

Manual for High-Temperature Industrial Facilities and Hot Environments

1. Purpose and Scope

This manual establishes standards for measurement, management, and emergency response in high-temperature (heat) work environments in accordance with the Occupational Safety and Health Act. The aim is to protect workers' health. The scope includes high-heat facilities such as blast furnaces, electric furnaces, heating furnaces, kilns, underground work, drying operations using heat sources, and all types of outdoor high-temperature work.

2. Understanding Heat Work and Its Risks

Heat work refers to operations where exposure to high temperatures may cause heat-related illnesses such as heat cramps, heat exhaustion, or heat stroke. Radiation heat from high-temperature equipment, insufficient ventilation, extreme heat waves, and prolonged exposure can cause not only health damage but also disasters such as explosions, fires, or material loss. Since the human body regulates temperature through sweating, proper intake of water and salt is essential. The basic principles are: **Water** (regular hydration), **Air** (ventilation and circulation), and **Rest** (adjusting workload, especially during hot hours).

3. Heat Measurement and Evaluation (WBGT)

The key indicator is **WBGT (Wet Bulb Globe Temperature Index)**, which integrates air temperature, humidity, and radiant heat.

- Measurements must be conducted regularly at least once every six months, and additionally if symptoms are reported or risks suspected.
- Measurements should be taken at the nearest worker position to the heat source or within the main working zone, during the hottest exposure hour, every 10 minutes continuously.
- Evaluation must reflect WBGT values, metabolic workload, and clothing correction factors to determine whether exposure standards are exceeded and to set appropriate work–rest cycles based on task intensity.

4. Environmental Management

- For indoor high–temperature workplaces: apply local and general ventilation, isolate heat sources, and block radiant heat.
- For outdoor work: install shade structures or roofing, and use water spraying if necessary to reduce perceived temperature.
- Cooling systems should not be set excessively lower than the outside temperature.
- Underground work areas must be maintained at **37°C or lower**.

5. Work Management

- New and reassigned workers must undergo **heat acclimatization** through gradual increase in work hours.
- Reduce high-energy and continuous tasks; schedule heavy labor during cooler hours.
- During heat wave advisories, mandate **10–15 minutes of regular breaks**.
- Provide rest areas separate from the workplace, cool and spacious enough for lying down.
- Supply cold clean water and salt at worksites; post restricted access signs in high-heat zones.
- Work involving soaked clothing must have facilities for undressing, bathing, washing, and drying.

6. Protective Equipment and Health Management

- Provide heat-resistant gloves and suits for workers handling high-heat objects.
- Wear clothing that is absorbent, breathable, and has low heat absorption; wear ventilated hats under direct sunlight.
- Check workers' health before shifts and conduct periodic monitoring during work.
- Based on health examinations, reassign work or provide health guidance (including sleep and nutrition).
- Work allocation must consider conditions such as obesity, cardiovascular disease, skin disease, fever, and age over 45.

7. Symptoms of Heat-Related Illnesses and Initial Response

- **Heat Stroke:** Loss of consciousness, seizures, vomiting, high fever (usually $>40^{\circ}\text{C}$), absence of sweat, dry skin. → Stop work, move to cool area, loosen/remove clothing, apply rapid cooling (water, ice packs, fans), call 119. Do **not** give oral fluids if unconscious.
- **Heat Exhaustion:** Headache, nausea, dizziness, fatigue, thirst. → Rest in cool place, reduce temperature, rehydrate with electrolytes, seek medical care if needed.
- **Heat Cramps:** Muscle spasms and pain in limbs/abdomen due to excessive salt loss from sweating. → Cool down, drink 0.1% saline, stretch/massage affected area.
- **Heat Collapse/Syncope:** Dizziness, fainting, rapid weak pulse, hypotension, mild temperature rise. → Lay in cool place, elevate legs.
- **Heat Fatigue:** Thirst, reduced urination, sensory abnormalities. → Rest and rehydrate with water and electrolytes.
- **Heat Rash:** Red papules and itching caused by blocked sweat glands. → Keep skin dry and cool.

8. Common Emergency Procedures

1. Check consciousness; if needed, call 119 immediately.
2. Move the patient to a shaded or cool indoor space.
3. Remove or loosen clothing; apply rapid cooling with water, ice packs, or fans.
4. If conscious, provide water and electrolytes; if unconscious, **do not** administer orally.

9. Heat Wave Response by Warning Level

- **Advisory ($\geq 33^{\circ}\text{C}$ perceived temperature):** Shorten or reschedule outdoor work during peak heat hours.
- **Warning ($\geq 35^{\circ}\text{C}$):** Suspend outdoor work except for unavoidable cases.
- **Danger ($\geq 38^{\circ}\text{C}$):** Suspend all outdoor work except essential disaster and safety management tasks.

10. Preventive Measures in Hot Environments

- **Body Cooling:** Avoid direct sunlight, poor ventilation, sudden movements, and tight clothing. Shield or isolate heat sources; drink cool fluids frequently in small amounts.
- **Work Environment:** Control temperature/humidity via openings, exhaust, and cooling; dehumidify and disinfect damp areas regularly.
- **Work Management:** During heat waves, reduce/stop work and enforce scheduled rest; provide shaded/cool rest facilities and hydration with electrolytes.
- **Protective Equipment & Facilities:** Supply personal heat-resistant suits/gloves; provide changing, washing, drying, and bathing facilities.
- **Health Management & Training:** Adjust rest times by perceived temperature; monitor worker health before/during shifts; conduct ongoing training on heat risks, prevention, and emergency care.

11. On-Site Command and Control in High-Temperature Facility Incidents

- Incident commander assumes authority upon arrival and maintains a unified command, prioritizing crew safety.
- Conduct initial, detailed, and safety assessments repeatedly; order withdrawal if necessary.
- Establish staging areas and command posts; manage resources and communications; operate with written operational and safety plans.
- All activities must follow the **two-person rule** and PPE compliance; all channels prioritize emergency evacuation communications.
- After response, conduct factual debriefing and After Action Review (AAR) to share improvements.

12. Fire Response in General Buildings within High-Temperature Environments

- Strategies must reflect building type (wood, semi-fireproof, fireproof), purpose, and scale.
- Prioritize life rescue.
- Mark and communicate search completion clearly to all personnel by radio and visible signals.

13. Response to Metal Fires

- Metal fires may react dangerously with water or ignite spontaneously.
- On arrival, remove surrounding flammable and combustible materials to prevent spread.
- Wear appropriate protective gear and SCBA, rotating crews regularly to minimize exposure to toxic chemicals.
- Response varies by metal type: for **alkali metal fires**, smother with dry earth, dry sand, or expanded vermiculite, then immerse residual metal in petroleum/mineral oil to block moisture and oxygen.
- Consider evacuation orders for nearby residents against toxic gas spread; refer to the **Hazardous Materials Emergency Response Guidebook**.

14. Fire Response in Thermal Power Plants

- High fire loads exist due to large storage of coal and other combustibles, along with hazardous chemical handling risks.
- Water cooling in overheated boilers risks steam explosion; **do not** use water or CO₂ extinguishers on high-temperature/high-pressure steam piping.
- Prevent explosion from toxic/flammable gas leaks via ventilation and inert gas injection, supported by cooling water operations.
- Prevent contaminated fire water from leaking into sewers or rivers; request support from relevant agencies for water pollution prevention.

15. Fire Response in Nuclear Power Plants

- High secondary disaster risk (radiation exposure) with large-scale impacts; minimize exposure time.
- Regardless of radiation release, wear radiation protective suits and carry contamination monitoring equipment.
- Entry into controlled zones must be coordinated with the Radiation Safety Officer or designated authority.

16. Response to Confined Space Accidents in Hot Environments

- Confined space work in hot environments poses risks of toxic gas retention, limited exits, and rescue difficulty.
- Safety officer must assume toxic gas presence before entry; workers must wear PPE and carry gas detectors.
- Always wear SCBA; enter in pairs; use guide ropes during searches.
- A **work permit** must record task details, worker info, oxygen/gas levels, follow-up measures, and ventilation plans; validity limited to same-day work.
- Adequate ventilation before and during operations is essential.
- Assign a safety watcher outside the confined space with constant communication; track worker entry/exit.

17. Response to Hazardous Chemical Accidents in Hot Environments

- Do not position vehicles/equipment downwind, in depressions, or within containment areas near the leak site.
- Approach from upwind; assess material data and site conditions from safe distance; establish exclusion zones.
- Wear appropriate PPE (e.g., **Level A chemical protective suits**).
- After containment, conduct neutralization of residual substances if necessary, and verify concentrations below permissible exposure using analyzers.
- Effective management begins with identifying all hazardous chemicals in use (type, quantity, purpose, location) and utilizing MSDS and workplace environment reports.

18. Response to Forest Fires in Hot Environments

- Fire spread is rapid on slopes with high risk of spot fires.
- Enter forest zones in pairs (two-person rule); all personnel must know evacuation routes.
- Approach fire from downwind toward weaker flame zones; prioritize evacuation of residents in nearby settlements.

19. Safety Management Personnel and Roles in High-Temperature Facilities/Environments

- **Employer:** Legally obligated to protect worker safety and health and comply with national industrial accident prevention policies. Must involve workers in risk assessments.
- **Safety and Health Manager:** Oversees workplace management on behalf of the employer; leads and manages risk assessments.
- **Supervisors:** Identify hazards through worker participation; in confined space work, decide methods before starting, check air quality, inspect equipment, and supervise PPE use.
- **Health Manager:** Conducts workplace health management, including environment measurement, special health exams, MSDS management, PPE supervision, and occupational disease prevention.
- **On-Site Safety Officer:** Supports incident commander during firefighting; checks crew PPE, monitors health, identifies hazards, reports, and communicates risks.
- **Workers:** Must participate in hazard identification, risk determination, mitigation planning, and compliance verification. Required to report hazards via established reporting systems.