

**Code of Conduct on Business Responsibility for a MSME Cluster:**

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**ENVIRONMENTAL, SOCIAL AND GOVERNANCE ISSUES IN THE FOUNDRY INDUSTRY**

S. No.	ESG Aspect	Issue	Remarks
<b>ENVIRONMENTAL</b>			
1.	<b>Inefficient usage of Raw Materials</b>	<ul style="list-style-type: none"> <li>- Apart from large and some medium type of foundries none of the foundries are operated on advanced technology. Hence most of the foundries do not have any temperature control or measurement techniques<sup>1</sup>.</li> <li>- <b>No proper measurements taken:</b> <ul style="list-style-type: none"> <li>• Most of units do not keep a record of coke usage<sup>1</sup>.</li> <li>• Most of the firms use molasses as binder and mullers and mixers to mix the sand and molasses. But there are no correct measurements and the mixing is done on approximations judged by molder/helper<sup>1</sup>.</li> </ul> </li> <li>- Mostly in small and micro foundries there are no systems of measurement of raw materials neither these small foundries can afford to do testing<sup>1</sup>.</li> <li>- Approximately 80-86% of the rejected raw material or finished products can be reused further during the casting<sup>1</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>- Lack of measurement systems leads to inefficient usage of raw material and quality of the melting with respect to its hardness<sup>1</sup>.</li> <li>- Leads to higher amount of coke and molasses usage. Lesser usage of coke will also ensure reduction in carbon emission<sup>1</sup>.</li> </ul>
2.	<b>Air Emission</b>	<ul style="list-style-type: none"> <li>- <b>Improper waste management:</b> Slag and sand are the waste of the foundries. However there is no proper infrastructure to manage this wastes properly which also adds upto air pollution as it generates lot of dust particles. There is no proper dumping place which results in air pollution<sup>1</sup>.</li> <li>- <b>Sulphur:</b> Cupola furnaces characteristically produce sulphur dioxide due to the presence of sulphur in the coke<sup>2</sup>. Sulphur Oxide emissions are generated from waste gases in cupola furnaces. Other sources of emission include gas hardening processes in mould- and core-making with chemically bonded sand, and in magnesium (Mg) melting<sup>3</sup>.</li> <li>- <b>Nitrogen Oxide:</b> These emissions are caused by high furnace temperatures and the oxidation of nitrogen<sup>3</sup>.</li> <li>- <b>Carbon Monoxide (CO):</b> This gas is generated from cupola furnaces and electric arc furnaces (EAFs). This is due to the cupola process itself. In EAFs, CO is generated from the oxidation of the graphite electrodes and the carbon from the metal bath during the smelting and refining phases. CO is also emitted when sand moulds and cores come into contact with the molten metal during metal pouring activities<sup>3</sup>.</li> <li>- <b>Chlorides and fluorides:</b> These exist in small quantities in waste gases from melting furnaces and are generated from flux,<sup>3</sup> salts and scale from the scrap charge and carbon additives, depending on the extent of combustion<sup>2</sup>.</li> <li>- <b>Volatile Organic Compounds (VOCs):</b> Mainly consisting of solvents (e.g., BTEX – benzene, toluene, ethyl benzene, and xylenes) and other organic compounds (e.g., phenols and formaldehyde), these are primarily generated by the use of resins, organic solvents, or organic based coatings in moulding and core making<sup>3</sup>.</li> <li>- <b>Metals:</b> Such emissions are caused by the volitisation and condensation of metals when pouring molten metal into moulds. The presence of metal in particulate emissions can be especially significant during alloying activities and during the introduction of additives<sup>3</sup>.</li> <li>- <b>Greenhouse Gases (GHGs):</b> The foundry process is energy intensive and a significant emitter of carbon dioxide (CO<sub>2</sub>), primarily associated with fuel</li> </ul>	<ul style="list-style-type: none"> <li>- Chronic pulmonary diseases like Bronchitis and asthma, are aggravated by a high concentration of SO<sub>2</sub>, NO<sub>2</sub>, particulate matter and photochemical smog<sup>6</sup>.</li> <li>- Carbon monoxide combines with the haemoglobin in the blood and consequently increases stress on those suffering from cardiovascular and pulmonary diseases<sup>6</sup>.</li> <li>- Carcinogenic agents like PAH's, Cr(VI), Cd etc. cause cancer<sup>6</sup>.</li> <li>- Hydrogen fluoride causes diseases of bone (fluorosis) and mottling of teeth<sup>6</sup>.</li> </ul>

<sup>1</sup> Diagnostic Study of Cast Iron Foundry Cluster Jaipur and Ajmer Block Cutter Casting Cluster, Foundation for MSME Clusters

<sup>2</sup> Foundry-Code of Practice 2005, Workplace Health and Safety Queensland

<sup>3</sup> Mapping Energy, Environment and Social Issues among MSME Clusters in India – Way Forward, IICA GIZ, 2013

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		<p>combustion<sup>5</sup>.</p> <ul style="list-style-type: none"> <li>- <b>Transport of raw materials:</b> Most of the major raw materials come from outside the state through road transport hence it adds upto carbon footprint<sup>1</sup>.</li> <li>- <b>Smoke:</b> <ul style="list-style-type: none"> <li>• <b>Carbonaceous Smoke:</b> Results due to the presence of oil, paint, grease, rubber, plastics etc. in the scrap. This airborne matter is formed by incomplete combustion of organic matters. The particles are very small and difficult to remove. These are caused by high coke rate and cooler top gases in the cupola<sup>4</sup>.</li> <li>• <b>Metallurgical smoke:</b> Formed due to the presence of volatile metals such as zinc. The oxidation of iron gives red coloured smoke<sup>4</sup>.</li> </ul> </li> </ul>	
3.	<b>Solid Waste</b>	<ul style="list-style-type: none"> <li>- <b>Sand Waste:</b> Sand waste from foundries using sand moulds is a significant waste in terms of its volume. Sand that is chemically bound to make cores or shell moulds is more difficult to reuse effectively and may be removed as waste after a single use<sup>5</sup>.</li> <li>- <b>Slag Waste:</b> Slag waste often has a complex chemical composition and contains a variety of contaminants from scrap metals. Common slag components include metal oxides, melted refractories, sand, and coke ash (if coke is used)<sup>5</sup>.</li> <li>- Around 80 per cent of the slag is used to by the local cement industry as it is one of the important raw materials for the cement industry<sup>1</sup>.</li> <li>- <b>Other Solid Waste:</b> Solid waste is generated from storage areas of sand, carbon powder, coke and other additives used in foundries. Wooden chip and dust are released in the pattern shop<sup>5</sup>.</li> <li>- <b>Sludge Treatment:</b> Sludge from wastewater treatment may contain heavy metals (e.g. chromium, lead, zinc, and nickel) and oil and grease<sup>3</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>- Slag may be hazardous if it contains lead, cadmium, or chromium from steel or non-ferrous metals melting<sup>5</sup>.</li> <li>- A small part of the sludge from wastewater treatment can be internally recycled; however the vast majority of it is landfilled<sup>3</sup>.</li> </ul>
4.	<b>Waste Water</b>	<ul style="list-style-type: none"> <li>- The most significant use of water in foundries is in the cooling systems of electric furnaces (induction or arc), cupola furnaces, and in wet de-dusting systems<sup>5</sup>.</li> <li>- In high-pressure die casting, a wastewater stream is formed, which needs treatment to remove organic (e.g., phenol, oil) compounds before discharge<sup>5</sup>.</li> <li>- Wastewater containing metals and suspended solids may be generated if the mould is cooled with water. Wastewater with suspended and dissolved solids and low pH may also be generated if soluble salt cores are used. Wastewater may be generated by certain finishing operations such as quenching and deburring, and may contain high levels of oil and suspended solids<sup>5</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>- Risk of contaminated water run-off to local waterways<sup>7</sup>.</li> </ul>
5.	<b>Noise</b>	<ul style="list-style-type: none"> <li>- Usage of blower during cupola operation and finishing of the products through lathe machines creates lot of noise pollution. This can result into causing deafness among the workers<sup>1</sup>.</li> <li>- The noise created by foundry machinery is complex due to the wide variety of noise sources and whether it is constant or intermittent<sup>2</sup>.</li> <li>- The foundry process generates noise from various sources, including scrap handling, furnace charging and EAF melting, fuel burners, shakeout and mould / core shooting, and transportation and ventilation systems<sup>5</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>- Regular exposure to high noise levels causes hearing loss through the destruction of the delicate hair cells (cilia hairs) in the inner ear's cochlea. This is often accompanied by tinnitus, or ringing in the ears. Damage to our ears is cumulative depending on the degree and length of exposure<sup>2</sup>.</li> </ul>
6.	<b>Dust</b>	<ul style="list-style-type: none"> <li>- <b>Dust:</b> is particulate generated from solids and dispersed into the air by movement. Foundry workers may be exposed to various types of dust, including nuisance dust, wood dust, metal dust and silica dust. Specific illnesses have been linked with exposure to certain types of dust<sup>2</sup>.</li> <li>- Foundry operations create dusty conditions exposing workers to various health risks<sup>2</sup>.</li> <li>- Black lung, metal fume fever, silicosis, pneumoconiosis etc. are all occupational maladies which are attributed to inhalation of one or other type of fine dust particles<sup>6</sup>.</li> </ul>	<p><b>Wood Dust<sup>2</sup></b></p> <ul style="list-style-type: none"> <li>- This may be accompanied by the risk of cancer of the nasal cavity and sinuses. Some wood dusts also act as sensitizers that may manifest itself as a skin rash, inflammation or as an asthmatic condition.</li> </ul> <p><b>Metal Dust<sup>2</sup></b></p> <ul style="list-style-type: none"> <li>- Iron dust may accumulate in the lungs</li> </ul>

<sup>4</sup> Energy and Environmental Management in Metallurgical Industries, R.C. Gupta, 2012

<sup>5</sup> <http://www.foundryinfo-india.org/images/EHSguide.pdf>

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		<ul style="list-style-type: none"> <li>- <b>Dust and particulate matters:</b> These are generated at each step of the production process with varying levels of mineral oxides, metals and metal oxides. These also arise from thermal (e.g., melting furnaces) and chemical/physical processes (e.g., moulding and core production), and mechanical actions (e.g., handling of raw materials, mainly sand, and shaking out and finishing processes)<sup>6</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>and cause siderosis,</li> <li>- Aluminum dust irritates the respiratory system and may result in chronic non-specific lung disease</li> <li>- Beryllium dust irritates the lungs and may result in tracheobronchitis, pneumonitis and berylliosis, and may also be a possible carcinogen \lead dust results in systemic poison effects</li> <li>- Manganese dust irritates the lungs and may have a chronic effect on the nervous system</li> <li>- Nickel dust irritates the respiratory tract and some nickel exposures may result in lung or nasal cancer.</li> </ul> <p><b>Silica Dust<sup>2</sup></b></p> <ul style="list-style-type: none"> <li>- The principal health effect associated with silica dust is silicosis, which is stiffening and scarring of the lungs.</li> <li>- Silicosis is a chronic disease and it results in increasing shortness of breath, coughing and chest pain. The effects are irreversible, and lead to degeneration in the person's health, invariably resulting in the premature death of the worker.</li> </ul>
7.	<b>Impact on local habitats</b>	<ul style="list-style-type: none"> <li>- Local habitats may have particular vulnerabilities to the materials, substances and processes used (e.g. drawing water from limited local supply, and impact of metal dust or heat on flora and fauna)<sup>7</sup>.</li> <li>- <b>Supply chain activities</b> (e.g. mining of fuel, coal, minerals and ores and use of fuels for transport)<sup>7</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>- These may damage land and water, affect air quality, and disrupt communities and local flora and fauna<sup>7</sup>.</li> </ul>
<b>SOCIAL</b>			
8.	<b>Working Conditions</b>	<ul style="list-style-type: none"> <li>- Foundry units are designed such a way that these lack proper air and light condition<sup>1</sup>.</li> <li>- The units are very poorly lit<sup>5</sup>.</li> <li>- Prevalence of high temperature, high noise intensity, dust concentration, poor ventilation, and variety of fumes<sup>8</sup>.</li> <li>- There are no proper drinking facilities and sanitary facilities for the workers<sup>1</sup>.</li> <li>- There is no separate washroom for female workers<sup>1</sup>.</li> <li>- There is no proper canteen or eating joints for the workers. They mostly eat in the street-food joints which are often unhealthy and that leads to some stomach infection/disease also<sup>1</sup>.</li> <li>- Need for bathing facilities for the workers inside most of the units premises as it helps the worker to freshen up and cool down the body<sup>1</sup>.</li> <li>- No proper cooling facilities available in the units<sup>1</sup>.</li> <li>- First-Aid box is often unavailable which can reduce the degree of injuries at an immediate effect<sup>1</sup>.</li> </ul>	
9.	<b>Excessive Heat</b>	<ul style="list-style-type: none"> <li>- Excessive heat, especially on or around the charge platform<sup>2</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>- Causes strength to decline, and fatigue occurs sooner than it would otherwise. Alertness and mental capacity may be</li> </ul>

<sup>6</sup> Environmental, Health, and Safety Guidelines for Foundries, International Finance Corporation and World Bank Group, 2008

<sup>7</sup> Sustainability issues in metal casting and forging, Manufacturing Skills Australia, August 2012

<sup>8</sup> Physiological profile of foundry workers in response to work place environment, More and Sawant, Biological Fourm, 2010

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			<p>affected also<sup>2</sup></p> <ul style="list-style-type: none"> <li>- Discomfort, heat fainting, heat stroke, irritability, dehydration, reduced concentration or attention, heat rash, reduced tolerance to chemicals and noise exposure, heat exhaustion, heat stroke<sup>2</sup></li> </ul>
10.	<b>Physical Hazards</b>	<ul style="list-style-type: none"> <li>- <b>Contact with hot metal or hot water:</b> Workers, who perform tasks with or near molten metal, may come into contact with metal splashes<sup>2</sup>. Burning injuries, minor to major accidents can also happen due to pouring of metals, shot blast as workers mostly do not use or adopt any protective measurement/outfit<sup>1</sup>.</li> <li>- <b>Equipment Handling:</b> Physical hazards in foundry operations may be related to handling of large, heavy, and hot raw materials and product (e.g. charging of furnaces); accidents related to heavy mechanical transport (e.g. trains, trucks and forklifts); injuries from grinding and cutting activities (e.g. contact with scrap material ejected by machine-tools); and injuries due to falls from elevation (e.g. high platforms, ladders, and stairs)<sup>6</sup>.</li> <li>- Exposure to <b>electrical hazards</b> due to the presence of heavy-duty electrical equipment throughout the foundries<sup>5</sup>.</li> <li>- Lifting and moving heavy loads at elevated heights using hydraulic platforms and cranes presents a significant occupational safety hazard in foundries<sup>6</sup></li> <li>- There is also the risk of injury from flying fragments or from metal scrap during charging, or in the yard adjacent to the charging machinery<sup>5</sup>.</li> <li>- In many foundries, the charge materials are lifted manually for loading into the cupola<sup>5</sup>.</li> <li>- The workers generally do not wear the any safety helmets or safety belts when working at heights<sup>3</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>- May result in severe burns and hot metal can even cause death<sup>1</sup>.</li> <li>- Manual lifting etc. is not only physically taxing but poses major hazards for workers as they are exposed to heat and high levels of CO2 at the cupola charging door<sup>5</sup>.</li> </ul>
11.	<b>Radiation</b>	<ul style="list-style-type: none"> <li>- High temperatures and direct infrared (IR) radiation are common hazards in foundries<sup>6</sup>.</li> <li>- Electromagnetic radiation is emitted from molten metal in the furnaces and pouring areas. Foundry workers are mainly exposed to infrared and ultraviolet radiation<sup>2</sup>.</li> <li>- Workers may be exposed to gamma rays and related ionizing radiation exposure risks<sup>6</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>- Direct infra-red radiation during the process of melting leads to eye diseases as most workers in foundry units do not use any kind of protective shield for eyes<sup>5</sup>.</li> <li>- Sparks from molten metal may also damage the eyes<sup>2</sup>.</li> </ul>
12.	<b>Hazardous Chemicals</b>	<ul style="list-style-type: none"> <li>- Direct skin exposure to hazardous chemicals during the various processes<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>- Headaches, nausea, fatigue, irritant or allergic dermatitis, asthma, bronchitis, chemical burns, irritation of the nose, eyes and respiratory tract, adverse effects on the central nervous system and other bodily systems, including the lungs, kidneys and liver<sup>2</sup></li> </ul>
13.	<b>Respiratory Hazards</b>	<ul style="list-style-type: none"> <li>- <b>Toxic Fumes and Gases:</b> Exposure to toxic metal fumes and gases<sup>2</sup></li> <li>- <b>Insulation Materials:</b> The use of insulation material is widespread in foundries and handling of this material during construction and maintenance may release fibers and present an occupational health hazard<sup>6</sup>.</li> <li>- <b>Dust and Gases:</b> Dust generated in foundries includes iron and metallic dusts, which are present in melting, casting and finishing shops; and wooden and sand dusts, which are present in the molding shop. The dust present in the melting and casting shops is generated by high temperature operations, and the fine particle size, and potential metallurgical fumes, creates a serious occupational inhalation risk. In the molding shop, workers are exposed to sand dust, which may contain heavy metals, and wood dust, which may have carcinogenic properties, particularly if hard wood is used<sup>6</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>- Asbestos and other mineral fibers widely used in older plants may expose people to inhalation risks of cancer-causing substances<sup>6</sup>.</li> </ul>

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14.	<b>Electrical Hazards</b>	- Workers may be exposed to electrical hazards due to the presence of heavy-duty electrical equipment throughout foundries <sup>3</sup> .	
15.	<b>Fire and Explosions</b>	- Extreme caution must be taken to prevent metal and metal slag from coming into contact with water or moisture, as this may result in an explosive reaction or ejection of molten metal with catastrophic consequences <sup>2</sup> . - Moist charge material introduced to molten metal is extremely dangerous and may lead to violent splattering or eruption of the molten metal <sup>2</sup> . - Handling of liquid metal may generate a risk of explosion, melt runoff, and burns, especially if humidity is trapped in enclosed spaces and exposed to molten metal. Other hazards include fires caused by melted metal, and the presence of liquid fuel and other flammable chemicals <sup>3</sup> .	
16.	<b>Health risk to population</b>	- Gaseous and dust emissions from the foundries pose potential health risk to the populations residing in the surrounding areas <sup>9</sup> .	- Some general health hazards are caused as a result of contact between the pollutants and the body such as eye-irritation, headache, nose and throat irritation, irritability of respiratory tract <sup>8</sup> .
17.	<b>Technology Upgradation</b>	- Technology developments may lead to redundancies for lower skilled workers <sup>7</sup> .	
<b>GOVERNANCE</b>			
18.	<b>Grievance Redressal</b>	- There is no committee on worker's safety or grievance mechanism platform has been formed either by the unit owners or by the labour. However informally through cupola operators or senior workers they convey their demand to the owners <sup>1</sup> .	
19.	<b>Worker Safety</b>	- At the operational level the workers do not use any safety outfit which is very necessary as drop of molting metal can cause serious accidents and even to the extent of death <sup>1</sup> . - There are also no insurance facilities for the workers as it highly required keeping in mind the hazardous nature of the industry. There are various potential diseases which can occur due to the prevailing working environment and the nature of the industry <sup>1</sup> .	
20.	<b>Lack of skill</b>	- Majority of the workers are not skilled. Even the skilled workers have developed their skills through experience and not through any institutional system <sup>1</sup> . In many operations lack of skill leads to wastage and defections.	
21.	<b>Technical Knowledge</b>	- Use of technology is limited. Many processes are not controlled and done manually. Most workers are used to working with approximations which leads to wastage as well as lack of standardisation in products <sup>1</sup> .	
22.	<b>Testing of products</b>	- Minimum usage of available Testing facilities leads to high degree of wastage <sup>1</sup> .	
23.	<b>Proper training to workers</b>	- - Workers wear loose garments to work and some are also bare-chested, which is a safety hazard <sup>5</sup> . - They are not aware of the safety measures that need to be followed at work. Proper training of the workers regarding health hazards and safety measures is necessary <sup>5</sup> . - The workers generally do not wear the any safety helmets or safety belts when working in the upper portions of the furnaces.	
24.	<b>Contract Labour</b>	- Majority of the workers are not permanent and earn their income as daily workers. There is a vast income difference between the permanent and daily workers. income of women workers is at least 30% lesser than the male workers as female workers is mostly engaged into semi hazardous and light kind of work.	

<sup>9</sup> Health Hazards of Foundries and Forges, Anuj Kumar Shrivastava, National Institute of Foundry and Forge Technology (NIFFT), 20010

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		<p>There is no system of benefits like provident fund, social welfare benefit etc as most of the workers are not working as permanent employee. there is no written benefit like ESI schemes, or free medicines, or free medical expenses during accidents or injuries<sup>1</sup>.</p> <p>-</p> <p>- Most workers are contract workers and are employed through contractors. These workers therefore do not enjoy the facilities (e.g., leaves, bonus, health facilities, etc.) that permanent workers have<sup>5</sup>.</p>	
25.	<b>Product Safety</b>	<p>- Poor quality practices and/or materials in any step in the process can affect the safety of products<sup>7</sup>.</p> <p>- Incorrect or inadequate labelling or product information may result in significant safety breaches/accidents<sup>7</sup>.</p>	
26.	<b>Unethical Practices</b>	<p>- The risk of collusion or unethical practice in supply chain contracts, which may cost the business through fines and/or negative media coverage<sup>7</sup>.</p>	
27.	<b>Power Requirements</b>	<p>- India is not able to meet its domestic power requirements so commercial establishments like the foundry market that require power for their daily operations are facing severe power shortages<sup>10</sup>.</p> <p>- Energy requirements for manufacturing metal castings are expected to increase with the growth of the foundry market in the coming decade. Most of the industry's energy requirements are for melting metals, but mold making and core making also require substantial amounts of energy<sup>10</sup>.</p>	
28.	<b>Managing Raw material costs</b>	<p>- Export taxes and import duties have increased the cost of raw materials, thereby squeezing the profit margins of manufacturers in the foundry market in India. In addition, high demand for raw materials is causing suppliers to increase their prices<sup>10</sup>.</p> <p>- The Foundry market in India mainly relies on imported raw materials to reduce costs and increase the quality of castings, regulations put forth by the government will be a challenge for metal casting manufacturers as they will ultimately lead to increased cost of operations and reduce the quality of castings during the forecast period. Government regulations on the import of metal scrap—including an increase in import duty on scrap metal—have seriously affected metal casting manufacturers in recent years<sup>10</sup>.</p>	

<sup>10</sup> <http://www.technavio.com/blog/the-ups-and-downs-of-the-foundry-market-in-india>