Use

Select hearing protectors suitable for the working environment and the type of job involved. Provide earmuffs when working in areas, where there is a risk of infection to the user through contact with the environment. Earplugs are recommended in work areas with high temperature and humidity.

8.5. Proper Wearing of Hearing Protectors

Improper wearing of hearing protectors can lead to diminished hearing protection. As illustrated in the below figure, provide adequate training, and ensure safe use of HPDs.



In addition, encourage employees to periodically check their hearing protectors during the workday, if they need to be adjusted to maintain a reliable fit and deformity or damage has not occurred with the provided HPD.

9. Audiometric Examinations and Noise Induced Hearing Loss (NIHL)

Refer to Appendix 4 on additional requirements on audiometric examinations.

- Conduct audiometric examinations before hiring an HZL employees and thereafter if the TWA noise exposure is at or above 85 dBA.
- **Ensure audiometric examinations are performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintaining and checking calibration and proper functioning of the audiometers being used.**
- **Provide baseline audiogram, within six months of identifying employees working in SEGs with TWA noise exposure at or above 85dBA, and thereafter annually.**
- **Notify employees designated for audiometric examinations of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric** examination.
- Noise Induced Hearing Loss (NIHL) also known as Standard Threshold Shift (STS) is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear. Notify NIHL cases, if any, to the site leader to take appropriate actions to reduce noise exposure and or remove NIHL employee from high noise exposure areas.

10. Training and education

Provide education and training for all employees exposed to TWA exposure greater than 85 dBA and within three months of job commencement for new employees. The training programme contents include:

- Relevant provisions of the Indian Factories Act, DGMS guidelines and the Model Factories Rules
- Adverse effects of noise on hearing.
- Purpose and benefits of the HCP.
- Purpose of hearing protectors.
- Advantages, disadvantages and attenuation of the various hearing protectors.
- Instructions on the proper selection, fitting, use, care and maintenance of hearing protectors.
- Importance of the consistent wearing of hearing protectors.

- Purpose and procedures of audiometric testing, including pre-test instructions; and
- Explanation of the audiometric results and preventive measures.

11. Record Keeping and Confidentiality

11.1. Maintain the following records electronically in the HZL server for a minimum of forty years. Refer Vedanta's Technical standard TS 12.

- Records of risk assessment
- Noise Control Plan
- Documentation of noise controls implemented
- Documentation to demonstrate the issue, fitting and training of hearing protectors;
- Documentation of employee's training;
- Records of audiometric calibration data (for audiometric technician);
- Records of programme evaluation.

11.2. List of employees whose routine eight-hour exposure to noise could exceed 85 dBA.

11.3. Maintain confidentiality of employee exposure and medical surveillance data. Provide access of the exposure and medical surveillance data to only to the affected employees.

12. Management Systems

12.1. **Support Resources**

Location head /Unit head / CSC/ Corporate EHS/ S&FS is available to assist with implementation of this standard.

12.2. **Audit Requirements and Key Performance Indicators (KPI)**

Each location shall audit compliance with this standard as part of its Safety audit program at least annually. Refer to Appendix 3 HCP Audit Checklist. Complete the following KPIs and update annually.

Key Performance Indicator			
Total Number of Employees			
Number of employees Exposed to Noise (dBA)			
<80dBA TWA	**>80dBA<85dBA TWA**	**>85dBA TWA**	**No data available***
	Peak >135 dBA <137 dBA	**Peak >135 dBA**	
Total of orange and red			
* Exposed but measurements not taken			

Key Performance Indicator Audiometric Exams			
Total Number of Employees Covered			
Number of employees With NIHL per 100 employees			
0	**1**	**4**	**No data available***
Total of orange and red			
* Audiometric exams not conducted			

12.3. **Standard Renewal Process**

This standard shall be reviewed and revised as necessary and, at a minimum, not later than three years from the date of the last revision.

12.4. **Deviation Process**

Deviations from this standard must be authorized by the CSC. Deviations must be documented and documentation must indicate causes of deviation. Deviation authorization must be renewed periodically and no less frequently than every three years.

12.5. **Contact**

In the event that interpretation or clarification is needed, questions shall be directed to the Safety & Fire Services Head and Zone/ Corporate SRP Subcommittee.

Appendix 1: Terminologies used

36. **Administrative Controls**: A category of hazard control that uses administrative / management involvement in order to minimize employee exposure to the hazard. Some examples are: job enrichment job rotation work/rest schedules work rates periods of adjustment.
37. **Area Sound Pressure Level (SPL) measurements**: Collection and analysis of representative samples in general work areas at the employees' typical hearing zone in order to determine the noise levels from the operation of various equipment.
38. **Controls**: Measures designed to eliminate or reduce hazards or hazardous exposures. Examples include: engineering controls, administrative controls, personal protective equipment. Hazards can be controlled at the source, along the path to the employee, or at the employee.
39. **Time Weighted Average**: The time weighted average concentration or levels of a chemical or biological agent for an 8-hour day or a 40-hour week to which it is believed nearly all operators may be exposed, day after day, without experiencing harmful effects.
40. **Medical Surveillance**: The systematic approach to monitoring health changes in operators to identify and determine which effects may be work-related.
41. **Similar Exposure Groups:** Group of people who have similar exposure potential

Appendix 2: Sample Noise Hazard Identification Checklist

Department :

Processes Involved :

Conducted By :

Employee Representative :

Date :

Checking "Yes" to any of the following items indicates a need for a detailed noise assessment.

Items to be checked	Yes	No	Remarks
1. Is it difficult for the employees to carry out normal conversation without raising their voices at the current noise level?			
2. Is there any feedback from the employees regarding the difficulty of hearing warning shouts or alarms?			
3. Do any of the employees involved in the work process experience a reduction in hearing over the course of their work? (The reduction in hearing can also occur after work.)			
4. Do any of the employee's experience any of the following conditions: - Ringing or buzzing in the ears; - Unequal hearing in one ear compared to the other ear; - Muffled hearing?			
5. Has the company made compensation claims to any employees for NID?			
6. Does any machine or equipment in the work area contain manufacturer's noise label that indicates that noise levels generated by the machine or equipment can exceed 85 dB(A)?			
7. Do the records of the audiometric examinations show that any past or present employees have suffered NID?			
8. Does the workplace belong to a noisy industry, for example, construction, woodworking, metal working or repairing?			
9. Are there any noisy processes, for example, hammering, punching, grinding, cutting or usage of pneumatic tools being carried out at the work area?			

Appendix 3: Hearing Conservation Program effectiveness checklist

Date of Evaluation:		
Name of Evaluators	Designation	Signatures

Planning for Hearing Conservation Programme	**Yes**	**No**	**Remarks**
Is a program administrator appointed for the Hearing Conservation Programme (HCP)?			
Does the programme administrator have the relevant knowledge to coordinate all aspects of the programme? (Relevant knowledge includes: Understanding of the individual elements of the HCP, relevant provisions of the legislation, effects of noise on hearing and the purpose of hearing protectors and audiometric examinations.)			
Elements of Hearing Conservation Programme			
Identification of Noise Hazard	**Yes**	**No**	**Remarks**
Has risk assessment been conducted and documented for all noisy processes?			
Is the risk assessment reviewed and revised at least once every three years; and upon occurrence of any bodily injury or significant change in work practices or procedures?			
Is the noise monitoring performed once every three years or when there are changes in the conditions which are likely to cause any persons in the workplace to be exposed to excessive noise (more than 85 dB(A) over eight hours)? (For workplaces with 10 or more persons exposed to excessive noise.)			
Is the noise monitoring conducted by a competent person?			
Is the noise measuring equipment used for noise monitoring calibrated before use?			
Are the contents of the report communicated to all persons exposed to excessive noise not later than 14 days after preparation of the report?			

Is the latest noise monitoring result compared with the previous report to determine if there is any significant change in noise levels?			
Have appropriate steps been taken to include or exclude employees in the HCP whose exposures have changed significantly?			
Elements of Hearing Conservation Programme			
Noise control	**Yes**	**No**	**Remarks**
Are all practicable measures taken to reduce or control noise from any machinery, equipment or processes such that no employees are exposed to excessive noise?			
Is a competent person appointed to advise the management on proper noise control measures?			
Are employees encouraged to participate in the development of noise control measures?			
Are noise emission levels considered during the selection and procurement of new machines?			
Is a noise control plan to reduce the excessive noise through engineering controls established?			
Is the noise control plan implemented?			
Is the noise control plan reviewed at least once every three years after noise monitoring is conducted?			
Are the noise control projects monitored to ensure timely completion?			
When the implementation of engineering controls is not reasonably practical, are the administrative controls implemented to reduce employees' exposure to excessive noise?			
Is noise monitoring performed after noise control to evaluate the residual risk?			
Is a maintenance programme established to ensure that all noise control systems or devices remain effective and do not deteriorate over time?			
Hearing Protectors	**Yes**	**No**	**Remarks**
Are suitable hearing protectors provided to all persons exposed to excessive noise?			

Are procedures established and implemented to ensure that: - Hearing protectors are properly issued and maintained; - Persons exposed to excessive noise use hearing protectors - Such persons are instructed on the proper use of hearing protectors			
Are employees provided with a range of appropriate hearing protectors to allow them to choose the ones which fit them comfortably?			
Are the hearing protectors checked regularly for wear and defects and replaced immediately when necessary?			
Are replacements for hearing protectors readily available to employees who are using the disposable hearing protectors?			
Are warning signs indicating the use of hearing protectors placed at all entrances to areas where persons are or are likely to be exposed to excessive noise?			
Are regular inspections conducted to ensure that employees wear hearing protectors correctly and consistently in designated areas?			
Is there an incentive or disincentive scheme in place to encourage employees to put on hearing protection?			
Training and Education	**Yes**	**No**	**Remarks**
Is a training programme implemented and conducted every year for all persons exposed to excessive noise?			
Is training provided to all new employees within three months of commencing work?			
Does the training programme include instructions in: - Effects of noise on hearing; - Purpose of hearing protectors and its proper use and maintenance; and - Purpose and procedure of audiometric examinations - HCP team members receive training on carrying out their functions (especially concerning HPD fitting and utilization			
Is the training content reviewed periodically?			

Does the management demonstrate commitment to HCP by personal example, such as wearing hearing protectors in designated areas and participating in the training programme?			
Audiometric Examinations	**Yes**	**No**	**Remarks**
Are all employees who are exposed to excessive noise medically examined by a designated workplace doctor and certified fit to work in the occupation before commencement of work?			
Are yearly audiometric examinations conducted for all persons exposed to excessive noise?			
Are the audiometric examinations performed by competent persons who are properly trained?			
Are records of audiometric examinations kept for at least five years from the date of examination?			
Are the audiometric examination results evaluated to determine information such as identification of high-risk group, etc?			
Are the results of the audiometric examinations communicated to the employees?			
Is counselling provided to employees who show significant threshold shifts and are they informed of the preventive measures they can take to avoid further hearing loss?			
Are follow up actions arising from the evaluation of the audiometric results implemented and documented?			

Appendix 4: Audiometric Testing Requirements

Ensure audiometric booths are certified regularly (at least once every 2 years) depending on the use and conditions - a certificate of compliance can be issued and kept with the booth for inspection by the Authority.

Ensure audiometers are calibrated annually (or more often if the machinery is moved or frequently used). Retain the calibration certificates for reference.

Preparation

- Examine the ears with an otoscope prior to audiometry testing to determine if there are any blockages in the ear canal due to ear wax or other material.
- Inform the stakeholders of the planned audiometric test, so that they can have a 'quiet time' of ideally 16 hours beforehand.
- Ideally, test the stakeholders at the beginning of the day to minimize exposures to noise likely to occur during the day.
- If this is not feasible, ensure the stakeholders use HPDs at all times during the day. Inform the stakeholders of bringing ear protection to bring to the audiometric examination.

Normal results

A person with normal hearing will be able to recognize and respond to all of the tone frequencies administered at various volumes in both ears by the audiometry test. An adult with normal hearing can detect a range of low- and high-pitched sounds that are played as softly as between nearly 0-20 decibels. Normal speech is generally spoken in the range of 20-50 decibels.

Abnormal results

Audiometry test results are considered abnormal if there is a significant or unexplained difference between the levels of sound heard between the two ears, or if the person being tested is unable to hear in the normal range of frequencies and volume. The pattern of responses displayed on the audiogram can be used by the audiologist to identify if a significant hearing loss is present and if the patient might benefit from hearing aids or corrective surgery.

After Audiometry

After the test, the audiologist reviews the results. Depending on the potential for hearing loss, the doctor can recommend preventive measures, such as wearing earplugs around loud noises, or any corrective measures needed, such as wearing a hearing aid.

Resources

Organizations

American Academy of Audiology. 8201 Greensboro Drive, Suite 300, McLean, VA 22102. (703) 610-9022. http://audiology.org.

Audiology Awareness Campaign. 3008 Millwood Ave., Columbia, SC 29205. (800) 445-8629.

Other

"How to Read Your Hearing Test." Hearing Alliance of America. http://www.earinfo.com.
"Understanding Your Audiogram." The League for the Hard of Hearing. http://www.lhh.org.

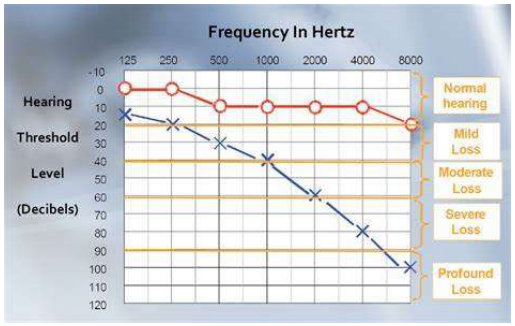


Figure A: Audiometric determination of hearing loss

Figure B: Audiometric examination room

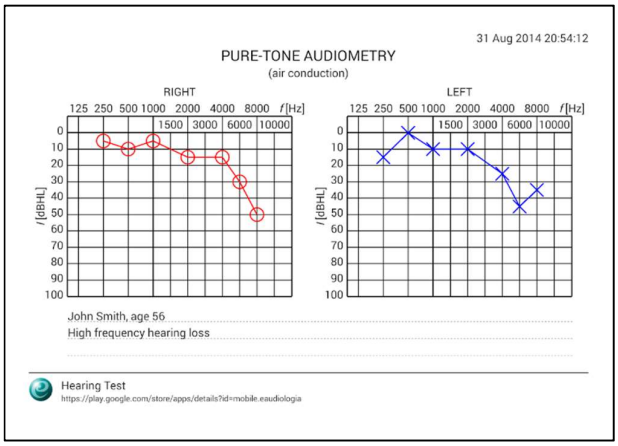


Figure C: Sample audiogram

HZL Standards

Heat Stress Prevention Program

Abbreviations

- CSC - Corporate Safety Council
- CSRP - Corporate Standards, Rules and Procedure Subcommittee
- DWP - Designated Workplace Physician
- EHS - Environment, Health and Safety
- HZL - Hindustan Zinc Limited
- PL - Permissible Limit
- PPE - Personal Protective Equipment
- IHSA-Initial Heat Stress Assessment
- CHSA-Comprehensive Heat Stress Assessment
- ACGIH- American Conference of Governmental Industrial Hygienists
- WBGT-Wet-bulb globe temperature
- TLV- Threshold limit value

Table of Contents

1. Introduction

Employee exposure to Heat Stress can result into the following illness and decreased productivity and increased likelihood of injuries.

Heat exposures have potential of causing health effects such as:

- Heat Rash
- Heat cramps
- Heat Exhaustion
- Heat Stroke

Understanding heat stress can help operators to stay safe while working in hot environments.

1.1. Purpose

This purpose of this standard is to protect HZL stake-holders from heat exposure which may cause heat related illness.

This standard would assist Environmental Health and Safety (EHS) coordinators and Managers and other HZL stakeholders to recognize, evaluate and control occupational health risks from heat stress. to reduce the risk to the health of individuals working on, or visiting the sites. The guidance provided in this standard should help ensure compliance with regulatory requirements.

2. Scope

This standard applies to all HZL business units and operations through all development phases and construction, operation to closure and, where applicable, for post closure management.

3. Management Responsibilities

Line management has the responsibility to implement this standard.

4. Definitions

Factory Manager/ Mines Manager/ Project Head - A person who is legally notified and authorized by the Occupier to discharge his duties.

Operator/workers - any person who directly or indirectly is involved with the process, with a likely exposure potential to physical, chemical or biological agents.

Visitor - any third-party person who has not been inducted under HZL's safety policy. Such person may be a subject matter expert/consultant/ OEM/Supplier from another organization.

Risk Assessment - The formal process of identifying, assessing and evaluating the safety, health and environmental risks that may be associated with a hazard. For example: Hazard Identification Risk Analysis, Job Safety Analysis etc.

5. People (Roles and Responsibilities)

5.1. Program administrator

The program administrator could be the site safety officer. The program administrator's responsibilities include.

- Coordinating the Program.
- Monitoring its progress;
- Assessing its performance;
- Evaluating its effectiveness;
- Reviewing the program at regular intervals.

5.2. Site Leadership

5.2.1. Ensure relevant elements of the program (e.g., initial and comprehensive heat stress risk assessment, heat stress prevention and controls) are implemented at the site.

5.2.2. Assign at least one competent person to implement the relevant elements of the program. This person is also Safety Officer. The Safety Officer's primary responsibility is to (a) conduct IHSA and CHSA, (b) assist in implementation of heat stress prevention and control measures and (c) provide or arrange the provision of the heat stress training relevant to the needs of the site.

5.3. Supervisor/Head of Department

5.3.1. Ensure all stakeholders including HZL employees and contractors are implementing work practices to reduce potential for heat stress;

5.3.2. Ensure heat stress prevention and control measures are implemented;

5.3.3. Report to the site leader and the SME-IH any change in process, equipment, area, new additional heat sources requiring review of heat stress risk assessment and additional heat stress prevention and control measures

5.4. Subject Matter Expert (SME) – Industrial Hygiene (IH)/ Safety officer

The SME primary responsibility is to provide or arrange the provision of the training relevant to Heat Stress Management.

5.4.1. Implementation, or facilitate implementation, of all elements of program, including Initial Heat Stress Assessment (IHSA), Comprehensive Heat Stress Assessment (CHSA), advice on heat stress prevention and control measures, record keeping, record retention and self-audit.

5.4.2. Communicate results of IHSA and CHSA to relevant site personnel and the Chief Medical Compliance Officer/ Designated Workplace Physician.

5.5. Workers

Workers have the following responsibilities: -

5.5.1. To be familiar with the hazards associated with working in hot environments, the symptoms of heat related disorders and the pertinent standard operating procedures for the environment;
5.5.2. To work in accordance with written standard operating procedures for work in hot environments;
5.5.3. To use the appropriate equipment and materials provided for work in hot environments;
5.5.4. To consult a physician of choice regarding personal risk factors that may affect heat tolerance. Physician recommended accommodations should be discussed with the supervisor;
5.5.5. To promptly report any known or suspected accidents, unsafe conditions or unsafe procedures to his/her supervisor.

5.6. Designated Workplace Physician / Industrial Nurse

5.6.1. Conduct periodical medical surveillance to identify onset of an occupational illness related to heat stress (See Appendix 2) when indicated by the risk assessment;
5.6.2. Notify the supervisors of any potential occupational illness to workers.

5.7. Stakeholders including employees and contractors:

5.7.1. Follow work-practices aimed at reducing potential heat stress as detailed in Section 8 of program.
5.7.2. Report to supervisor or manager any unsafe working condition or work practices which may results to heat stress.

6. Procedures:

Heat Stress Risk Assessment: The process of occupational health risk assessment for heat stress includes Initial Heat Stress Assessment (IHSA), and Comprehensive Heat Stress Assessment (CHRA).

6.1. Initial Heat Stress Assessment (IHSA):

6.1.1. Safety Officer conducts IHSA in consultation with SME-IH/EHS.
6.1.2. As a first step towards heat stress risk assessment, prepare and maintain an inventory of all activities with potential for heat exposure at the site.
6.1.3. Conduct a walkthrough of all the activity areas and qualitatively identify if heat stress potential exists.
6.1.4. Include in the inventory, department/location in which the potential for heat stress exist.

6.2. Comprehensive Heat Stress Assessment (CHSA):

6.2.1. Conduct CHSA for the activities and areas where heat stress potential exists.

6.2.2. CHSA methods consist of determining wet bulb temperature of air in a workroom in relation to dry bulb temperature (as per Model Rule 22 prescribed under the section 13 on 'Ventilation and Temperature'- Model Rules framed under Factories Act).

6.2.3. Permissible limit for heat is calculated from the following environmental parameters assuming that potentially heat stress exposed workers are well-hydrated and acclimatized.

- Dry Bulb Temperature (DBT)
- Wet Bulb Temperature (WBT)
- Globe Temperature (GT)
- Air movement
- Work rate

7. Heat Stress Measurements (HSM)

7.1. Conduct HSM in all areas with potential for heat stress exposure as determined in IHSA

7.2. Ensure HSM is representative, reproducible and reliable.

7.3. In order for representative HSM, conduct monitoring:

- During multiple shift if a single shift monitoring is not representative of potential heat stress exposure;
- During different seasons considering variability in heat stress monitoring parameters such as, temperature and relative humidity.

7.4. For reproducible HSM, collect adequate number of samples (e.g., 6 or 3 samples for each activities/area).

7.5. For reliable HSM:

- Use a calibrated and reliable heat stress monitor that measures, DBT, WBT, and GT
- Ensure calibrator is calibrated by an independent agency at least annually.
- Follow instrument manufacturers' instructions;
- Keep the instrument in the area to be monitored for at least 15 minutes.

7.6. Measure DBT, WBT, GT to determine Wet Bulb Globe Temperature Index (WBGT). Measuring GT is important when radiant heat is present such as near furnaces in smelter or in open areas in mines.

7.7. The instruments for heat stress measurements also have integrated capabilities to measure DBT, WBT, and GT and to calculate WBGT.

7.8. Appendix 2 provides additional information on heat stress monitoring;

7.9. Maintain a detailed record of HSM including:

- Date and time of monitoring;
- Activity/task/area description;
- Values of measured parameters; DBT, WBT, GT, air movement;
- Instrument calibration date;
- Field calibration details;
- Duration for potential heat stress exposure where heat stress measurements are conducted.

Based on WBT and DBT (for IFA) and WBGT TLV (for ACGIH) data, determine heat stress control measures, work-rest schedule and rehydration schedule.

8. Heat Stress Evaluation Criteria Prevention and Controls:

8.1. As per DGMS, WBT should not exceed 33.0°C for WBT greater than 30.5°C. Table 1 is used as acceptable WBT limits for different DBT in IFA and state rules.

8.2. Ensure DGMS, IFA and ACGIH WBGT TLV as a standard to determine if heat stress exposure is above the WBT (for DGMS and IFA) limit and above ACGIH WBGT Limit.

Table-1 IFA- DBT VS WBT

Dry-Bulb Temperature °C	Wet-Bulb Temperature °C
30 – 34	29
35 – 39	28.5
40 – 44	28
45 – 47	27.5

Table-2 Screening Criteria for ACGIH WBGT TLV in °C

% of work	Light	Moderate	Heavy	Very Heavy
75 to 100%	**31.0**	**28.0**	**-**	**-**
50 to 75%	**31.0**	**29.0**	**-**	**-**
25 to 50%	**32.0**	**30.0**	**29.0**	**28.0**
0 to 25%	**32.5**	**31.5**	**30.5**	**30.0**

8.3. Please refer to Appendix 1 for definition workload (e.g., light, moderate, heavy)

8.4. Implement the following principles of heat stress prevention and controls in the areas identified whenever heat stress exposure is above permissible limit and TLV specified.

Acclimatization: Allow non-acclimatized workers (new arrivals or workers returning from vacation) time to acclimatize for 5-7 days before starting hard work in a hot environment in summer.

Use of suitable thermal barriers: When it is difficult to control the process temperature at source due to operational requirement, evaluate feasibility of providing thermal barriers between the heat source and the workers to cut down the radiant heat.

Personal Protective Clothing: Provide reflective clothing if high radiant heat is present. PPE is not feasible in most of the hot environment and should be used as a last line of protection.

Reduction of Metabolic Workload: Reduce manual handling and other strenuous activities which generates body heat to the extent feasible with mechanical material handling, for instance.

Provision of Cold Drinking Water: The workers should be educated and advised to take plenty of cold water very frequently to replenish the fluid loss due to heavy sweating during work in heat. Provision should, there, be made for easy availability of cold water very close to shop floors. Provide cooled and air-conditioned rest areas with water or electrolyte drinks available.

Provide **Engineering controls** such as mechanical ventilation, cool air supply, providing shade for protection against sunlight. Provide forced air ventilation such as fans to increase air velocity to facilitate skin evaporation and cooling

9. Training and education

Conduct pre-placement and annual heat stress management training, covering at least the following elements:

- Recognition of heat stress symptoms and to control heat exposure;
- Procedures for contacting emergency medical services, and if necessary, for transporting employees to a point where they can be reached by an emergency medical service provider;
- Importance of acclimatization;
- Work pacing and the importance of rest breaks;
- Importance of rehydration-The importance of frequent consumption of small quantities of water, up to 4 cups per hour under extreme conditions of work and heat;
- All elements of this HSMP;
- Conduct training in a language understood by most of the workers.

Understanding Heat Stress Disorders:

9.1. Heat Rash (Prickly Heat)

Symptoms:

- Red blotches and extreme itchiness in areas persistently damp with sweat;
- Prickling sensation on the skin when sweating occurs.

Heat rashes typically disappear in a few days after exposure. If the skin is not cleaned frequently enough the rash may become infected.

9.2. Heat Cramps

Symptoms:

- Loss of salt through excessive sweating;
- Cramping in back, legs and arms.

9.3. Heat Exhaustion

Heat exhaustion occurs when the body can no longer keep blood flowing to supply vital organs and at the same time send blood to the skin to reduce body temperature.

Symptoms:

- Weakness;
- Difficulty continuing work;
- Headache;
- Breathlessness;
- Nausea or vomiting;
- Feeling faint or actually fainting.

It takes 30 minutes to cool the body down once a worker becomes overheated and suffers heat exhaustion.

9.4. Heat Stroke

Heat stroke occurs when the body can no longer cool itself and body temperature rises to critical levels.

Symptoms:

- Confusion;
- Irrational behaviour;
- Loss of consciousness;
- Convulsions;
- Lack of sweating;
- Hot, dry skin;
- Abnormally high body temperature.

10. Medical Evaluation

10.1. The purpose of medical evaluation is (a) to identify an onset of the heat stress related illness, (b) to identify if the illness is work-related or not and (c) to take corrective measures to reduce potential heat stress related illness.

10.2. Provide medical clearance for work in heat for any person with a chronic medical condition (e.g. high blood pressure, obesity) or requiring the use of certain prescription drugs.

10.3. Determine the need, frequency and content of medical surveillance based on the results of the heat stress assessment.

10.4. Communicate any abnormal medical conditions to the SME-IH or Site Safety Officer to determine if an illness is work-related or not and to take appropriate actions to reduce heat stress risk.

10.5. Ensure a competent Occupational Physician conducts medical evaluation.

11. Record Keeping and Confidentiality

11.1. Maintain the following records electronically in the HZL server and in the office of program administrator:

- Initial and comprehensive heat stress assessment reports;
- List of activities and work areas with risk zones.
- Training records
- Medical surveillance records

11.2. Maintain absolute confidentiality of medical surveillance data. Provide access of the medical surveillance data to only the affected employees. Keep hard copy of the records in lock and key with limited access. Provide password protection for electronic record keeping of the above referred data.

12. Self-Audit

- Evaluate program effectiveness annually by conducting internal audit using Appendix 3.
- The EHS, site Safety Officer, and Head of the Department will participate in the program evaluation;
- Track any deficiency identified in the audit to completion.

13. Management Systems

23.1. **Support Resources**
Location head /Unit head / CSC/ Corporate EHS/ S&FS are available to assist with implementation of this standard.

23.2. **Audit Requirements**
Each location shall audit compliance with this standard as part of its Safety audit program.

23.3. **Standard Renewal Process**
This standard shall be reviewed and revised as necessary and, at a minimum, not later than three years from the date of the last revision.

23.4. **Deviation Process**
Deviations from this standard must be authorized by the CSC. Deviations must be documented and documentation must indicate causes of deviation. Deviation authorization must be renewed periodically

and no less frequently than every three years.

23.5. **Contact**

In the event that interpretation or clarification is needed, questions shall be directed to the Safety & Fire Services Head and Zone/ Corporate SRP Subcommittee.

Appendix 1: Terminologies used

42. **Acclimatization:** The physiological changes that occur in response to a succession of days of exposure to environmental heat stress and reduce the strain caused by the heat stress of the environment; and enable a person to work with greater effectiveness and with less chance of heat injury. Newly assigned workers must be acclimatized to the hot weather to allow the body to slowly adapt to the hot environment. The workers need at least one to two weeks to adjust to local weather conditions and the workload. Workers should undergo a 14-day heat acclimatization (HA) program in the first 2 weeks of employment. The HA takes the form of gradual increase in work duration under the hot environment, increasing from 2 hours per day to the full work duration over 14 days.
43. **Dry Bulb (DB) Temperature (DBT):** DBT is measured by a thermal sensor, such as an ordinary mercury-in-glass thermometer, that is shielded from direct radiant energy sources. DBT is indicative of ambient air temperature.
44. **Electrolytes;** Electrolytes are various ions, such as sodium, potassium, or chloride, required by cells to regulate the electric charge and flow of water molecules across the cell membrane. Muscle contraction is dependent upon the presence of calcium, sodium, and potassium. Without sufficient levels of these key electrolytes, muscle weakness or severe muscle contractions may occur.
45. **Evaporative Cooling:** Evaporative cooling takes place when sweat evaporates from the skin. High humidity reduces the rate of evaporation and thus reduces the effectiveness of the body's primary cooling mechanism.
46. **Globe Temperature (GT):** The temperature inside a blackened, hollow, thin copper globe measured by a thermometer whose sensing element is in the center of the sphere. Globe temperature is indicative of radian heat.
47. **Wet Bulb Temperature (WBT):** WBT is measured by exposing a wet sensor, such as a wet cotton wick fitted over the bulb of a thermometer, to the effects of evaporation and convection. WBT is indicative of relative humidity.

Work Load Definition:

48. **Light:** Sitting with light manual work with hands or hands and arms, and driving. Standing with some light arm work and occasional work.

49. **Moderate:** Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and truck work, or light pushing and pulling. Normal walking.

50. **Heavy:** Intense arm and truck work, carrying, shoveling, manual sawing; pushing and pulling heavy loads; and walking at a fast pace.

51. **Very Heavy:** Very intense activity at fast to maximum pace.

Appendix 2: Comprehensive Heat Stress Assessment

1. Methods:

1.1. Select activities and areas for CHSA from IHSA. List those activities in Table 2.

1.2. Use an instrument that measures dry Bulb Temperature, Wet Bulb Temperature, Globe Temperatures

1.3. Follow manufacturer's instructions to measure DBT, WBT, GT in at all locations identified with heat stress potential from IHSA.

1.4. Most important instructions for the measurements are:

1.4.1. Wet the wick of WBT sensor with distilled water.
1.4.2. Position the instrument in the area at about 5 feet height where workers are working.
1.4.3. Keep the instrument in the area for at least 15 minutes before taking measurements.
1.4.4. Calibrate the instrument as per manufacturer's instructions.

1.5. Enter all measured parameters are entered in Table 2 below:

Table 2: Heat Stress Parameters

Area/Activity	Date	Time	DBT (^{0}C)	WBT(^{0}C)	GT (^{0}C)	WBGT	Action Items
unloading operator	August 2, 2020	13:00	35	32	37		Practice engineering controls, avoid working alone, ensure adequate fluid intake

1.6. Compare the recorded results as per:

1.6.1. As per DGMS, WBT should not exceed 33.0°C and for WBT greater than 30.5°C, ventilation needed (required minimum air movement: 1 m/s);
1.6.2. Ensure DGMS and ACGIH standard are used for compliance plan, use lowest of the exposure level between ACGIH and IFA/DGMS;
1.6.3. Model Rule 22 prescribed under the section 13 on 'Ventilation and Temperature' stipulated that in any factory the maximum wet-bulb temperature of air in a work-room at a height of 1.5 meters above the floor level shall not exceed 30°C and adequate air movement of at least 30 meters per minute shall be provided, and in relation to dry bulb temperature, wet bulb temperature in the work-room at the said height shall not exceed that shown in the schedule table 1 (refer section 8).

WBGT values are calculated using one of the following equations;

1. With direct exposure to sunlight:

   $WBGT_{out} = 0.7\ T_{nwb} + 0.2\ T_g + 0.1\ T_{db}$

2. Without direct exposure to the sun:
   $WBGT_{in} = 0.7\ T_{nwb} + 0.3\ T_g$

   where:

   T_{nwb} = natural wet-bulb temperature (sometimes called NWB)
   T_g = globe temperature (sometimes called GT)
   T_{db} = dry-bulb (air) temperature (sometimes called DB)

1.7. List all action items in last column based on Section 8 of program (Heat Stress Prevention and Controls)

Appendix 3: Self-Audit Checklist

Evaluation Item	Confirmation criteria	Yes/No	Action Item
Is IHSA conducted?	Review written IHSA and ensure all activities/areas are covered		
Are heat stress measurements conducted, Permissible Limit determined, degree of potential heat stress risk identified?	Review completed heat stress measurement sheet		
Is calibrated instrument used and methods followed for heat stress measurement?			
Is pre-placement and annual training conducted and does training cover all elements?			
Are engineering controls including exhaust ventilation, forced air fans, cool supply air provided where needed (based on Permissible Limit)			
Is acclimatization practiced?	Interview recently joined workers and identified if they have been acclimatized		
Is work-rest regime followed based on heat stress assessment findings?			
Is cool water supply available?			
Medical surveillance done initially and periodically?			

Name/Title of Program Evaluators

Evaluation Date

Evaluation decision: Acceptable/Not Acceptable

Signature