



इस्पात मंत्रालय
MINISTRY OF
STEEL

सत्यमेव जयते



SAFETY
FIRST

SAFETY GUIDELINES

FOR IRON & STEEL SECTOR





Foreword

Steel is one of the most important materials in the modern world and forms the backbone of any industrial economy with strategic importance. Steel has extensive application in building infrastructure, defence, construction, industrial machinery, engineering applications, consumer products etc. Over the years the Indian steel industry has grown substantially and has become one of the leading steel producers in the world, currently at 2nd position.

The Iron & Steel industry is hazardous in nature and concerted efforts are needed by all the stakeholders to ensure safe working environment to the employees and also to prevent/ eliminate accidents. As the Indian steel industry is poised to achieve higher milestones of production capacity and efficiencies, it also needs to address the growing need of ensuring safety to its workforce.

Ministry of Steel proactively, undertook extensive interactions with the stakeholders from the industry viz. SAIL, RINL, Tata Steel, JSW, JSPL, Essar Steel (Arcelor Mittal Nippon Steel), Tata Steel BSL, NMDC, MECON, KIOCL, MOIL, Jindal Stainless; industry associations viz. ISA, AIIFA, SIMA, AISRA, ASPA; and academia/institutions viz. IIT Kharagpur, NISST etc., to evolve a set of common minimum guidelines for safety which can act as a minimum safety benchmark for adoption by the Indian steel industry. To facilitate formulation of these guidelines, Ministry of Steel constituted a core team of experts in the form of a Working Group & Sub Group comprising representatives from SSO (SAIL), Tata Steel, IIT Kharagpur, NISST, AIIFA, AISRA & ASPA.

As an outcome of the above efforts of the core team and the stakeholders, 25 Safety Guidelines for the Iron & Steel Sector have been formulated. These guidelines pertain to specific activities/ hazards faced by the Indian steel industry (both large & small). These guidelines have been uploaded in Ministry of Steel's website and have also been published in a booklet form.

Ministry of Steel would like to complement the stakeholders for their participation & valuable inputs and urge the stakeholders from the Indian steel Industry for adoption of these guidelines wholeheartedly. Ministry of Steel would like to thank the aforementioned core team (Working Group & Sub Group) for their valuable contribution in formulation of these guidelines and Corporate Affairs Division, SAIL for their efforts in bring out this publication.



धर्मेन्द्र प्रधान
धर्मेन्द्र घुघान
Dharmendra Pradhan



मंत्री

पेट्रोलियम एवं प्राकृतिक मैस ;
इस्पात मंत्रालय
भारत सरकार, नई दिल्ली

Minister
Petroleum & Natural Gas ;
Steel
Government of India
New Delhi

Message

The steel industry is the backbone of the economy impacting almost every sector of the economy of the country namely infrastructure, construction, manufacturing, automobile, oil & gas, power etc. The Indian steel industry is the second largest in the world and is on a solid growth trajectory to achieve 300 MTPA capacity as envisaged in the National Steel Policy 2017.

The iron & steel industry involves a combination of complex processes and large scale operations, which are hazardous in nature. There are potential dangers inherent in the industry's working environment to which its employees are exposed. The Iron & Steel industry needs to prevent injuries & accidents and provide a healthy working environment to its workforce. We should be aiming to have a completely hurt free work environment for our workforce. With the above objective, Ministry of Steel has worked proactively in identifying the hazards that prevails in the iron & steel making industry and measures that need to be adopted to eliminate accidents. Ministry of Steel undertook extensive interactions with the stakeholders and formulated 25 Safety Guidelines for the Iron & Steel Sector.

I am happy to note that these safety guidelines has been published in a booklet form to facilitate large scale adoption of these guidelines by the stakeholders. I urge the steel industry to adopt these guidelines.

(Dharmendra Pradhan)



फग्गन सिंह कुलस्ते
FAGGAN SINGH KULASTE



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**MINISTRY OF STATE FOR STEEL
GOVERNMENT OF INDIA**
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दिनांक : 29.11.2019

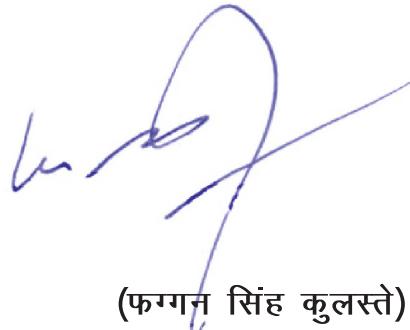
संदेश

लौह एवं इस्पात क्षेत्र में सुरक्षा विषयक चिंताओं का समाधान करने के उद्देश्य से माननीय पेट्रोलियम एवं प्राकृतिक गैस तथा इस्पात मंत्री की अध्यक्षता में जून, 2019 में एक बैठक आयोजित की गई थी। इस बैठक में तत्काल आधार पर व्यापक सामान्य न्यूनतम सुरक्षा दिशा-निर्देश तैयार किए जाने का निर्णय लिया गया था।

मुझे यह जानकर प्रसन्नता है कि इस्पात मंत्रालय ने इस विषय में तत्परता से कार्य प्रारंभ किया और लौह एवं इस्पात कंपनियों, उद्योग संघों, प्रमुख अकादमिक संस्थानों, अग्रणी विशेषज्ञ परामर्शदाताओं आदि जैसे स्टेक होल्डरों के साथ व्यापक रूप से बातचीत की। इन चर्चाओं और विचार-विमर्श के आधार पर दिशा-निर्देश तैयार हैं, जिन्हें एक बुकलेट के रूप में प्रकाशित किया गया है।

ये दिशा-निर्देश लौह एवं इस्पात क्षेत्र के बड़े तथा छोटे दोनों तरह के उत्पादकों के लिए सुरक्षा संबंधी पारिस्थितिक तंत्र को सुदृढ़ बनाने और दुर्घटनाओं को रोकने में सहायता प्रदान करेंगे।

इसलिए मैं लौह एवं अयस्क समुदाय से इन दिशा-निर्देशों को सकारात्मक रूप से अपनाने का अनुरोध करता हूँ।



(फग्गन सिंह कुलस्ते)

विनय कुमार

सचिव

Binoy Kumar
Secretary



भारत सरकार
इस्पात मंत्रालय

GOVERNMENT OF INDIA
MINISTRY OF STEEL

26th November, 2019

Message

Over the years Indian Steel Industry has undergone rapid transformation and has expanded to a production capacity of 142 Million Tonne, employing more than 25 lakhs manpower. Presently India is second largest steel producer in the world. With an aim to become a \$ 5 trillion economy by 2024-25 and an investment of Rs.100 lakh crore on infrastructure, requirement of steel is going to increase appreciably and is estimated that an additional 60 MT capacity needs to be added in next 4-5 years. The National Steel Policy envisages 300 MT capacities by 2030.

As the country is witnessing increase in production, our steel plants are also witnessing changes in equipment and mills employing latest technology. In all such development, equal focus has to be given to safety in the plants.

The health & safety of the employees in the steel sector is crucial since it has social, moral, legal and economic consequences. The Indian Steel Industry needs to eliminate the incidents of accident/fatalities. While larger steel plants have some Standard Operating Practices for ensuring safety, there are no such practices available in the smaller steel units for which safety need to be ensured.

Taking stock of the situation, Ministry of Steel has undertaken formulation of comprehensive safety guidelines for the steel sector in consultation with the stakeholders. These guidelines have been brought out in a booklet form. I urge for adoption of these guidelines by the steel industry at large.

I hope adoption of these guidelines by the steel industry shall help the industry in minimizing/eliminating accidents.

Binoy Kumar
(Binoy Kumar)



भारत सरकार GOVERNMENT OF INDIA
इस्पात मंत्रालय MINISTRY OF STEEL
उद्योग भवन UDYOG BHAVAN
नई दिल्ली-110107 NEW DELHI-110107

Dr. Rohit Yadav
Joint Secretary

22th November 2019

Message

As per the direction of Hon'ble Steel Minister, the Technical Division of Ministry of Steel undertook extensive interactions with the stakeholders with an aim to formulate common minimum safety guidelines for the Iron & Steel Sector, for elimination of accidents.

To achieve the above objective, a Working Group comprising of experts from the Industry & Academia was constituted by Ministry of Steel, with an aim to study the various safety practices followed by the iron & steel industry and evolve comprehensive/ common minimum safety guidelines to be followed for ensuring safety to the workers/ employees engaged in the sector. A Sub Group of the Working Group comprising NISST and the Industry Associations, was also constituted for addressing the specific safety needs of the mini steel sector. Safety Department of IIT Kharagpur, an institute par excellence, assisted in evolving these guidelines.

Twenty five Safety Guidelines for the iron & steel sector have been formulated which addresses specific activities/ hazards associated by the steel industry for both the large and small players. These guidelines have been uploaded in Ministry of Steel's website. The Stakeholders in the iron & steel sector have been encouraged to adopt these guidelines.

The publication of these 25 Safety Guidelines in a booklet form shall go a long way in adoption of these guidelines by the stakeholders.



(Dr Rohit Yadav)

25 Safety Guidelines for Iron & Steel Sector

INDIA, 2019



इस्पात मंत्रालय
**MINISTRY OF
STEEL**

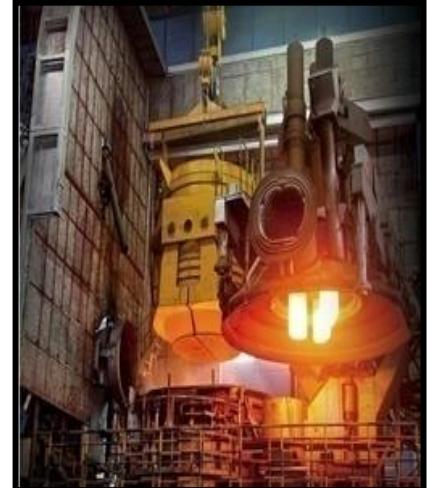


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1.0 Introduction to Iron & Steel sectors in India

1.1 Industry Background

Steel is a product of large and technologically complex industry having strong forward and backward linkages in terms of material flows and income generation. It is also one of the most important products of the modern world and of strategic importance to any industrial nation. From construction, industrial machinery to consumer products, steel finds its way into a wide variety of applications. It is also an industry with diverse technologies based on the nature and extent of raw materials used. In India, steel has an output multiplier effect of nearly 1.4X on GDP and employment multiplier factor of 6.8X.

At the time of independence in 1947, India had only three steel plants - the Tata Iron & Steel Company, the Indian Iron and Steel Company and Visveswaraya Iron & Steel Ltd and a few electric arc furnace based plants. The period till 1947 thus witnessed a small but viable steel industry in the country, which operated with a capacity of about 1 million tonne and was completely in the private sector. From the fledgling one million tonne capacity status at the time of independence, India has now risen to be the 2nd largest crude steel producer in the world and the largest producer of sponge iron. As per official estimates, the Iron and Steel Industry contributes around 2 per cent of the Gross Domestic Product (GDP) and employs about 25 lakh people directly or indirectly. From a negligible global presence, the Indian steel industry is now globally acknowledged for its product quality. As it traversed its long history since independence, the Indian steel industry has responded to the challenges of the highs and lows of business cycles.

1.2 Industry Structure

The industry in India is classified based on the nature of the manufacturing companies into Integrated Steel Producers (ISP) and Secondary Producers.

Integrated Steel Producers are companies that are present throughout the steel value chain - starting from the extraction of Iron Ore to the manufacturing and marketing of finished steel. The Integrated Steel Producers account for around 55.0 % of finished steel production in India. The integrated steel players in India include Steel Authority of India, Rashtriya Ispat Nigam Limited (Vizag Steel), Tata Steel, JSPL, JSW Steel and Essar Steel.

The Mini Steel Plant/ Processing Units in the iron and steel industry which accounts for about 45 % total finished steel production, is composed of production units which are a diverse lot with widely varying product range, technology and scale of operation and include major product/industry segments such as pig iron produced by mini blast furnaces (MBFs), sponge iron, steel produced in electric arc (EAFs) or Induction Furnaces (IFs), standalone cold rolled steel sheets and coils producers, re-rollers producing hot rolled long products such as rebars, wire rods and structurals, standalone

GP/GC and color coated steel sheets/coil producers, wire drawing units, standalone tinplate producers etc. The units covered under the Secondary Sector produce either a product that serves a basic raw material to steel making such as pig iron or sponge iron or they use a semi finished or intermediate steel product to convert the same to another product of higher value. The sector also includes crude steel (semi finished products such as ingots, billets and blooms) produced using electric arc or induction furnaces using scrap or DRI in capacities less than one million tonne a year. These units are generally small in size compared to the integrated steel

1.3 Over view of steel sector

1.3.1 Global Scenario

- In Jan-May 2019, the world crude steel production reached 764.072 million tonnes (mt) and showed a growth of 5.03% over Jan-May 2018.
- China remained world's largest crude steel producer in same period (404.879 mt) followed by India (45.314 mt), Japan (42.294 mt) and the USA (37.169 mt).
- World Steel Association has projected Indian steel demand to grow by 7.1% in 2019 while globally, steel demand has been projected to grow by 1.3% in 2019. Chinese steel use is projected to show 1.0% growth in 2019.
- Per capita finished steel consumption in 2018 was 224.5 kg for world and 590.1 kg for China (Source: World Steel Association). The same for India was 70.9 kg in 2018.

1.3.2 Domestic Scenario

- The Indian steel industry has entered into a new development stage, post de-regulation, riding high on the resurgent economy and rising demand for steel. Rapid rise in production has resulted in India becoming the 2nd largest producer of crude steel during 2018, from its 3rd largest status in 2017.
- The country is also the largest producer of Sponge Iron or DRI in the world and the 3rd largest finished steel consumer in the world after China & USA.
- In 2018-19, production of total finished steel (alloy + non alloy) was 131.572 mt, a growth of 3.7% over last year.

1.3.3 National Steel Policy-2017

With passage of time and continued growth in the domestic steel industry, it was felt that the NSP 2005 needs to be in sync with changing times. Accordingly, after a detailed review, the Government has released the

National Steel Policy 2017, which has laid down the broad roadmap for encouraging long term growth for the Indian steel industry, both on demand

and supply sides, by 2030- 31, with a vision to create a technologically advanced and globally competitive steel industry that promotes economic growth.

The National Steel Policy aims at building a globally competitive industry with a crude steel capacity of 300 MT by 2030-31 from present level of 125 million tons per annum (MTPA) and increase per Capita Steel Consumption to 160 Kgs. by 2030-31 amongst other objectives.

The creation of additional capacity for fulfilling the anticipated demand will require significant capital investment of about Rs. 10 lakh Crore by 2030-31 and will also increase employment in the range of 6-36 Lakhs by 2030-31 from the current level of 25 Lakhs i.e. around 1 million additional work-forces through direct & indirect opportunities. Hence ensuring safety of the people going to be deployed in executing the new projects along with that of existing manpower would be a crucial factor amongst others in achieving the policy objectives and sustainable growth of industry as well.

2.0 Occupational Safety & Working Conditions Management in India- An overview

Under the Constitution of India, labour is a subject in the concurrent list (under 7th schedule) where both the Central and the State Governments are competent to enact legislation subject to certain matters reserved for the Central Government. The Constitution of India provides detailed provisions for the rights of the citizens and also lays down the principles in the governance of the country called as "Directive Principles of State Policy". These Directive Principles provide for securing the safety and health and strength of employees, men and women, that the tender age of children are not abused, that citizens are not forced by economic necessity to enter avocations unsuited to their age or strength (Article 39), just and humane conditions of work and maternity relief are provided (Article 42), that the Government shall take steps, by suitable legislation or in any other way, to secure the participation of employee in the management of enterprises, establishments or other organizations engaged in any industry (Article 43A), for ensuring that no child below the age of 14 is employed to work in any factory or mine or engaged in any other hazardous employment (Article 24).

On the basis of Directive Principles as well as international instruments, the Government of India, Ministry of Labour & Employment, had declared the

National Policy on Safety, Health and Environment at Workplace (NPSHEW) on 20th February, 2009. The purpose of this National Policy is to establish a preventive safety and health culture in the country through elimination of the incidents of work related injuries, diseases, fatalities, disasters and to enhance the well being of employees in all the sectors of economic activity in the country.

2.1 Major Laws relating to Occupational Safety & Working Conditions Management

There are four main legislations that cover Occupational Safety & Working Conditions Management at workplace.

- (i) The Factories Act, 1948 , covering factories wherein the enforcement of safety at workplace is by the Chief Inspector of Factories in the respective states,
- (ii) The Mines Act, 1952 and Mines Rules, 1955 for mining industry where the enforcement is by the Directorate General of Mines Safety (DGMS) under Ministry of Labour & Employment , Government of India,
- (iii) The Dock Workers (Safety, Health and Welfare) Act, 1986 followed by notification of the Dock Workers (Safety, Health and Welfare) Regulations, 1990 dealing with the major ports of India and the enforcement is by the Directorate General of Factory Advice Service & Labour Institutes (DGFASLI), under Ministry of Labour & Employment , Government of India, and
- (iv) The Building & Other Construction Workers (Regulations of Employment and Conditions of Service) Act, 1996 , covering construction workers at construction sites wherein the enforcement is by the Directorate General Labour Welfare in the central sphere and by the Labour Commissioners/Factory Inspectorates in the States/UTs

2.2 Other related legislations on Safety, Health and Environment

Apart from the four main legislations mentioned above, there are legislations relating to certain substances, machinery, environment which also addresses certain issue of Occupational Safety & Working Conditions. These statutes are applicable to all sectors including the unorganized sectors:

- a) The Indian Boilers Act, 1923 (amended 2007)
- b) The Dangerous Machines (Regulation) Act, 1983
- c) The Motor Transport Workers Act, 1961 (amended 1986)
- d) The Shops and Commercial Establishments Acts
- e) The Explosives Act, 1884 (amended 1983)
- f) The Petroleum Act, 1934
- g) The Inflammable Substances Act, 1952
- h) The Insecticides Act, 1968 (amended 2000)
- i) The Oil Fields (Regulation and Development) Act, 1948
- j) The Petroleum and Natural Gas Regulation Board Act, 2006
- k) The Environment (Protection) Act, 1986 (amended 1991)
- l) The Water (Preventions Control of Pollution) Act, (Amended 1988)
- m) The Water (Prevention & Control of Pollution) Cess Act, 1977 (Amended 2003)
- n) The Air (Prevention & Control of Pollution) Act, 1981 (Amended 1987)
- o) The Public Liability Insurance Act, 1991 (Amended 1992)
- p) The Motor Vehicles Act, 1988 (Amended 2013)

- q) The Atomic Energy Act, 1962 (Amended 1987)
- r) The Electricity Act, 2003 (Amended 2007)
- s) The Disaster Management Act, 2005
- t) Employees' Compensation Act of 1923
- u) The Employee's State Insurance Act, 1948

2.3 International Labour Standards on Occupational Safety and Health (OSH) standards

The following Conventions related to Occupational Safety and Health are ratified by India.

- a) C032 -Protection against Accidents (Dockers) Convention (Revised), 1932 (No.32)
- b) C 045- Underground work (Women) convention, 1935
- c) C127 - Maximum Weight Convention, 1967 (No. 127)
- d) C136 - Benzene Convention, 1971 (No. 136)
- e) C174 - Prevention of Major Industrial Accidents Convention, 1993 (No. 174)
- f) C No. 115- Radiation Protection Convention, 1960

2.4 Authority or body Responsible for Occupational Safety & Working Conditions Management

The occupational safety and health is one of the subjects allotted to Ministry of Labour & Employment (MoL&E), under the Government of India, allocation of Business Rules. To deal with the subject relating to Occupational Safety & Working Conditions Management in the case of Factories, the same is implemented by the State Governments under the Chief Inspector of Factories. In case of Mining, the implementation is under the Directorate General of Mine Safety (DGMS). As for Port Sector (i.e. twelve major ports) the implementation is under the Directorate General of Factory Advisory Services (DGFASLI). A separate division on industrial safety and health exists in the MoL&E. The Industrial Safety and Health division of the Ministry discharges the overall functions relating to policy decisions and laying down guidelines for countrywide adoption in the above sectors.

The Ministry also carries out liaison with the International Labour Organisation (ILO) and other countries. The Ministry undertakes co-ordination at the national level by periodically convening the State Labour Ministers Conference and State Labour Secretaries Conference, in which policy matters and issues on uniformity in labour laws are discussed. Directorate General Factory Advice Service & Labour Institutes (DGFASLI) and Directorate General of Mine Safety (DGMS) assist the Ministry in the technical aspects of occupational safety and health in the above sectors.

Chief Inspector of Factories (CIFs)/ Directorate of Industrial Safety and Health (DISH) of respective State Governments/UTs are dealing with enforcement of the Factories Act, 1948 and the State Factories Rules framed there under for the factories registered under the said Act in the aspect of occupational safety and health in the manufacturing sector.

Director General Labour Welfare (DGLW) (Labour welfare organization) is dealing the matters concerning policy and legislation related to workers in the un organized sector and administration of welfare funds for specified categories of workers through nine regions headed by welfare commissioner who implement the welfare schemes made under the welfare funds.

DGLW also deals with Rashtriya Swasthya Bima Yojana (RSBY). DGLW enforces the various Labour laws and rules made there under in the central sphere including the Building and other Workers (Conditions of Service and Regulation of Employment) Act, 1996 for the workers working in the construction sector.

3.0 Status of Safety in the Steel Industry

Occupational Safety & Working Conditions is relatively neglected area by Indian industry and because of this while India has approximately 3% share of global manufacturing, India has almost 30% share of the industrial fatalities globally. Even Steel industry in India lags its global peers on this parameter and has patchy safety performance with many major incidents involving multiple fatalities. Most of the companies actually do not even have a proper safety management system comparable to global best practices. Though most of large ISPs are OHSAS- 18001 certified, never the less their contribution in workplace fatalities is not insignificant. Contractor workers which accounts for nearly half of the manpower deployed in steel industry are more susceptible to incidents as they are unskilled, not so educated and unaware of the hazardous work environment. However, in-spite of all efforts, their share in fatalities continues to be higher on year to year basis. Safety is still being managed in isolation and not as an essential / integral part of overall business decisions, culture & performance in most of the organizations. Efforts for benchmarking by taking lessons from past failures & good practices from peer industry are limited to few organizations only.

4.0 Hazards in Steel Industry

4.1 Hazards in Primary/ Integrated Steel Making

Integrated Iron and Steel Industry inherently has many potential hazards which need to be mitigated properly. The Industry has been classified as hazardous process industry as per Chapter 1 Sec-2 (cb) of Factories Act 1948 (Amended in 1987). The hazards mainly emanate from extremely high temperature process involving liquid metal, generation of by-product gases which have toxic and explosive constituents, large amount of material handling/ transporting and manpower intensive multi-unit operations. The hazardous chemicals, electricity, steam, working at height, working in confined space etc. in addition to project activities add to the risks, especially when they are carried out besides the existing operating units.

The various hazards along with the areas of their presence are enumerated in the table below-

Type of Hazard/Risk	Major areas where Hazard is faced
Toxic gases (rich in Carbon monoxide)	All over the plant
Explosive Gases (Rich in Hydrogen and Methane)	All over the plant
Harmful Chemicals	Coal Chemicals plant, CRM
Liquid metal/ slag (burn, explosions)	Blast Furnace, SMS, Continuous casting, Foundries
Extreme Temperature (-180 °C to 1700 °C)	Coke Ovens, Blast Furnace, SMS, Continuous casting, Foundries, Rolling Mills and Cryogenic Oxygen Plant
Fire	All over the plant
Electric Shock, Electrocution, Flash over	All over the plant and project sites
Rail/ Road Traffic Movement	All over the plant and project sites
Moving/ Rotating machines (Hit, Caught, pressed etc.)	All over the plant and project sites
Working at Height	All over the plant and project sites
Dust, noise, heat and Vibration	All over the plant
Material Handling	All over the plant and project sites
Confined Space (suffocation/gas poisoning)	Furnaces, Tanks, Gas Pipelines, Gas holders, Sumps, Pits, Oil cellar, Conveyor/cable galleries, Silos, etc.
High pressure Steam, Water & industrial gases	All over the plant

The above safety hazards are associated with varying levels of risks which may lead to injuries as given in the table below-

Sl. No.	Type of hazards
A	Physical Hazards
Sub type	Hazard description / Risk
Noise	Exposure to noise levels exceeding those set by the competent authorities may result in noise-induced hearing loss. Exposure to high noise levels may also interfere with communication and may result in nervous fatigue with an increased risk of occupational injury.
Vibration	<p>Exposure of workers to hazardous vibration is mainly known as:</p> <p>(a) whole-body vibration, when the body is supported on a surface that is vibrating, which occurs in all forms of transport and when working near vibrating industrial machinery; or</p> <p>(b) Hand-transmitted vibration, which enters the body through the hands and is caused by various processes in which vibrating tools or work pieces are grasped or pushed by the hands or fingers.</p>

Sl. No.	Type of hazards
A	Physical Hazards
Sub type	Hazard description / Risk
Heat and cold stress	Risks arise in special conditions: (a) temperature and/or humidity are unusually high; (b) workers are exposed to high radiant heat; (c) high temperatures and/or humidity occur in combination with heavy protective clothing or a high work rate; (d) temperature is unusually low;
Lack of proper illumination	Poor lighting affects the Occupational Safety & Working Conditions of people at work causing symptoms like eyestrain, migraine and headaches. Symptoms of this include headaches, lethargy, irritability and poor concentration.
Work equipment and machinery guarding	The use of work equipment, including machinery and hand and portable power tools, may result in incidents, many of which are serious and some fatal. Lack of guards or inadequate guards, interlocks, safety devices, improper maintenance, no adherence to SMPs etc. can lead to incidents caused by entanglement, sheering, crushing, trapping, cutting, etc.
Cranes and hoists	All machinery used to lift and/or transport equipment, materials, molten metal or slag should be designed, constructed and erected, inspected, maintained and operated as specified by the manufacturer/ site specific SOPs/ SMPs which otherwise would lead to crane failure / overturning , failure of tools & tackles like slings etc. leading to material slippage, hitting nearby structures/ overhead line etc.
Control of hazardous energy	The iron and steel industry regularly uses different sources of energy (electric, mechanical, hydraulic, pneumatic, etc.). The safe control of energy should be addressed by procedure and carried out by appropriately trained personnel in accordance with the nature of the energy source and the characteristics of the facilities.
Falling objects	Failure to properly secure loose materials at height, maintaining proper stack heights, preventing unauthorized entry etc. leading to fall of objects and hitting a nearby person
Slips, trips and falls	Inadequate housekeeping, improper covers on opening, unsuitable platforms or walkways equipped with handrails and protective barriers etc. may lead slip & trip injuries. Fall from height may occur due to non -usage of fall arrest equipment.
Rail & road transport	Internal transport, such as road and rail vehicles, transfer cars etc. used in the transport of raw materials, intermediates, products, waste etc. has the potential to cause injuries to workers and other people.The hazards can be caused by interaction between vehicles, vehicles and other objects and personnel, or by loads falling off or from the vehicle.
Fire & explosion	Steel Plants stores & handles number of flammable chemicals like tar, naptha, benzol, fuel gases, oils, LPG, Propane, Oxygen etc. which possess potential fire & explosion hazards. Hot metal/ slag sparks, welding sparks, electrical short circuiting etc. can also lead to fire in surrounding areas if combustible materials are present.

Sl. No.	Type of hazards
A	Physical Hazards
Sub type	Hazard description / Risk
Confined spaces	Bin, silos, tunnels, ESPs, manholes, etc. are examples of confined spaces where entry of persons & carrying out jobs requires special precautions. Toxic or flammable gases, oxygen displacement and engulfment are the principal hazards.

Sl. No.	Type of hazards
B	Chemical Hazards
Sub type	Hazard description / Risk
Chemicals in the workplace	<p>These substances may present a hazard as the result of contact with the body or absorption into the body. Absorption can occur through the skin, by ingestion or by inhalation.</p> <ul style="list-style-type: none"> • Chemicals can have acute (short-term) and/or chronic (long-term) Health effects. • Chemicals may present a safety hazard as a result of their chemical and physical properties.
Inhalable agents (gases, vapours, dusts and fumes)	<p>The production of iron and steel involves the consumption and generation of a variety of inhalable agents including, but not limited to, gases, vapours, dusts, fumes, smokes and aerosols. These agents comprise a variety of toxicological hazards including irritants, chemical asphyxiants, fibrogens, allergens, carcinogens and systemic toxicants. The pulmonary system (lungs) can be affected by exposure to harmful agents through acute (short-term) injury to lung tissue, the development of pneumoconiosis, pulmonary dysfunction and the development of lung cancer. Silica dust is most harmful to lungs and causes silicosis. Certain harmful agents that are inhaled through the lungs can cause target organ damage and/or systemic toxic effects. Certain asphyxiants can cause death in a matter of seconds at high concentrations by displacing oxygen. Specific agents that may be found in the iron and steel industry include heavy metals (e.g. lead, chromium, zinc, nickel and manganese) in the form of fumes, particulates and adsorbates on inert dust particles. Acid mists from pickling areas can cause skin, eye and respiratory irritation.</p>

Sl. No.	Type of hazards
C	Radiation Hazards
Sub type	Hazard description / Risk
Ionizing radiation	All exposure to ionizing radiation should be kept as low as possible, as there is evidence that damage caused by radiation may be permanent, and that there is a significant increase in the incidence of cancer and some types of malignancies, as a consequence of even low doses of ionizing radiation. Radiation levels to be periodically measured through installation of Radiation Detection Equipments as per amended 2 nd Schedule of Factories Act.
Non-ionizing radiation	Non-ionizing radiation is usually referred to as ultraviolet (UV), visible and infrared (IR) radiation. Absorption in the UV and visible portions of the spectrum

Sl. No.	Type of hazards
C	Radiation Hazards
Sub type	Hazard description / Risk
	produces photochemical reactions. In the IR region, all of the absorbed radiant energy is converted into heat. Exposure to some radio-frequency and microwave radiation can result in the formation of cataracts of the eye. Exposure of the eyes to visible and IR radiation can cause thermal injury to the retina and damage to the lens, which may result in the formation of cataracts. Exposure of the eyes to UV radiation can result in inflammation of the conjunctiva and cornea.

Sl. No.	Type of hazards
D	Ergonomic Hazards
	Hazard description / Risk
	These hazards are due to tool design, equipment design, job and task design, work station design, and manual handling etc.

Sl. No.	Type of hazards
E	Psychological Hazards
	Hazard description / Risk
	These hazards are due to shift work, work load, harassment, discrimination, bullying, and stress etc

4.2 Cause of Incidents

As per ILO Code of practice on Safety & Health in the Steel Industry, 2005
Below are the most common causes of injury in the iron and steel industry:

- (i) Slips, trips and falls on the same level;
- (ii) Falls from height;
- (iii) Unguarded machinery;
- (iv) Falling objects;
- (v) Engulfment;
- (vi) Working in confined spaces;
- (vii) Moving machinery, on-site transport, forklifts and cranes;
- (viii) Exposure to controlled and uncontrolled energy sources;
- (ix) Inhalable agents (gases, vapours, dusts and fumes);
- (x) Contact with hot metal, Reactive substances, hazardous chemicals;
- (xi) Fire and explosion;
- (xii) Extreme temperatures;
- (xiii) Radiation (non-ionizing, ionizing);
- (xiv) Noise and vibration;
- (xv) Electrical burn, Electrical Flash and electric shock;
- (xvi) Manual handling and repetitive work etc.

As per World Steel Association (WSA), the five most common causes of safety incidents in Steel Industry worldwide and preventative measures have been identified as follows:

1. **Moving machinery** – Isolate, lock or pin all energy sources before any machinery is accessed.
2. **Working at heights** – Provide regular training, appropriate harnessing equipment and ensure checks are in place when working at height.
3. **Falling objects** – Ensure regular checks are in place to remove or secure objects in risk areas.
4. **On-site traffic** – Ensure all traffic on the site is operated safely, including road, rail and pedestrians, and remove all unnecessary traffic.
5. **Process safety incidents** – Identify potential process safety hazards that could cause explosions or fires and take adequate precautions.

4.3 Hazards in Mini Steel Plant / Processing Units

In most of the Mini Steel Plant / Processing Units, use of old equipment/technology, abysmal level of safety awareness, lack of proper maintenance, non availability of SOPs/ SMPs, inadequate infrastructure facilities for training & skill development, improper housekeeping, non availability / usage of PPEs., dearth of technical man power, high production targets, duty over stay etc. coupled with lack of management commitment towards safety has been a area of concern. The salient safety hazards in this sector are more or less similar to integrated steel plants as shown below:

Sl. No	Type of hazards	Source of hazards
A	Physical Hazards	<ul style="list-style-type: none">• Moving equipment like charging crane, conveyors, Moving ladles, tilting furnace etc.• Fugitive Dust at Raw Material Handling section, Crusher, DRI Kiln• Excessive Dust during Loading/unloading operation,• Failure of high pressure steam ,water or oil lines,• Working in confined space like cleaning of silos/ cyclones etc.• Falling of personal from working platform / from height• Noise, heat & vibration
B	Electrocution/ Electrical Hazards	<ul style="list-style-type: none">• Faulty equipment / Faulty connections/ failure to adhere to SOPs
C	Fire & Explosion	<ul style="list-style-type: none">• Oil and Lubricant Room (spillage)• Fine Coal Hoppers• Coal Gasifier

Sl. No	Type of hazards	Source of hazards
		<ul style="list-style-type: none"> • Coal Storage area, • Electrical Short circuit • Boiler malfunctioning • ESP malfunctioning • Spilled liquid metal coming in contact with water, • Pool fire may occur in case of direct contact of FO/LDO with flame

Nothing is more important than Occupational Safety & Working Conditions of the people at work. Ensuring safety of the workforce is a fundamental duty for

any company management, so a proper management system for addressing safety issues is of paramount importance. After all, excellence in health also produces superior business performance. The most successful steel companies are also the safest.

For this, it is important that Steel Industry should have common safety standards which will serve as reference document for use by all concerned.

5.0 Way Forward

Safety, Health, and improved Working Conditions are pre-requisite for well being of the worker and also for economic growth of the country as healthy workforce would be more productive and occurrence of less accidents and unforeseen incidents would be economically beneficial to the employers also.

Ministry of Steel, GOI has taken the initiative by recognizing the need for formulating the safety guidelines for effective management of risk in the iron & steel sector.

As a way forward, MOS has constituted a Working Group to develop safety guidelines for both large & small producers/ processors in the iron & steel sector.

6.0 Objectives

The Safety guidelines aim to contribute towards:

- i. Protecting workers in the iron and steel industry from workplace hazards;
- ii. Preventing work-related injuries and incidents;
- iii. Assisting and facilitating the improved management of occupational safety issues at the workplace;
- iv. Improving knowledge and competence;
- v. Promoting the implementation and integration of consistent Safety Management Systems with a view to improving working conditions.

7.0 Scope of Work

The scope of work covers Safety guidelines in Iron and Steel sector which includes:

- a) Integrated steel plant (Plants having all range of activities from receiving of Raw material to dispatch of finished product including auxiliary facilities like power plant, oxygen plant, etc).
- b) Mini Steel Plant / Processing Units (Mini Blast Furnaces, Electric Arc Furnace, Induction furnace, Sponge iron plant, Re-rollers, independent hot & cold rolling, galvanizing and coating units etc.)
- c) Project /Construction activities in steel industry.

These guidelines shall not be applicable to Mining industry which are governed by Mines Act, 1952 and Mines Rules, 1955 and safety rules in mining industry are being enforced by DGMS (Directorate General of Mines Safety) under Ministry of Labour & Employment , GOI.

8.0 Application

These Safety guidelines should provide guidance, in accordance with the provisions of national laws and regulations, to:

- a) All the government authorities, workers' and employers' organizations and industry associations, whether legislative or advisory, whose activities influence the Occupational Safety & Working Conditions and welfare of workers in the Iron and Steel industry.
- b) All those individuals at the level of the iron and steel-making facilities, i.e. employers, persons in control of premises, and workers and contractors, as appropriate to their duties and responsibilities for safety and working condition.
- c) All operations in the iron and steel industry.

The provisions of the Safety guidelines may be considered as minimum guidelines. They are not intended to replace applicable laws, regulations. More stringent applicable requirements should have priority over the provisions of the Safety guidelines.

All these guidelines are generic in nature which provides the basic framework; however specific safe practices may be evolved according to process requirements and site conditions by the users.

9.0 Methodology

The following methodology was adopted by the working group constituted by clause no. 5.0.

- a) Study of various safety practices followed across India in Iron & Steel Industry (Primary/ Integrated & Mini Steel Plant / Processing Units/ International Standards).

- b) Enlisting of the mostly applicable & Common Safety guidelines in Iron & Steel Sector.
- c) Compilation of Safety Guidelines and sharing for horizontal deployment
- d) Inputs from Mini Steel Plants / Processing Units incorporated
- e) Stakeholder consultation

10.0 Safety guidelines for Iron & Steel Sector

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23.	Energy isolation	SG/22	374
24.	Safe handling of Liquid Metal	SG/23	381
25.	Transportation in steel industry	SG/24	391
26.	Loco Operation	SG/25	420

11.0 References

- a) Inter Plant Standardization in Steel Industry (IPSS) 1-11 Standards on Personal safety appliances & Procedures
- b) Tata Steel Workplace Safety Standards
- c) SAIL Plants Safety Manual
- d) BIS Standards on Safety
- e) ILO Code of Practice on Safety &Health in Steel Industry
- f) National Steel Policy, 2017
- g) National Occupational Safety and Health (OSH) Profile, Prepared by DGFASLI in collaboration with ILO.

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	GLOSSARY OF TERMS RELATED TO SAFETY AND ABBREVIATIONS	Doc. No: I Rev no. : 00 Effective Date : 14.10.2019

1. Objective

Various terms & abbreviations connected with safety management are used frequently in Iron & Steel Industry. In this safety guideline, these terms with the meanings assigned to them are provided in alphabetical order for the sake of clarity.

2. Scope

This safety guideline covers the definitions of terms & abbreviations related to safety.

3. Definitions

- i) **Accident-** An unintended occurrence arising out of and in the course of employment of a person resulting in injury.
- ii) **Audit-** A systematic, independent and documented process for obtaining evidence and evaluating it objectively to determine the extent to which defined criteria are fulfilled. Audits should be conducted by competent persons internal or external to the facility that is independent of the activity being audited.
- iii) **Biological Hazards -** Inhalation, ingestion, or contact with harmful Biological agents.
- iv) **Chemical Hazards-** Inhalation, ingestion, or contact with harmful chemical agents
- v) **Competent person-** A person with suitable training, and sufficient knowledge, experience and skill, for the performance of the specific work. He is approved by the competent authority either by Govt. or recognized Institution.
- vi) **Contractor-** A person or an enterprise providing services to an employer at the facility in accordance with national laws and regulations, or with agreed specifications, terms and conditions. For the purpose of this guideline, contractors include principal contractors, subcontractors and labour supply agents.
- vii) **Dangerous occurrence-** Readily identifiable event, as defined under national laws and regulations, with potential to cause the property damage but no injury to workforce.

- viii) **Employer**- Any physical or legal person that employs one or more workers.
- ix) **Engineering controls**- Use of technical measures such as enclosure, ventilation and workplace design to minimize exposure.
- x) **Electrical Hazards**- Electric arc which may cause eye damage or burns; electric shock or burns resulting from contact with parts at hazardous voltages; breakdown of insulation; leakage current; etc.
- xi) **Exposure limit**- An exposure level specified or recommended by a competent authority to limit injury to health. The terms adopted by the competent authority vary from country to country and include: “administrative control levels”; “maximum allowable concentrations”; permissible exposure limits”; “occupational exposure limits”; and “threshold exposure values”.
- xii) **Fire or Explosion Hazards**- Linked with fire or explosion, or incurred as their secondary consequences including damage to property.
- xiii) **Frequency rates**- Number of lost time injuries or Reportable lost time injuries per million man hours worked.
- xiv) **Hazard**- The inherent potential to cause physical injury or damage to the health of people.
- xv) **Hazard identification**- The systematic process of identifying hazards in the workplace.
- xvi) **Incident**- An unsafe occurrence arising out of or in the course of work where no personal injury is caused.
- xvii) **Job Safety Analysis**- Job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job. In a JSA, for each basic step of the job, it is to identify potential hazards and to recommend the safest way to do the job.
- xviii) **Lost Time Injury (LTI)** - Any work-related injury, resulting in the company employees, contractor or third party contractor employee not being able to return to work for their next scheduled work period. Returning to work with work restrictions does not constitute a lost time injury status, no matter how minimal or severe the restrictions, provided it is at the employee's next scheduled shift.
- xix) **Mechanical Hazards**- Projections, sharp points or edges which may cause cuts/lacerations; excessive noise/vibration; impact; entrapment of limbs in moving and stationery equipment; stability factor; etc.
- xx) **Man-Hours Worked**- The total number of employee-hours worked by all employees working in the industrial premises. It includes managerial,

supervisory, professional, technical, clerical and other workers including contractors' labour.

- xxi) **Near miss incident**- An incident that physically occurred but there was no personal injury to the employee, contractor or visitor but which could have resulted in a serious injury and needs to be followed up in the same way as a Lost Time Injury but recorded as a near miss.
- xxii) **Occupational accident**- An unexpected occurrence, including acts of violence, arising out of or in the course of work which results in a fatal or non-fatal occupational injury.
- xxiii) **OSH management system**- A set of interrelated or interacting elements to establish OSH policy and objectives, and to achieve those objectives.
- xxiv) **Permit to Work**- The permit-to-work is a documented procedure that authorises certain people to carry out specific work having high risk and involving multiple agencies in a coordinated manner. It sets out the precautions required to complete the work safely, based on a risk assessment. It describes what work will be done and how it will be done; the latter can be detailed in a 'method statement'.
- xxv) **Protocol** - It is a document which lists the activities sequentially for the work to be taken up along with the persons responsible for that particular job with a view to ensure safety.
- xxvi) **Recording**- A procedure, specified in national laws and regulations, for ensuring that the employer maintains information on:
 - a) Occupational accidents and diseases;
 - b) Dangerous occurrences and incidents.
- xxvii) **Reporting**- A procedure, specified by the employer, in accordance with national laws and regulations and with the practice of the enterprise, for the submission by workers to their immediate supervisor, the competent person, or any other specified person or body, of information on:
 - a) Any occupational accident or injury to health which arises in the course of or in connection with work;
 - b) Suspected cases of occupational diseases;
 - c) Dangerous occurrences and incidents.
- xxviii) **Risk**- A combination of the likelihood of an occurrence of a hazardous event and the severity of injury or damage to the health of people caused by this event.
- xxix) **Residual Risk**- Risk remaining after protective measures have been taken.

- xxx) **Risk Analysis**- The use of available information to identify hazardous events and to estimate the risk.
- xxxi) **Risk Evaluation**- The process in which on the basis of risk analysis and taking into account factors such as social, economic and environmental aspects, judgments are made on the acceptability of the risk.
- xxxii) **Risk Assessment**- The process of risk analysis and risk evaluation.
- xxxiii) **Restricted Work Case (RWC)** - Any work-related injury other than a fatality or a Lost Time Injury where the injured person cannot fulfill his normal work the day following the injury but is able to undertake a temporary job, work at his normal job but not full-time, or work at a permanently assigned job but unable to perform all duties normally assigned to it. If the injury has led to lower productivity or slower work from the worker, but the worker is still capable of undertaking all of their routine tasks, then this would not be classified as restricted work.
- xxxiv) **Reportable injury**- Where in any factory an accident occurs which causes death, or which causes any bodily injury by reason of which the person injured is prevented from working for a period of forty-eight hours or more immediately following the accident.
- xxxv) **Reportable Lost Time Injury**- An injury causing death or disablement to an extent as prescribed by the relevant statute.
- xxxvi) **Radiation Hazards**- Radio-frequency, infra-red, ultra-violet, high intensity light, coherent light, ionizing radiation etc.
- xxxvii) **Safety**- Freedom from unacceptable risk of harm.
- xxxviii) **Severity rate**- Number of man days lost due to lost time or reportable lost time injuries per million man hours worked.
- xxxix) **Tolerable Risk**- Risk which is accepted in a given context based on the current values of society.
- xl) **Thermal Hazards**- High or low temperature.
- xli) **Unsafe act**- Any action that may endanger a person or people working around him/her. Examples: When working at heights (on a roof for instance) without using a safety harness or not clipped on; not wearing a seatbelt when driving a vehicle.
- xlii) **Unsafe situation**- Any situation judged as being such that, sooner or later, it may lead to a risk of an incident inflicting harm to one or more persons. Example: Missing or broken hand rail leading to risk of falling from height.

- xliii) **Work-related injury-** Death or any personal injury resulting from an occupational accident.
- xliv) **Work-related injuries, ill health and diseases-** Negative impacts on health arising from exposure to chemical, biological, physical and organizational factor.
- xlv) **Warning Notices-** Signal words
 - a) DANGER- to call attention to high risk
 - b) WARNING- to call attention to medium risk
 - c) CAUTION- to call attention to a low risk

4. Abbreviations

- i) **ATPV**- Arc Thermal Performance Value
- ii) **BF**- Blast Furnace
- iii) **COG**- Coke Oven Gas
- iv) **CO**- Carbon Mono oxide
- v) **CCS**- Continuous Casting Shop
- vi) **CNG** – Compressed Natural Gas
- vii) **CPR** - Cardio-Pulmonary Resuscitation
- viii) **DES**- Dust Extraction System
- ix) **DA** - Dissolved Acetylene
- x) **EA**- Executing authority
- xi) **EOT**- Electrical Overhead Travelling
- xii) **FDA** – Fire Detection & Alarm System
- xiii) **FR**- Flame Resistant
- xiv) **GTU**- Gravity Take Up Unit
- xv) **GCP**- Gas Cleaning Plant
- xvi) **HIRA**- Hazard Identification & Risk Assessment
- xvii) **HMTC**- Hot metal Transfer Car
- xviii) **HOD**- Head of Department
- xix) **HPP**- High Pressure Pump
- xx) **IPSS**-Inter Plant Standardization in Steel Industry
- xxi) **IOD**- Injury on Duty
- xxii) **JSA**- Job Safety Analysis
- xxiii) **LOTO**: Lock out ,Tag out
- xxiv) **LPG** – Liquefied Petroleum Gas

- xxv) **LTI**-Lost Time Injury
- xxvi) **LEL**: Lower explosive limit
- xxvii) **LED**- Light Emitting Diode
- xxviii) **LRS**- Ladle Repair Shop
- xxix) **MEWPs** -Mobile elevating work platforms
- xxx) **MCWPs** - Mast climbing work platforms
- xxxi) **MSDS**- Material Safety Data Sheet
- xxxii) **MCC**- Motor Control Centre
- xxxiii) **MVWS**-Medium Velocity Water Spray System
- xxxiv) **OEM**- Original Equipment Manufacturer
- xxxv) **OD Pipe**- Outside Diameter of Pipe
- xxxvi) **PPE**- Personal Protective Equipment
- xxxvii) **PCM**- Pig Casting Machine
- xxxviii) **PPM** - Parts per million
- xxxix) **RCBO** - Residual Current Breaker Overload
- xl) **RCCB** - Residual Current Circuit Breaker
- xli) **RWC**- Restricted Work Case
- xlii) **RM**- Rolling Mills
- xliii) **SED**- Safety Engineering Department
- xliv) **SOP** – Standard Operating Practices
- xlv) **SMP**- Standard Maintenance Practices
- xlvi) **SWL**- Safe working load
- xlvii) **S/P**- Shunting Porter
- xlviii) **SMS**- Steel Melting Shop
- xlix) **SAE flange**- Society for Automotive Engineers flange
- I) **TLV- TWA** : Threshold Limit Value – Time Weighted Average
- ii) **TIG Welded**- Tungsten Inert Gas Welded
- iii) **UEL**- Upper Explosive Limit
- iv) **UT** - Ultrasonic Test
- liv) **VRD** - Voltage Reducing Device
- lv) **Y/M**-Yard Master

References:

1. ILO Code of practice on safety and health in the Iron and Steel industry, 2005
2. World Steel guidance document on 'Safety & Health Principles and Definitions'.
3. Factory Act, 1948
4. IS 3786-1983 on 'Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Accidents'
5. IPSS: 1-11-001-98 –Definition of terms related to safety.

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	STORAGE, HANDLING & USE OF GAS CYLINDERS	Doc. No: SG/01 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

This guideline is meant for safe storage, handling and use of gas cylinders in the steel industry for protection against various hazards such as Fire / Explosion / Gas Leak / Bursting of Gas Cylinders/ hit by cylinders.

2. Scope

This guideline applies to all Works and project sites of Iron & Steel companies. Medical gas cylinders are not covered in the scope of this guideline.

3. Procedure

3.1 Definitions

Cylinder: any closed metal container having a volume exceeding 500 ml but not exceeding 1,000 litres intended for the storage and transport of compressed gas, including any liquefied petroleum gas (LPG) container/ compressed natural gas (CNG) cylinder fitted to a motor vehicle as its fuel tank but not including any other such container fitted to a special transport or under-carriage and includes a composite cylinder, however, the water capacity of cylinders used for storage of CNG, nitrogen, compressed air, etc. may exceed 1,000 litres up to 2,500 litres provided the diameter of such cylinder does not exceed 60 cm.

3.2 License Requirement as per Statutory Provisions:

- i) No person shall fill any cylinder with compressed gas and no cylinder filled with compressed gas shall be possessed by anyone except under and in accordance with the conditions of a licence granted under these rules. The licensee shall be responsible, for all operations connected with the filling and possession of cylinders in the licensed premises.
- ii) No license needed for possession in certain cases as per Rule-44 of Gas Cylinder Rules, 2016.
 - a) Possession of any cylinder filled with a compressed gas by a carrier or other person for the purpose of transport in accordance with the provisions of these rules;
 - b) Possession of cylinders for own use and not meant for sale or trading filled with –

- Any other flammable but non-toxic gas when the total number of cylinders containing such gas does not exceed 25 or the total weight of gas does not exceed 200 kg., whichever is less, at a time;
- Any non-flammable non-toxic gas when the total number of such cylinders does not exceed 200 at a time;
- Any toxic gas when the total quantity of such cylinders does not exceed 5 at a time;
- Acetylene gas contained in cylinder in dissolved state when the total quantity of such cylinder does not exceed twenty five at a time.

The provisions of sub-clause 44(b) shall not be applicable for liquefied petroleum gas when the total quantity of gas does not exceed 100 kg at a time for own use, distribution or sale from a sales room belonging to the dealer or distributor of respective oil marketing company.

Notwithstanding anything contained in rule 43, licence shall not be obligatory for working places where LPG cylinders are directly connected to the manifold, but the requirements of IS :6044 Part-1 shall be complied with, such manifold installations and shall be constructed adapting the sound engineering practices and the quantity of the LPG at any point of the time shall not exceed the limits prescribed in IS-6044 Part-1.

3.3 General Safety Precautions for Storage of Cylinders

- i) The gas cylinder storage shed must be located in an isolated area, as far as practicable.
- ii) The gas cylinder storage shed shall have roofing to protect from direct sunlight and have adequate ventilation.
- iii) Gas cylinders shall not be stored in exits or egress routes.
- iv) Gas cylinders shall not be stored in damp areas, near salt or corrosive chemicals, fumes, heat or in areas having exposure to the weather.
- v) The gas cylinder storage shed shall not be located close to any inflammable chemicals / fuel storage area / source of combustion activities / open flames / steam pipes.
- vi) Full and empty cylinders are to be stored separately.
- vii) The gas cylinders shall be stored in segregated manner, considering incompatibility [example bulk DA (Dissolved Acetylene) & bulk Oxygen; bulk Hydrogen & bulk Oxygen, bulk LPG & bulk Oxygen, toxic and flammable gas cylinders]. Incompatible gas cylinders must be stored at least at a gap of 3 meters.
- viii) Incompatible gas cylinders must not be transported together.
- ix) The store in-charge / supervisor shall maintain the up-to-date inventory of Gas cylinders.
- x) Other than notified gas cylinders, no other material of any kind shall be stored inside the area.

- xi) All the gas cylinders shall be kept in upright position with chaining to prevent accidental fall.
- xii) A system of marking of gas cylinders for their individual identification & record of their hydrostatic test to be maintained by custodian deptt.
- xiii) All gas cylinders shall be capped when not in use.
- xiv) All gas cylinders shall be stored so that cylinders are used in the order in which they are received.
- xv) The gas cylinder storage area shall not have any loose electrical cables, wires or lines in the vicinity.
- xvi) Do not keep cylinders in battery room or oil storage room.
- xvii) Adequate warning signs / labeling / no smoking caution / safety instructions shall be displayed in the gas cylinder storage area in legible manner.
- xviii) Display of Material Safety Data Sheet (MSDS) of the stored gas to be done at appropriate place in legible & in local language/ English.
- xix) Avoid storing cylinders in confined location with improper ventilation.
- xx) Oxygen and Fuel cylinders shall be kept separately.
- xxi) Restrict entry to the cellar, allowing only trained persons to enter and work there.
- xxii) Clean up spillages immediately to prevent slipping hazards.
- xxiii) Ensure the cellar has adequate lighting.
- xxiv) Avoid placing cylinders on uneven surface. The cylinder may fall, causing injury or damage.
- xxv) Explosive gases like hydrogen to be stored in separate sheds with proper fencing as per the guidelines.
- xxvi) Acetylene and LPG must never be stacked horizontally in storage or in use.
- xxvii) Regularly check for leakages, if any.
- xxviii) Depending on the properties of gases stored, maintain proper temperature in the storage area, avoiding excessive or low temperature build up.

3.4 Handling and Usage

- i) Gas Cylinders shall be handled only by properly trained persons. Training must include the contents of this guideline as well as any specific information relevant to the gas being used. While handling cylinders, the cylinder shall not be dragged or rolled.
- ii) Instructions shall be issued to all suppliers for mandatory affixing of cap guards, providing color coding and warning sticker as per Gas Cylinder Rules, 2016. In addition, supplier shall issue Test and Inspection Certificates.
- iii) Do not issue a cylinder unless contents are clearly identified.
- iv) Do not alter the color coding and marking of Gas Cylinders, as given below.

Type of Gas Cylinder	Color of cylinder shell	Color of the band at the neck end of the cylinder
Non-flammable & non-toxic	White	--
Non-flammable but toxic	White	Yellow
Flammable but non-toxic other than LPG	White	Red
Flammable and toxic	White	Red and Yellow
Gas mixture	Major gas colour	Minor gas colour with and width approximately 1/5th of the cylinder length
Fire Extinguishers	Red	Red

- v) Do not use cylinders as rollers, work supports or jacks (dropping or playing with cylinders shall be strictly prohibited.)
- vi) Transporting of cylinders by rolling them over the ground / floor / surface is strictly prohibited.
- vii) Transporting of cylinders by dragging / sliding / pulling them from their nozzles is strictly prohibited.
- viii) Local movement of cylinders shall be done either by placing them over proper trolleys or by carrying them over the shoulders.
- ix) Prevent damage to cylinders. Locate cylinders where they will be protected from physical damage by striking or falling objects, corrosion or damage from public tampering.
- x) Containers shall not be used for any other purpose than holding the contents as received.
- xi) Damaged or leaking cylinders must be reported immediately for proper disposal. Cylinders shall not be picked up by pulling the cap. Any leaking cylinder must be handled as per guidance provided in section 3.7.
- xii) Magnets shall not be used for lifting cylinders.
- xiii) Lowering & lifting of cylinders shall not be done manually. It shall be done by mechanized means (using winch, telfer, crane etc.) with proper cage for holding the cylinders.
- xiv) Where appropriate lifting attachments have not been provided on the cylinder/ container, suitable cradles or platforms to hold the containers shall be used for lifting.
- xv) Do not use welded cylinders.
- xvi) Leaking, defective, fire burned and corroded containers shall not be used.
- xvii) Do not use chain slings for lifting cylinders; only fiber sling should be used.
- xviii) Do not allow cylinders to come in contact with electrical apparatus or live wires.
- xix) Do not lay gas cylinders on wet soil.

- xx) Do not lubricate cylinders valve threads.
- xi) Do not handle cylinders or valve assemblies with greasy hands or oil rags.
- xii) Oil or grease shall not come in contact with the cylinder valve assembly or the regulator fittings.
- xiii) Use red hose for acetylene and other fuel gases and black / green hose for oxygen. Never interchange hoses.
- xiv) To train workmen to handle and store cylinders properly and in case of any problem, it has to be capped and sent back to the supplier.
- xv) Nozzle tips shall be always kept clean to prevent back fire.
- xvi) Use hoses of equal length and do not coil the hoses around regulator or cylinder.
- xvii) Ensure that regulator pressure control valve is relieved (i.e. closed) before attaching to tanks.
- xviii) Close valves on gas cylinders when a system is not in use.
- xix) Remove all pressure from regulators not currently used (by opening equipment valves downstream after the regulators are closed).
- xx) Shut-off valves must not be installed between pressure relief devices and the equipment they are to protect.
- xxi) Use pressure relief valves in downstream lines to prevent high pressure buildup in the event that a regulator valve does not seat properly and a tank valve is left on.
- xxii) Relief valves should be vented to prevent potential buildup of explosive or toxic gases.
- xxiii) Never allow flames or concentrated heat sources to come in contact with a gas cylinder.
- xxiv) Never allow a gas cylinder to become part of an electrical circuit.
- xxv) Never partially open a tank valve to remove dust or debris from the cylinder inlet.
- xxvi) Never use cylinder gas as compressed air.
- xxvii) Pressurize the regulators slowly and ensure that valve outlets and regulators are pointed away from all personnel when cylinder valves are opened.
- xxviii) Cylinders which require a wrench to open the main valve shall have the wrench left in place on the cylinder valve while it is open. Use adequately sized wrenches (12" long) to minimize ergonomic stress when turning tight tank valves. Never apply excessive force when trying to open the valves. Cylinders with "stuck" valves should be returned to suppliers to have valves repaired.
- xxix) Do not attempt to open a corroded valve; it may be impossible to reseal.

- xli) Valves should only be opened to the point where gas can flow into the system at the necessary pressure. This will allow for quicker shutoff in the event of a failure or emergency.
- xlii) Use a cylinder cap hook to loosen tight cylinder caps. Never apply excessive force or pry off caps. Return to supplier to remove "stuck" caps.
- xlii) Keep piping, regulators and other apparatus gas tight to prevent gas leakage.
- xliii) Confirm gas tightness by using compatible leak test solutions (e.g., soap and water) or leak test instruments.
- xliv) Release pressure from systems before connections are tightened or loosened and before any repairs.
- xlv) Never use adapters or exchange fittings between tanks and regulators.
- xlvi) Ensure flash arrestor in both cylinder & torch sides for cutting purpose.
- xlvii) Gas isolation shall not be done by kinking / twisting the flexible hose. In case the same is done then the hose shall not be re-used.
- xlviii) Flame proof light / electrical fittings shall be used in "storage areas".
- xlix) Follow proper procedures and use the right equipment, including safety goggles, safety jackets, heavy-duty gloves and protective footwear.
- I) Avoid placing cylinders on uneven surface. The cylinder may fall, causing injury or damage.
- ii) Ensure the area has adequate lighting.
- iii) Never use gas cylinders for the purpose for which they are not intended.

3.5 Manifolds, Valves and Regulators

The following information applies to the use of manifolds, valves and/ or regulators:

- i) Where compressed gas containers are connected to a manifold, the manifold and its related equipment, such as regulators, shall be of proper design for the product(s) they are to contain at the appropriate temperatures, pressures and flows.
- ii) Use only approved valves, regulators, manifolds, piping and other associated equipment in any system that requires compressed gas. Care must be taken to ensure that pressure gauges on regulators are correct for the pressure of the gas cylinder used.
- iii) Valves and regulators should undergo periodic maintenance and repair. A visual inspection should be performed before each usage to detect any damage, cracks, corrosion or other defects. Long term maintenance or

replacement periods vary with the types of gases used, the length of use, and conditions of usage.

- iv) Valves and regulator maintenance histories should be known before usage. Valves that pass visual inspection are still subject to failure, therefore it is critical that toxic or poisonous gases are used in ventilated enclosures and have local exhaust ventilation in place for downstream pressure relief valves, etc.
- v) Valves and regulators should only be repaired by qualified individuals
- vi) Display the license no. at the main entrance of cylinder storage area if the number of industrial LPG cylinders stored is more than five.

3.6 Gases with specific hazard classes

The following information regarding specific classes of gases is offered as additional guidance to be used in conjunction with the general usage requirements listed previously:

- i) Flammable Gases
 - a) Flammable gases, except for protected fuel gases, shall not be used near ignition sources. Ignition sources include open flames and sparks, sources of heat, oxidizing agents and ungrounded or non-intrinsically safe electrical or electronic equipment.
 - b) Portable fire extinguishers shall be available for fire emergencies. The fire extinguisher must be compatible with the apparatus and the materials in use.
 - c) Flames shall not be used for detecting leaks. A compatible leak detection solution shall be used for leak detection.

Flame shall not be used for detecting leaks. Leak detecting sensor to be installed in the basement area for getting signal in the control room based on preset PPM concentration level. Subsequently, a compatible leak detection solution shall be used for identification of leak detection points on piping/equipments.

Name of compatible leak detection solution to be indicated for ready reference & use.

- d) Spark proof tools shall be used when working with or on a flammable compressed gas cylinder or system.
- e) Access doors to areas which use or store flammable gases shall be posted "No Open Flames".
- ii) Fuel, High Pressure and Oxidizing Gases

Oxidizing gases are non-flammable gases (e.g., oxygen), but in the presence of an ignition source and fuel can support and vigorously accelerate combustion. Do not use oil in any apparatus where oxygen will be used.

iii) Toxic and Highly Toxic Gases

Unless otherwise indicated, all gases must be stored in a continuously mechanically ventilated gas cabinet, fume hood or other enclosure.

3.7 Handling leaks and emergencies

i) **Preplanning**

Despite strict adherence to safety practices, accidents involving gases may occur. Users of compressed gas cylinders must be familiar with necessary safety precautions. Standard Operating Procedures (SOPs) for using compressed gases shall include a discussion of possible accident scenarios, appropriate employee responses and should take into account the following factors:

- a) The nature of the operation (e.g. equipment used and type of injury that might be inflicted).
- b) The quantities of material that might be released and the type of containment (i.e. compressed gas tank size, manifold systems, etc.).
- c) The chemical and physical properties of the compressed gas
- d) The hazardous properties of the compressed gas (e.g. its toxicity, corrosivity and flammability).
- e) The availability and locations of emergency supplies and equipment.
- f) A contingency plan which identifies building evacuation routes, emergency telephone numbers, chemical containment procedures, fire extinguisher usage, etc., should be posted at the site

ii) **Minor Leaks**

Occasionally a gas cylinder or one of its component parts may develop a leak. Most of these leaks occur at the top of the cylinder in areas such as the valve threads, pressure safety device, valve stem and valve outlet. The following information applies to the remediation of minor leaks:

- a) If possible, verify suspected leaks using a flammable gas detector or soapy water solution (a flame should not be used for detection). If the leak cannot be stopped by tightening a valve gland or packing nut, emergency action procedures should be initiated and concerned person should be notified.
- b) For flammable, inert or oxidizing gases, the cylinder shall be moved to an isolated & well-ventilated area away from combustible materials. Post signs that describe the hazard.
- c) For corrosive and toxic gases, the cylinder shall be moved to an isolated, well-ventilated area and use suitable means to direct the gas into an appropriate chemical neutralizer if possible.
- d) If it is necessary to move a leaking cylinder through populated portions of the

building, place a plastic bag, rubber shroud or similar device over the top and tape it (duct tape preferred) to the cylinder to confine the leaking gas.

- e) During shifting of the leaking cylinder, safety masks to be used by the personnel involved for shifting.

iii) Major Leaks

- a) In the event of a large gas release or if an accident takes place in which readily available Personal Protective Equipment (PPE) is inadequate to ensure worker safety, activate the following Emergency Procedures:
- b) Immediately call Fire Brigade and report the incident.
- c) Activate building and area fire alarms.
- d) Evacuate the area, securing entrances and providing assistance to others on the way out.
- e) Provide emergency response officials with details of the problem upon their arrival.

iv) Accidents Involving Personnel Injury

Assist persons involved and administer immediate first aid which may include:

- a) Washing under a safety shower (in case of burning clothing or chemical exposures).
 - b) Removing contaminated clothing.
 - c) Wash the eyes properly at eyewash station.
 - d) Administering artificial respiration.
 - e) Notify personnel in adjacent areas of any potential hazards (e.g. activate building or area alarms).
 - f) Move injured personnel only if necessary to prevent their exposure to further harm.
- v) Only authorised personnel should be allowed to repair cylinder and/or its cylinder valve.

References:

1. Gas Cylinder Rules, 2016
2. IPSS 1-11-029-17: Safety Standard on Storage, Handling & Use of Gas Cylinders in Steel Industry.

GAS CYLINDER STORAGE

	DANGER Compressed gas
	Keep well ventilated
	No smoking or naked flames
	No entry to unauthorised personnel

Industrial Gas Cylinder Safety Guidelines

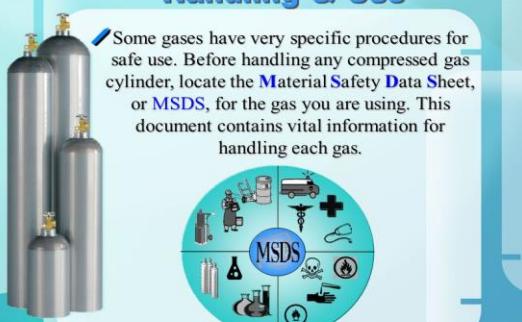
- Understand the Cylinder Properly
- Use the Personal Protective Equipment (PPE)
- Use Regulators Properly While Handling Cylinders
- Use Proper Handling Equipment to Move the Cylinder
- Inspect the Cylinders before Using Them
- Store the Cylinders Correctly





Safe Practices for Handling & Use

Some gases have very specific procedures for safe use. Before handling any compressed gas cylinder, locate the **Material Safety Data Sheet**, or **MSDS**, for the gas you are using. This document contains vital information for handling each gas.



Compressed Gas Cylinders

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	WORKING AT HEIGHT	Doc. No: SG/02
		Rev no. : 00 Effective Date : 14.10.2019

1. **Objective:** Falls are among the most common causes of serious work related injuries and deaths. The safety guideline aims to ensure safety while working at height (more than 2 meter height) and protection from fall.
2. **Scope:** This safety guideline covers general requirements for working at height, safe approaches viz. ladders, scaffolds, MEWP (Mobile Elevated Working Platform) etc. including safety requirements for Roof & side sheet changing work and is applicable for all sectors of Iron & Steel Industry.

3. Procedure

3.1 Definitions

- i. **Anchorage** – A secure point of attachment may or may not part of the work structure, to which lifelines, drop lines, or lanyards are affixed. An anchorage must be capable of supporting a minimum dead weight of **2000 kilograms** for every person attached to it. An anchorage not meeting the **2000 kilograms** requirement must be part of a complete personal fall arrest system which maintains a safety factor of at least two and is ascertained and used under the supervision of a qualified person. An anchorage is often a beam, girder, column, or floor.
- ii. **Travel restraints** - Travel restraint systems physically prevent a person from approaching an unprotected edge. The user is totally restrained from reaching a position where a fall is possible.
- iii. **Anchorage Connector** – A component or device that is installed on an anchorage and is specifically intended for attaching a fall-arrest system to the anchorage. Anchorage connection straps, carabiners, and girder grips rated to support minimum dead weight of 2000 kilograms can be purchased from fall-protection equipment manufacturers.
- iv. **Base Plate** A steel plate providing a flat bearing surface with a spigot or screw jack for distributing the load from posts (standards). It has an integral spigot and fixing holes for use with sills.
- v. **Bearer (Transom)** -A horizontal transverse scaffold member, that may support platform units, and which is supported by at least two runners (ledgers) or connected directly to at least two posts (standards).
- vi. **Brace** -A rigid connection of scaffold tubing that holds one scaffold member in a fixed position with respect to another member to give the scaffold rigidity.
- vii. **Bay**- The space between the centerlines of adjacent posts (standards) along the face of a scaffold
- viii. **Carabineer** – A trapezoid or oval-shaped connector component with a gate

or similar arrangement that remains closed until it is intentionally opened for connection or disconnection.

- ix. **Competent person** – A person/ engineer of the executing department performing the job , executing contractor ,& consultant if any, who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees, plant and who can take prompt, corrective measures to eliminate them.
- x. **Deceleration Device** – Any mechanism, such as a rope grab, rip-stitch lanyard, specially- woven lanyard, tearing or deforming lanyards, automatic self-retracting lifelines/lanyards, etc., which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limit the energy imposed on an employee during fall arrest.
- xi. **Descent Device** – A device or piece of equipment used to escape from an elevated structure such as a work platform, tower, column, or an overhead crane cab.
- xii. **Fall Hazard** – A condition or situation that could result in a fall.
- xiii. **Fallout** – An unintentional separation of a person from a body-support component during or after fall arrest.
- xiv. **Fall Prevention** – Eliminating fall hazards during all phases of work at heights, including access and egress. Examples of fall prevention measures include using complete scaffolds, aerial lifts, and secured ladders.
- xv. **Free Fall** – An un-arrested fall.
- xvi. **Harness (Full-Body)** – A device with straps that can be attached to a personal fall-arrest system. The straps are fastened around a person's body to contain the torso and distribute fall- arrest forces over at least the upper thighs, pelvis, chest, and shoulders.
- xvii. **Leading Edge** – The edge of a floor, deck, or grating that changes location as additional floor or deck sections are placed.
- xviii. **Lifeline** – A flexible vertical or horizontal line, secured to an anchorage or between two anchorages, to which a lanyard or harness may be attached.
- xix. **Lanyard** - A flexible line with a positive means to lock end connections closed (i.e., locking type snap hooks or carabiners with a self-closing, self-locking keeper) that is used to secure the wearer of a full body harness to a lifeline or a point of anchorage.
- xx. **Ladder** - A device used for climbing vertically between levels.
- xxi. **Outrigger** - The structural members of a supported scaffold used to increase the base width of a scaffold in order to provide support for and increased stability of the scaffold.
- xxii. **Positioning Device System** – Equipment that allows a person to work with both hands free while standing in such a way (for example, leaning backwards) that a fall could result. Positioning device systems are often used on framework construction and concrete rebar placement.

- xxiii. **Personal Fall-Arrest System** – A system used to arrest a fall from a working level. A personal fall arrest system consists of an anchorage, connectors, a body harness, and may include a lanyard with a locking snap hook, deceleration device, lifeline or suitable combination of these.
- xxiv. **Qualified person** – A person / engineer of the executing department performing the job, executing contractor & consultant if any, who by possession of a recognized degree certificate or professional standing or who by extensive knowledge, training , and experience , has successfully demonstrated his or her ability to solve or resolve problems related to the subject matter, the work or the project.
- xxv. **Retractable Lifeline** – A fall-arrest device that allows free travel without slack rope, but locks instantly when a fall begins. Retractable lifelines may be used when vertical movement is required but must be limited, such as in tanks, manholes, and pressure vessels, or on roofs.
- xxvi. **Rollout** – A process by which a snap hook or carabineer unintentionally disengages from another connector or object.
- xxvii. **Rope Grabs (Fall-Arrester)** – Automatic lifeline devices that act by inertia to grab the lifeline if a fall occurs. Rope grabs are used when vertical movement is required, such as work from boatswain chairs or suspended scaffolds.
- xxviii. **Self-Locking Snap Hook** – A hook-shaped connector with a gate or similar arrangement that remains closed and locked until it is intentionally opened for connection or disconnection. When the gate is released, it automatically closes.
- xxix. **Scaffold** - A temporary elevated platform (supported or under hung) and its supporting components (including ties) used for supporting workmen, materials, or both.
- xxx. **Shock-Absorbing Lanyard** – A flexible line that secures a person wearing a harness to an anchorage, anchorage connector, lifeline, or drop line, with an integral energy shock absorber that limits shock load forces on the body. Most energy shock absorbers are made of a webbing material with tear-away stitching designed to gradually absorb the fall-arrest load. A lanyard must have a nominal breaking strength of **2000 kilograms** and may be nylon or Dacron® rope, flexible aircraft steel cable, or webbing.
- xxxi. **Sole Board or Sole Plate**- A steel spreader used to distribute the load from a base plate to the ground.
- xxxii. **Tie** - Scaffold components installed to provide an anchor point for a scaffold to a building or structure, including tie tubes attached to the scaffold. Used to provide lateral stability to the scaffold.

3.2 Steps to take before working at height

- i) Check there is a safe method of getting to and from the work area.
- ii) Decide what particular equipment will be suitable for the job and the conditions on site.

- iii) Make sure work platforms and any edges from which people are likely to fall have guard rails and toe boards or other barriers.
- iv) Due considerations to be given for scaffolding and ladder standards. However as per site requirements and based on height & type of building/ structures proper sketch / scheme to be made. It is to be approved by a competent / qualified Engineer of the execution department performing the job. Make sure that the equipment needed is delivered to site in good time and that the site has been prepared for it.
- v) Check that the equipment and Body Harness is in good condition and make sure that whoever puts the equipment together is trained and knows what they are doing.
- vi) Make sure those who use the equipment are supervised so that they use it properly. The more specialized the equipment (for example, boatswain's chairs and rope access equipment or system), the greater the degree of training and supervision required to ensure safety.
- vii) Check any equipment provided by another company is safe on site before using it.
- viii) Find out whom to tell if any defects need to be remedied or modifications need to be made and keep them informed.
- ix) Make sure that tested equipment, systems etc. are used.
- x) When selecting a means of access:
 - a). Only when it is not practicable to provide a work platform with guard rails should other safe means of access (for example, boatswain's chairs or rope access techniques) be used;
 - b). Only when no other method is practicable, or risk assessment shows other methods are safer when work platforms cannot comply with all requirements for safe work (e.g. a guard rail has to be removed to land materials), should a way of arresting falls (for example, a harness and lines or nets) be relied upon;
 - c). If no other means of providing a safe place of work at height is available, then appropriately anchored harness should be worn. However, whenever harnesses are used a method must be available to enable people to be rescued from fall and be left suspended in their harness.
 - d). Nets may also be needed to protect those working to put guard rails or other protection in place. For overhead hot work fire proof nets are to be used in case nets are to be used.
 - e). Ladders should always be secured if possible both laterally & longitudinally at the ends. They should be primarily used for access and only be used as workplaces to do light work of short duration, and only if it is safe to do so. It is generally safer to use a stable tower scaffold or MEWP, Man lifter even for short-term work. Heavy work activity such as drilling or carrying heavy loads should never be carried out from a ladder. When using a ladder ensure that the ladder is as per standard drawings and the person on the ladder always has three points of contact, i.e. two legs and a hand. People should never have to lean sideways when up a ladder.
 - f). When selecting a safe system of work at heights, all the risks have to be

considered before one method is selected. For example, if nets are selected, is there adequate clearance under the nets to prevent injury to those who may fall into them? If harnesses are used, is there sufficient clearance from the ground to allow the shock absorbing lanyard or inertia reel to fully extend?

- xi) Before any work at height, check that there is adequate clearance for equipment. For example, overhead power lines can be a risk when erecting scaffolds or using MEWPs; there can be a risk of crushing against nearby structures when mobile access platforms are maneuvered.
- xii) Work permit for working at height shall be issued as per suggested checklist given in [Annexure-I](#).
- xiii) Before starting the day's work, the site shall be inspected by the executing officer for ensuring compliance of all safety aspects. After ensuring compliance of all safety aspects, the Contractor, the Executing Officer and the Authorizer should sign the above document given at giving clearance for starting the work. In the event of discontinuation of the work and before re-starting, the site inspection shall be re-done, as above by the executing officer.
- xiv) Following checks shall be carried out before issuing permit.
 - a) Personnel skill
 - Whether the Person is a certified rigger.
 - Whether Person is fit for working at height (ask for certificate from Doctor whether the person has vertigo-height phobia, for working at height more than 2 meter).
 - Person is trained on working at height.
 - Person is having valid height pass issued by SED (Safety Engg. Department) after completion of safety induction and verifying the medical fitness.
 - b) Suitability of approach.
 - Physical condition and suitability of steps, rung ladders.
 - Scaffolding ,ramps, stairs with respect to load
 - c) Suitability of platform
 - Whether handrails provided at 1.0 meter height with top rail middle rail and toe guard.
 - Whether extended support roof/working platform fabricated or available.
 - Whether secondary support provided while working at fragile or hazardous roof.
 - d) Availability of PPE and tools.
 - Helmet with chin strips, in working condition.
 - Full Body Harness with double lanyard with arrangement for life line support.
 - Fall arrester.
 - Manila rope used as lifeline or for any other purpose shall be checked

before each application, when it is in use. Diameter to be ascertained before use and to be certified by a competent & qualified Engineer of the department executing the job. The test procedure for manila rope will be same as being followed for all other construction tools & tackles.

e) Communication.

- Tools, tackles, figures, fasteners, cages, rope ladders, plant & machinery, cranes etc. to be used must be tested prior to use.
- Appropriate anchorage points identified / connected.
- Hazard of nearby work vicinity has been identified like, power line, power mobile equipment, gas line, etc. and proper care has been taken and same communicated to persons expected to work at height.
- Operator of mobile equipment in the close vicinity informed about job being done.
- Area on ground beneath the height where job is being executed has been properly barricaded/fenced indicating danger.
- Concerned departmental personnel whose work may get affected by the job have been identified and communicated.
- Loose material not to be kept at heights
- Damaged, torn, bend scrap sheets not to be used on platforms.
- Materials at heights are kept in arranged manner to avoid slip/trip/fall hazards.
- Tools, tackles, consumables, holders etc are kept tied to avoid their fall.

f) Any work at height shall be carried out only in presence of skilled supervisor.

g) Only trained persons shall be allowed to work at height.

h) Permit shall be issued only if the findings of the above checks satisfy the issuing authority.

i) If working at height includes gas cutting and welding, working in gaseous hazardous area, near electrical installation, work permit should be obtained from authorized agencies separately for each hazard.

j) Work permit shall be returned daily after completion of job.

k) Work at height shall be permitted only when a reasonable level-of natural sunlight is available as per the discretion of the contractor, the executing officer and the Authorizer. The work shall not be permitted in inclement weather conditions like, Heavy Rain, Lightning, scorching heat, Thunder storm, high wind velocity etc. When work at height is done indoors, there shall be adequate illumination.

l) Underneath area to be barricaded for providing protection against hazards due to falling objects.

m) Adequate Safety signage's / caution board to be conspicuously displayed for alerting personnel about imminent hazards.

n) Workers must leave their personal mobile phones prior to proceeding to

the work site(s) to avoid getting distracted to respond to phone calls which may lead to accidents. However workers may carry only authorised walkie-talkies for communication with supervisors.

- o) Toolbox talk / safety talk to be imparted to all personnel engage in height job and a record of same to be maintained. Toolbox talk should cover the JSA topics.
- xv) Adequate electrical safety measures shall be undertaken to eliminate risk of electric shock while working at height.
- xvi) Attack of honey bees on working persons at height in Iron & Steel sector is a common incident and at times it proves to be fatal. To ward off honey bees' attack and protect the working persons following safety measures should be taken up.
 - a) Beehives should be dismantled and suitable bee repellent should be sprayed at the location of beehives before the start of work in the area.
 - b) Blankets should be provided in sufficient numbers at a safe and secured place near the working area for quick access in the event of honey bees' attack.
- xvii) Extreme caution shall be exercised to avert risk of egress of dust, ash, gas, etc. while working at height at Bunker / Silo top / sides.
- xviii) If working on critical equipment at height on inclined as well as confined areas is unavoidable, then adequate protection such as multiple fall arrest system, lifeline, etc. must be undertaken to avert slipping
- xix) While working at height within confined spaces (such as Condensers) adequate protection such as multiple fall arrest system, lifeline, etc. must be undertaken to avert falls.

3.3 Systematic Approach to Continuous Fall Protection

Every site must take a three-step, systematic approach to protecting people from falls.

- i) **Eliminate Fall Hazards** – The first step in this approach is to assess carefully the workplace and the work itself in the earliest design/engineering stages of project work and during the planning stages of all work. The objective is to eliminate all fall hazards. Ask “who, what, when, where, why, how, and how much” questions about each possible exposure to a fall. This assessment of the site and the work not only helps eliminate hazards, but also identifies alternative approaches to the work that can measurably enhance productivity. Addressing fall protection in the early phases of a project means that safety can be designed into the work process, not added as an afterthought to an inherently unsafe work procedure. For example, the project can be designed so that structural steel can be assembled at grade and then raised as a “module,” thus eliminating a significant amount of work at heights.
- ii) **Prevent fall** – The second step in continuous fall protection also requires assessing the workplace and work processes. If fall hazards cannot be completely eliminated during the first step, try to prevent falls by improving the workplace. Avoid relying on a worker's behavior or fall-arrest equipment to prevent injuries. Early installation of stairs, guardrails, barriers, and travel

restriction systems can ensure a safe work environment.

- iii) **Use the Proper Fall-Arrest Equipment** – The third step, the last line of defense against falls, is to use fall-arrest equipment. Use fall-arrest equipment, however, only after determining that potential falls cannot be eliminated by changing work procedures or the workplace. Equipment such as harnesses, lanyards, shock absorbers, fall arresters, lifelines, anchorages, and safety nets can reduce the risk of injury if a fall occurs. Carefully assess the workplace and work processes to select the most appropriate equipment and to install and use it correctly.

Before using a personal fall arrest system, the supervisor and/or the user must address the following questions:

- a) Has the user been trained to recognize fall hazards and to use a personal fall-arrest system properly?
- b) Are all components of the system compatible according to the manufacturer's instructions?
- c) Have appropriate anchorage points and attachment techniques been reviewed?
- d) Has the free-fall distance been considered so that a worker will not strike a lower surface or object before the fall is arrested?
- e) Have pendulum-swing fall hazards been eliminated?
- f) Have safe methods to retrieve fallen workers been planned?
- g) Have the full-body harness and all of its components been inspected both before each use and on a quarterly basis?
- h) Is any of the equipment, including lanyards, connectors, and lifelines, subject to such problems as welding damage, chemical corrosion, or sandblasts?

Retractable Lifelines – A retractable lifeline is a fall-arrest device used in conjunction with other components of a fall-arrest system. A retractable lifeline should be used by only one person at a time. The retractable lifeline must be connected directly to the back D-ring of the safety harness and never used in conjunction with or connected to a shock absorbing lanyard. A properly inspected and maintained retractable lifeline, when correctly installed and used within the fall-arrest system, automatically stops a person's descent in a short distance after the onset of a fall. Consider using retractable lifelines when working in or on areas such as roofs, scaffolds, tanks, towers, vessels, and manholes. Also, consider using retractable lifelines when climbing such equipment as vertical fixed and portable ladders and telescoping derricks. The retractable lifeline must not be used again after it has worked as fall arrester once. Before using a retractable lifeline, the supervisor and/or the user must address the following questions:

- a) Has the user been trained to use a retractable lifeline correctly?
- b) Is the retractable lifeline being used in conjunction with a correctly configured fall arrest system?

Safety Net Systems – A safety net system is the least desirable fall-arrest system. If used below a work area where no gas cutting & welding jobs

involved, the system must be installed as close as practical under the walking or working surface. For over head gas cutting & welding, fire proof tested nets are to be used, otherwise all other means of fall arrest systems are to be used strictly. A safety net system must never be more than 30 feet (9.1 m) below the working surface (except for bridge / gallery / structural frame construction). Safety nets shall be capable of absorbing an impact force equal to that produced by a drop test. The test if practicable & safe to drop bag of sand as specified, shall be conducted by dropping a 400-pound (180 kg) bag of sand 30 ± 2 inches (76 ± 5 cm) in diameter into the net from the highest walking or working surface at which employees are exposed to fall hazards. The drop distance shall never be less than 42 inches (1.1 m) above the net level. A drop test must be conducted after initial installation and before use, whenever relocated, after major repair, and at six-month intervals if left in one place. Safety nets shall be inspected at least once a week for wear, damage, and other deterioration. Materials, scrap pieces, and equipment and tools, which have fallen into the safety net, shall be removed as soon as possible but at least before the next work shift. Before using a safety net, the supervisor and/or the user must address the following questions:

- a) Are workers protected from fall hazards while they install and dismantle the safety net system?
- b) Is the safety net installed as close as practical under the working surface? Except for Bridge / gallery / structural frames at height.
- c) Is there sufficient clearance under the net to prevent contact with surfaces or objects below if the net is subjected to an impact equal to that imposed under the required drop test?
- d) Does the safety net extend beyond the outermost projection of the work surface? For vertical distances of up to 5 feet (1.5 meters) between the net and the work surface, the minimum required horizontal distance from the net's outer edge to the working surface edge is 8 feet (2.4 meters). For vertical distances between 5 and 10 feet (1.5 meters and 3 meters), the horizontal requirement is 10 feet (3 meters). For vertical distances greater than 10 feet (3 meters), the horizontal requirement is at least 13 feet (4 meters).
- e) Are the safety net supports designed so that a fall victim will not land on them?
- f) Has the manufacturer or supplier of the net been consulted for assistance and recommendations concerning the proper type of net and proper installation and testing?

In case of site requirement of non-placement of the safety net and non-feasibility of adequate fastening and fixing the net, all other means of fall arrest system and fall hazards controlling measures are to be taken strictly.

Lifeline Installation – Horizontal and vertical lifelines shall be designed, installed, and used under the supervision of a qualified person as part of a complete personal fall arrest system. Horizontal lifelines allow horizontal movement while providing protection against falls provided the equipment is properly installed and used. A horizontal lifeline may serve as a mobile fixture point for the attachment of lanyards, lifelines, or retractable lifelines. A lifeline

must be wire rope of at least $\frac{1}{2}$ inch (1.20-centimeter) diameter, not more than two persons shall be permitted to attach their lanyards to a single horizontal life line, at one time. The lifeline shall be anchored between two posts/supports not more than six meter apart. If intermediate post required to be put at spacing more than 6 m , proper anchoring, post/support and life line arrangement to be made as per sketches with approval of competent & qualified Engineer of the executing department performing & supervising the job.

Vertical lifelines extend from an overhead independent anchorage and should be maintained in a vertical position while in use. A lanyard is attached to a vertical lifeline using a rope grab device. No more than one person may tie-off to a vertical lifeline.

Anchorage – Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms. Anchorages must be capable of supporting at least 2000 kilograms per employee attached, or shall be designed, installed, and used as follows:

- a) Part of a complete personal fall arrest system that maintains a safety factor of at least two.
- b) Under the supervision of a competent & qualified person.
- c) The anchorage points are to be certified by a competent & qualified Engineer of the department executing & supervising the job.

Standard Harnesses: Harnesses for general purpose work should be constructed with back D-ring, integral hip D-rings for work positioning capability, and tongue-buckle thigh straps. Standard harnesses are suitable for continuous fall protection while climbing, riding, or working on elevated platforms. They are suitable for positioning, fall arrest, and the rescue and evacuation of people who are working at heights.

Standard Lanyards: Lanyards should not be less than 10 mm in dia. adjustable up to 6 feet (1.8 meters). They should also have shock-absorbing capability and self-locking snap hooks. Only double lanyard safety belt is permitted. Only nylon or polyester or synthetic fiber lanyards shall be used. It shall not break under a minimum tensile load of 2000 Kg. The lanyard shall meet the requirement of IS 3521.

3.4 Safe Approaches for working at heights

i) Steel Scaffold

Some important points to remember when dealing with mobile scaffolds include:

- a) They should be erected, maintained, altered and dismantled by a certificated scaffold er of the correct class if they are more than five meters in height.
- b) They should be erected, maintained, altered and dismantled by a competent person if less than five meters in height.
- c) They should be erected to the manufacturer's instructions.

- d) They should be used on a sound, clear and level surface.
- e) Ensure working platforms are decked to the full width and adequately restrained against displacement.
- f) Ensure top and mid guardrails are erected on platforms.
- g) Erect platform toe boards to prevent items on the platform falling on people below.
- h) Provide safe means of access to work platforms.
- i) Where the platform incorporates a hatch door, ensure the hatch is closed except during access or egress.
- j) Where the scaffold platform is above a public thoroughfare, and due to the nature of the work falls of material are possible with injury to passers-by, special precautions (screens / nets) must be taken.

ii) Scaffold Materials

- a) The components used to assemble scaffolds shall be inspected before each use and shall conform to requirements of this section regarding materials, strength, dimensions, etc.
- b) Scaffold components manufactured by different manufacturers shall not be intermixed unless the components are compatible (fit together without mechanical force) and the scaffold's structural integrity is maintained. Scaffold components manufactured by different manufacturers shall not be modified in order to intermix them.
- c) Scaffold components shall be free from detrimental corrosion.
- d) Any scaffold component that is obviously damaged, excessively corroded, defective, or does not meet the applicable codes and standards shall be marked and be immediately destroyed and shall not be re-used on the project site. However, if possible, defective sections of planks or tubing may be cut off. In this case, the plank or tubing may be reused.
- e) Scaffold components made of dissimilar metals shall not be used together because of the potential for galvanic corrosion.
- f) Scaffold components shall not be exposed to acids or other corrosive substances, unless adequate precautions have been taken to protect the scaffold from damage.
- g) Where a built-in ladder is part of a scaffold system, it shall conform to the requirements for ladders (IS: 3696, Pt-II).
- h) Scaffold components shall be properly stored to prevent damage.

iii) Scaffold Foundation

- a) Foundations shall be sound, rigid, and capable of carrying the scaffold self-weight plus the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick or concrete blocks shall not be used to support scaffolds, planks, or timber sills.
- b) A sound base is essential. Therefore, the ground or floor on which a scaffold stands shall be carefully examined for its load-bearing capacity.

Sand or made-up ground (fill) may need compacting to ensure there are no cavities. Such bases as floors, roofs, etc. may need shoring from underneath.

- c) Timber sills (sole boards) at least 225 mm (9 inches) wide by 38 millimeters (1-1/2 inches) thick shall be used to spread the load on sand, made up ground, asphalt pavement, wooden floors, and other soft or slippery surfaces. The ground beneath sills shall be level and compact. A sill shall extend under at least two posts (standards), unless not feasible because of uneven or sloping ground. In this case, sills under individual posts (standards) shall be at least 765 mm (30 inches) long. Scaffold planks shall not be used as sills.
- d) All scaffold posts (standards) shall be pitched on steel base plates at least 150 millimeters (6 inches) by 150 millimeters (6 inches) and 6 millimeters (1/4-inch) thick. For Special Scaffolds, the base plate shall be designed to support the maximum scaffold post (standard) load. Timber sills shall be used where base plates may be exposed to corrosive materials.
- e) Screw jacks shall be used to compensate for variations in ground level. Screw jacks shall not be adjusted to more than two-thirds of the total length of the threaded section. Screw jacks shall be used and loaded in accordance with the manufacturer's specifications.
- f) Front-end loaders, forklifts, or pieces of equipment shall not be used to support scaffolds.
- g) Scaffolds shall not be hung from or supported by guardrails or handrails.
- h) A crane or other lifting device shall not lift any scaffold, unless it's a Special Scaffold specifically designed for lifting and the scaffold plan was reviewed in accordance with the requirements of the standard practices.

iv) Scaffold Stability

All freestanding scaffolds, whether mobile or static, need to be stabilized against overturning forces. Mobile scaffolds in particular are prone to tip over during use for a variety of reasons, including:

- a) Sudden stops while being moved. This is a key reason why they must not be ridden while being moved.
- b) Height to the top most platforms is greater than three times the minimum base dimension.
- c) People standing at or near the edge of the platform in conjunction with a sudden movement or action. This creates a temporary high point loading.
- d) Capacity being based on a distributed load, not a point load at the edge. This means overturning can occur even when the design load capacity of the platform is not exceeded.
- e) The narrower and lighter the scaffold, the more likely that it will tip over.

v) Scaffold Platform and Decking

- a) The decked width must be not less than 700 mm, with sufficient additional width to leave 450 mm minimum clear walkway at all times. The distance

between the outer edge of the platform to be guarded and the projection of the inner vertical face of a guardrail must not exceed 200 mm.

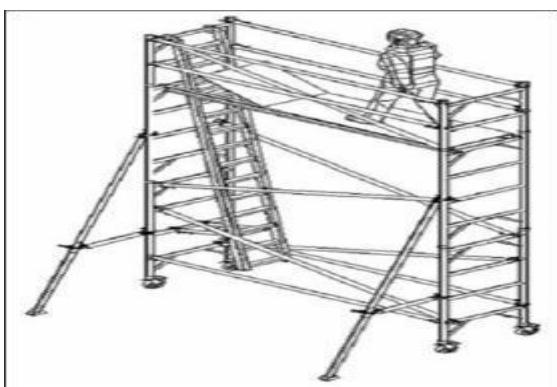
- b) Scaffold planks must be so placed, locked or secured as to prevent tipping or displacement during normal use, or movement by strong wind. End overhang must be 80 mm minimum to 220 mm maximum.
- c) It is good practice to butt planks in a decked platform. When butted, each end bearing shall be not less than 75 mm.
- d) When lapped, the amount of overlap must be not less than 150 mm. Decking planks which are lapped must be fitted with wedge cleats or fillets to reduce the risk of tripping or facilitate the wheeling of loads.
- e) Every working platform must be decked as close as practicable to the working face of the structure it is being used with. Where the height is greater than 3 m, a guardrail or other protection must be provided within 200 mm of the outer edge of the plank.

vi) Scaffold Guardrails , Midrails and Toe board

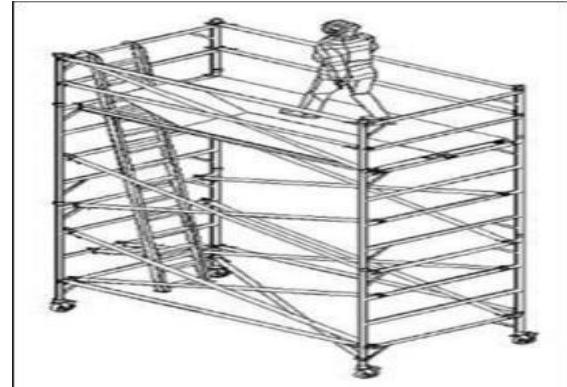
- a) Guardrails, including Midrails, must be provided on the exposed sides and ends of all Working platforms more than 3 m in height. The height to the top of the guardrail must be not less than 0.95 m or more than 1.1 m from the deck to be protected.
- b) A midrail is required on a working platform which should be placed exactly half of the height of the top rail.
- c) Each rail, when secured to the standards or upright members, must be capable of sustaining without failure or undue deflection a force at any point of 70 kg (690 N) vertical and horizontal, acting separately
- d) A toe board of 150 mm minimum height should be provided for protection against fall of materials from the platform.

vii) Scaffold- Clearance from Electrical Lines

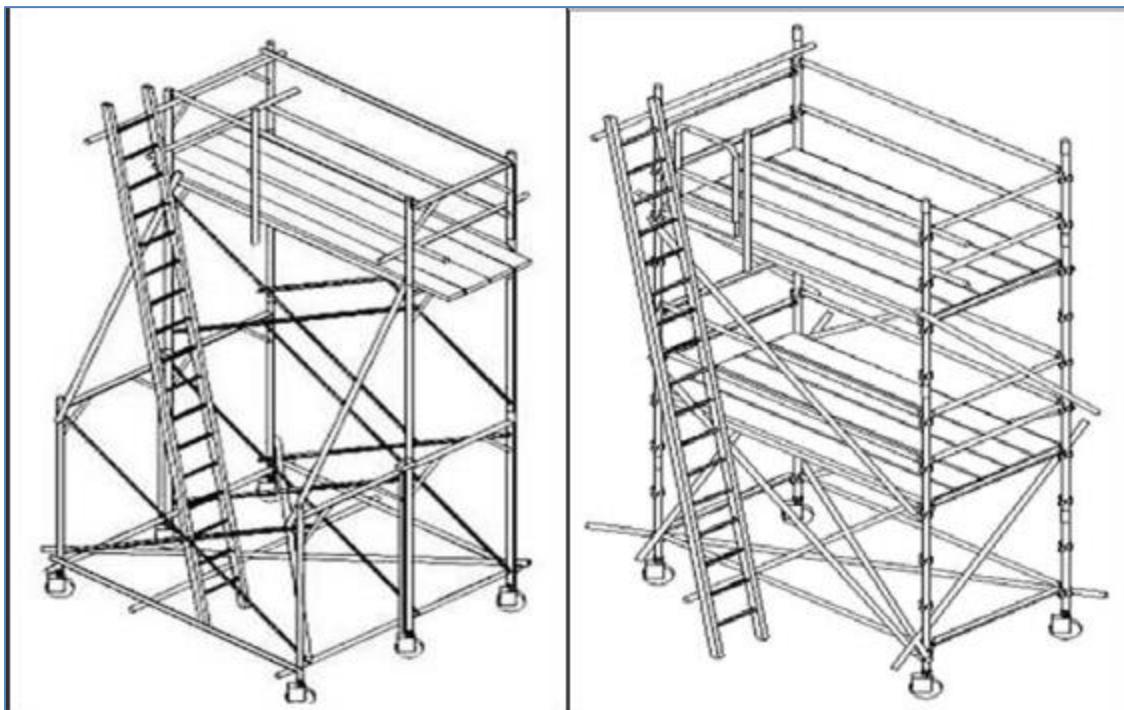
Voltage	Safe Clearance
750-15, 000 Volts	3.0 meter
15, 001-250, 000 Volts	4.5 meter
Over 250, 000 Volts	6.0 meter



Double deck width mobile scaffold

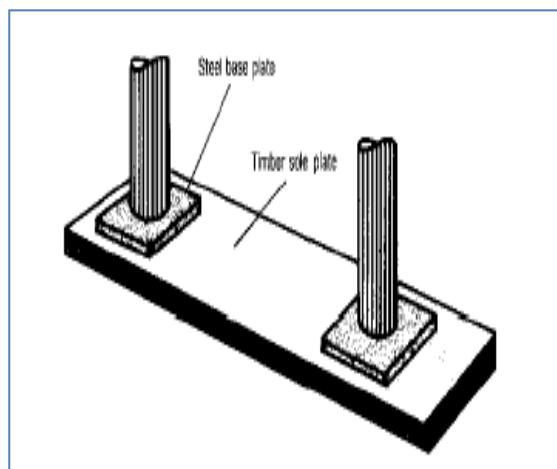


Five deck wide mobile scaffold

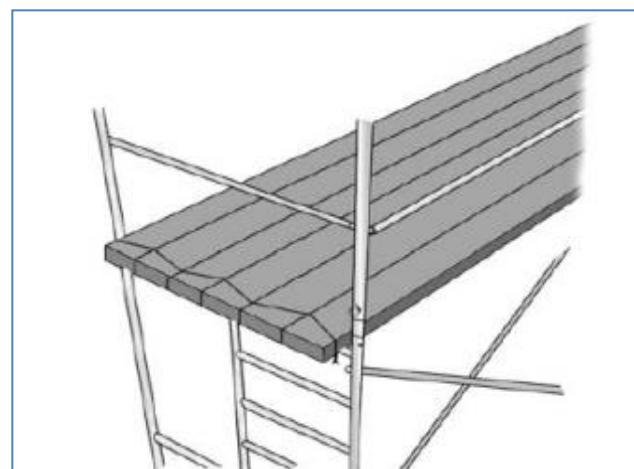


Frame mobile tower

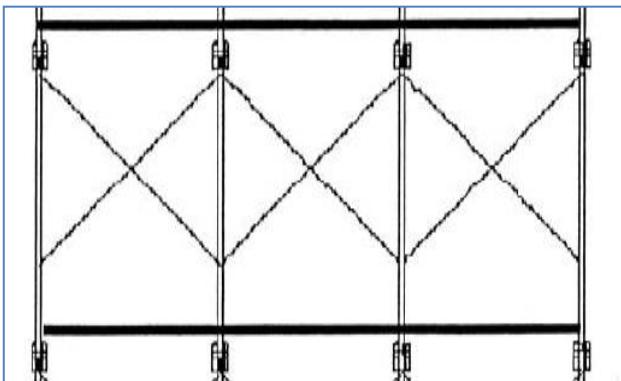
System mobile tower



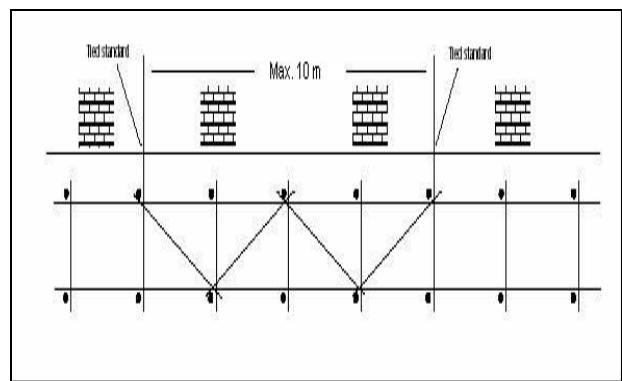
Use of base plate and sole board



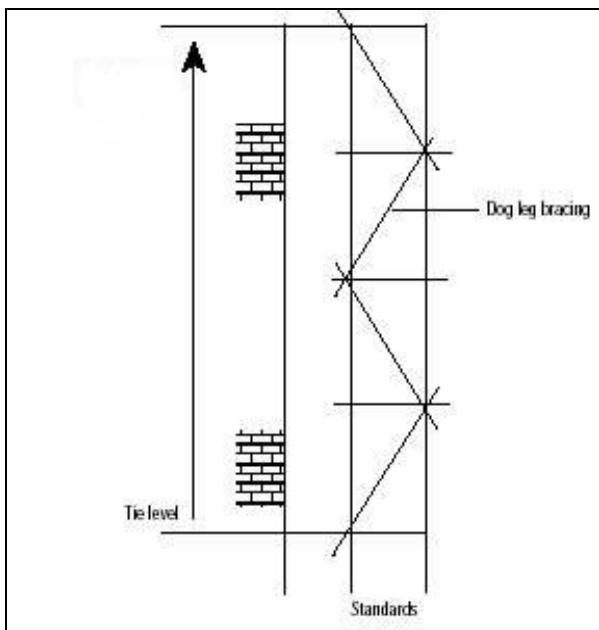
Platform Decking



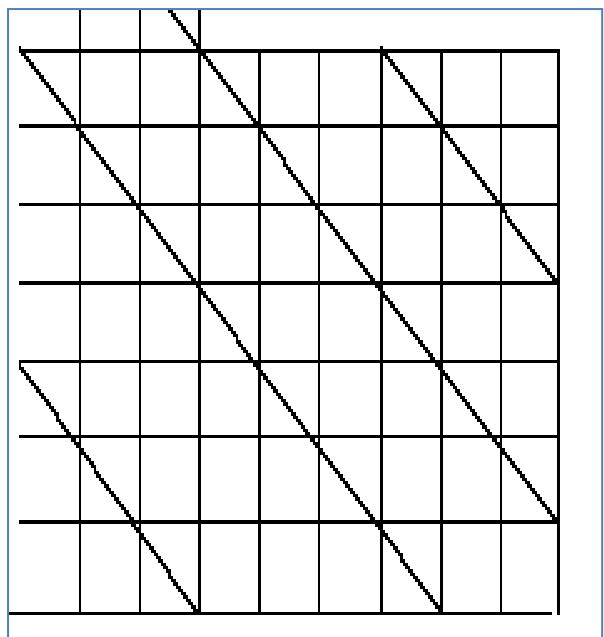
Cross Bracing



Plan bracing



Dogleg bracing



Diagonal bracing

viii) Approach Ladders & Staircase:

a) General points for Proper Use of Ladders

- Check the ladder for defects at the start of a shift, after it has been used in another location by other workers, or after it has been left in one location for a lengthy period of time (inspection procedures)
- Areas surrounding the base and top of the ladder should be clear of trash, materials and other obstructions since getting on and off the ladder is relatively more hazardous than other aspects of use.
- The base of the ladder should be secured against accidental movement. Use a ladder equipped with non-slip feet appropriate for the situation, nail a cleat to the floor, or otherwise anchor the feet or bottom of the side rails.
- The ladder must be set up on a firm level surface. If its base is to rest on soft, uncompacted or rough soil a mud sill should be used.

- The top of the ladder should be tied off or otherwise secured to prevent any movement. If this is not possible, given the type of ladder or circumstances of its use, one worker should hold the base of the ladder while it is being used.
- If a ladder is used for access from one work level to another, the side rails should extend a minimum of 914 millimetres (3 feet) above the landing. Grab rails should be installed at the upper landing so that a worker getting on and off the ladder has secure handholds.
- All straight or extension ladders should be erected at an angle such that the horizontal distance between the top support and the base is not less than one-quarter or greater than one-third the vertical distance between these points.
- Before setting up straight or extension ladders, check the area for overhead power lines. Ladders made of aluminum or other conductive material should never be used near power lines. Only competent electricians and linemen using ladders made of non-conductive material are allowed to work in close proximity to energized electrical lines.
- Portable ladders should never be used horizontally as substitutes for scaffold planks, runways or any other service for which they have not been designed.
- When a task can only be done while standing on a portable ladder, the length of the ladder must be such that the worker stands on a rung no higher than the fourth from the top. The ladder should also be tied off or equipped with a suitable stabilizer.
- Short ladders must never be spliced together to make a longer ladder. Side rails will not be strong enough to support the extra loads.
- Straight ladders should not be used as bracing, skids, storage racks or guys. They were not designed for these purposes and the damage caused by such abuse can later result in an accident during normal use.
- Unless suitable barricades have been erected, ladders should not be set up in passageways, doorways, driveways or other locations where they can be struck or displaced by persons or vehicles using the access route.
- Only one person at a time should be allowed on a single width ladder. In the case of a double-width ladder, no more than two people should be allowed on it at one time and each should be on a separate side.
- Ladders should not be placed against flexible or movable surfaces.
- Always face the ladder when climbing up or down and when working from it.
- Maintain 3-point contact when climbing up or down a ladder. That means two hands and one foot or two feet and one hand on the ladder at all times. This is especially important when you get on or off a ladder at heights.
- When working from a ladder, keep your center of gravity between the side rails. A person's center of gravity is approximately in the center of the body at belt height. The location of your center of gravity can shift when you reach out to either side of a ladder, especially with materials, tools or equipment in your hands. As the center of gravity of your body and hand-held objects moves beyond the side rails, the ladder is tending toward instability.

- Whenever, possible, avoid climbing up or down a ladder while carrying anything in your hands. Tools, equipment and materials should be placed in a container and raised or lowered by rope, if necessary.
- Workers should be instructed and frequently reminded to keep their boots free of mud, snow, grease or other slippery materials if they are using ladders.
- Always hold onto the ladder with at least one hand. If this is not possible because of the task to be done and in particular if the work is 3 metres (10 feet) or more above the floor, the worker should wear a safety belt and tie the lanyard off to the structure before beginning work.
- Never straddle the space between a ladder and another object.
- Persons frequently required using or work from ladders should wear protective footwear with soles and heels made of slip-resistant materials such as soft urethane.
- Never erect ladders on boxes, carts, tables or other unstable surfaces.
- Fall-arresting equipment such as ladder climbing devices or lifelines should be used when working from long fixed ladders or when climbing vertical fixed ladders.
- Never rest a ladder on any of its rungs. Ladders must rest on their side rails.
- When erecting long, awkward or heavy ladders, two or more persons should share the task to avoid injury from over-exertion.
- Instruct all personnel to watch overhead power lines before attempting to erect any ladder. When overhead power lines are in proximity of the work, aluminum ladders must not be used.

b) Specification of ladders & staircase

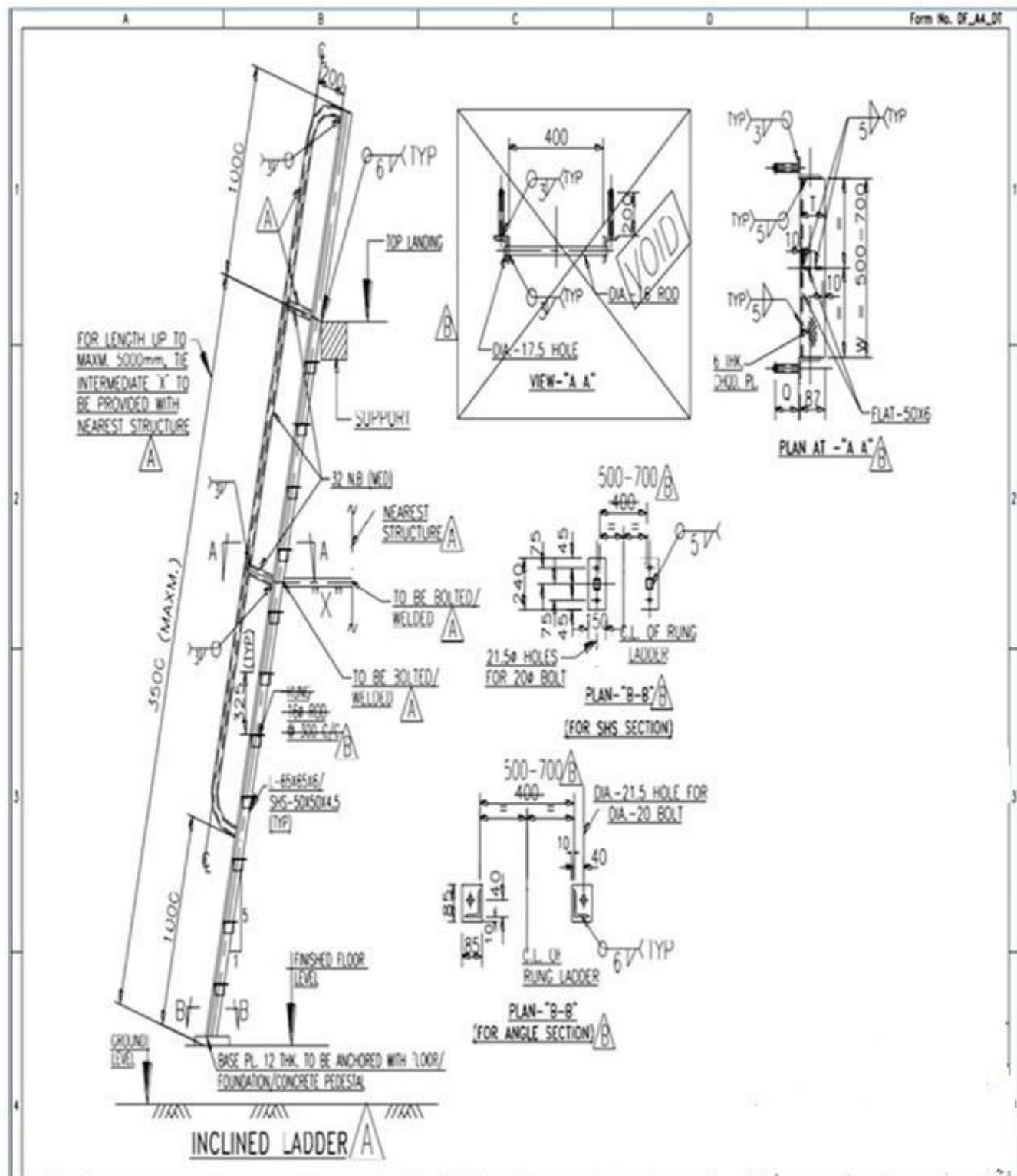
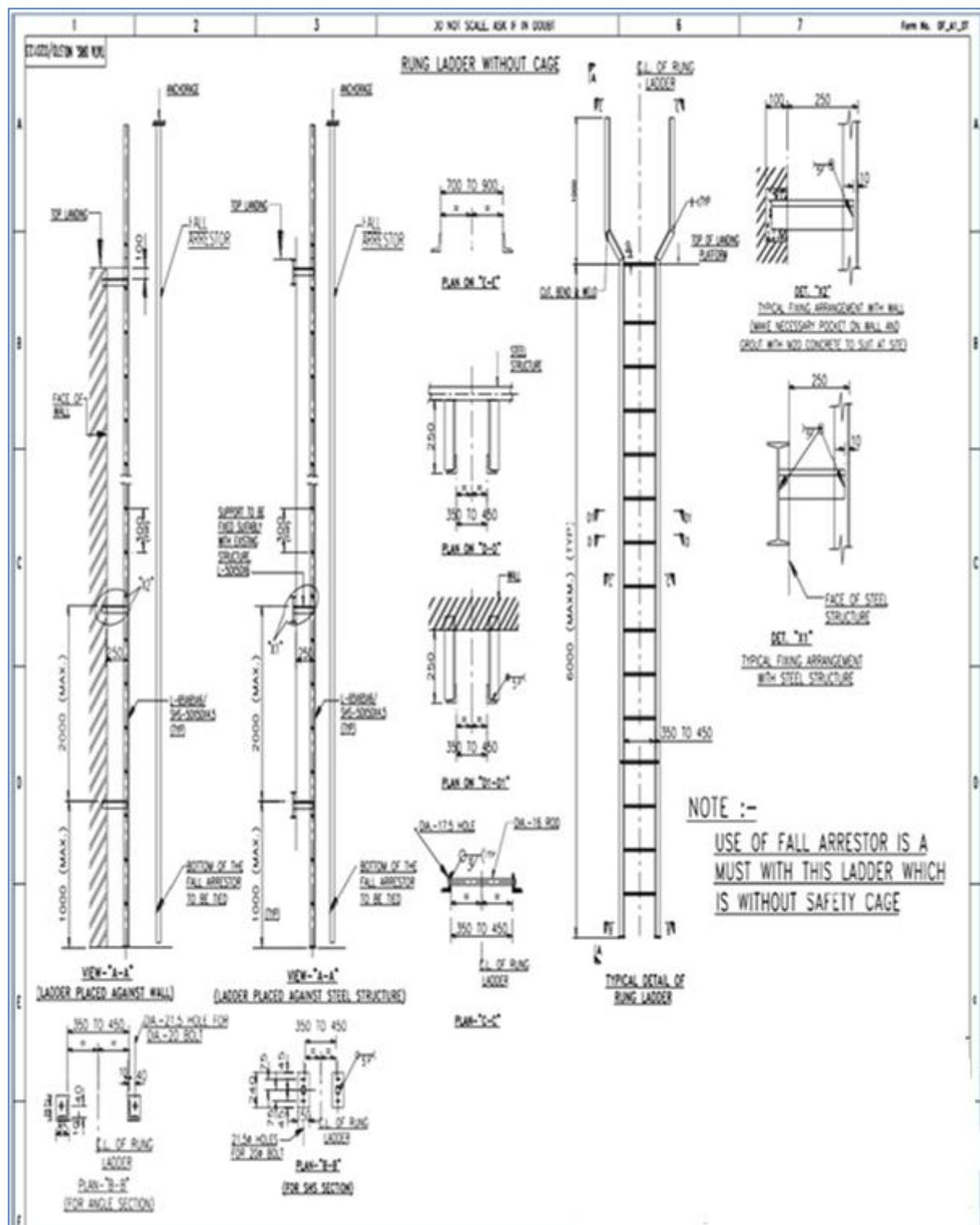


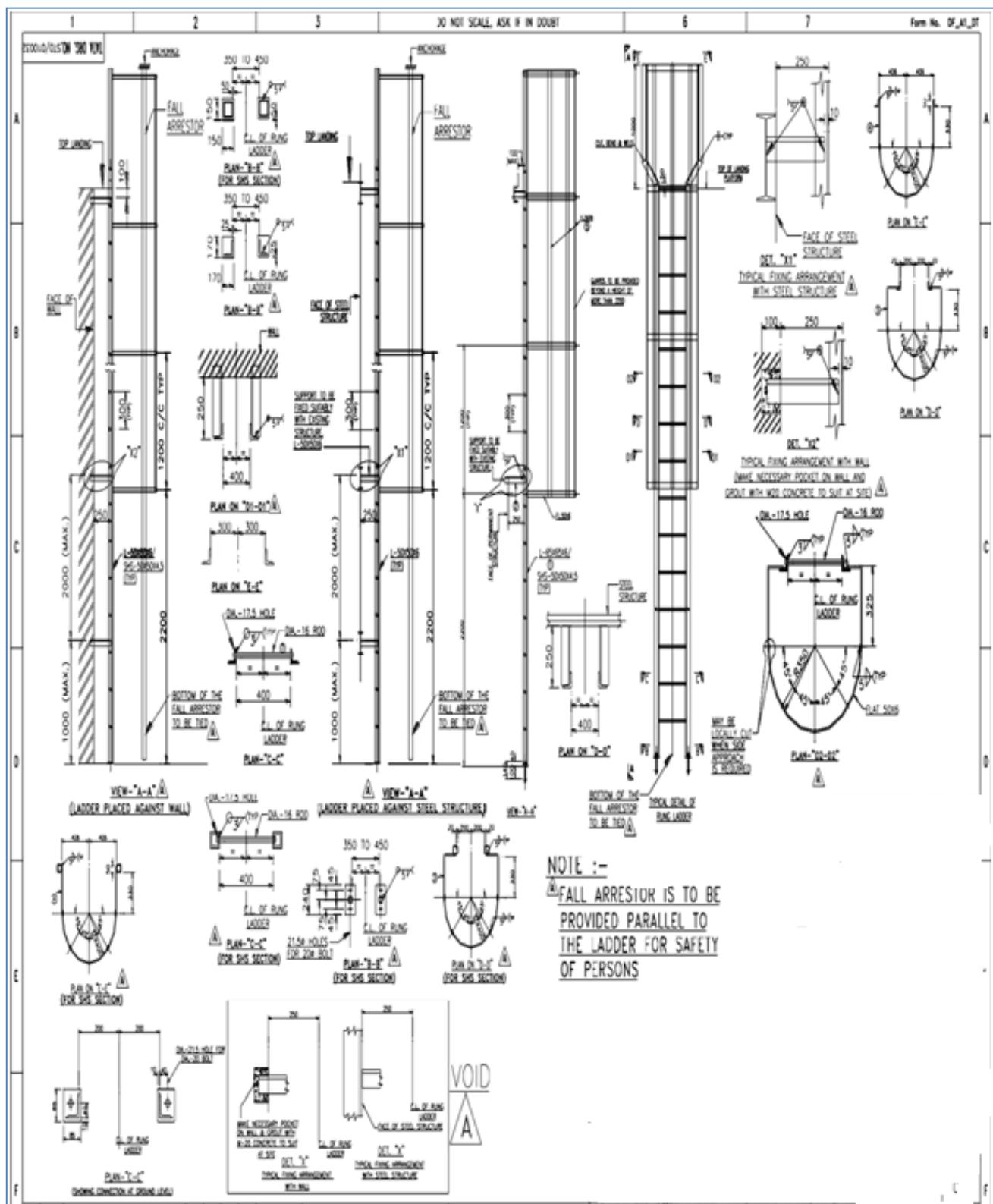
Fig.1- Inclined step ladder

A	B	C	D	Form No. DF_A4_07			
S -> LADDER - 50° 0 75°							
ANGLE	PITCH	R (MM)	T (MM)	Z (MM)	X (MM)	Q (MM)	REMARKS
50°	1.1918 : 1	240	201	1625	875	562	
52°	1.2799 : 1	245	191	1600	875	540	
54°	1.3764 : 1	250	182	1575	880	518	WIDTH
55°	1.4281 : 1	255	179	1550	880	505	MIN. = 500
56°	1.4826 : 1	260	175	1525	885	495	DESIRABLE = 500-700
58°	1.6003 : 1	265	166	1500	885	469	
60°	1.7321 : 1	270	156	1450	890	445	
62°	1.8807 : 1	275	146	1400	890	418	RISER (R) DESIRABLE = 200-250
64°	2.0503 : 1	280	137	1375	895	392	
65°	2.1445 : 1	285	133	1350	895	378	
66°	2.2460 : 1	290	129	1325	900	366	
68°	2.4751 : 1	295	124	1300	905	339	
70°	2.7475 : 1	300	109	1250	910	312	
72°	3.0777 : 1	310	101	1200	915	282	
74°	3.4874 : 1	320	92	1150	925	256	
75°	3.7321 : 1	325	87	1100	935	242	

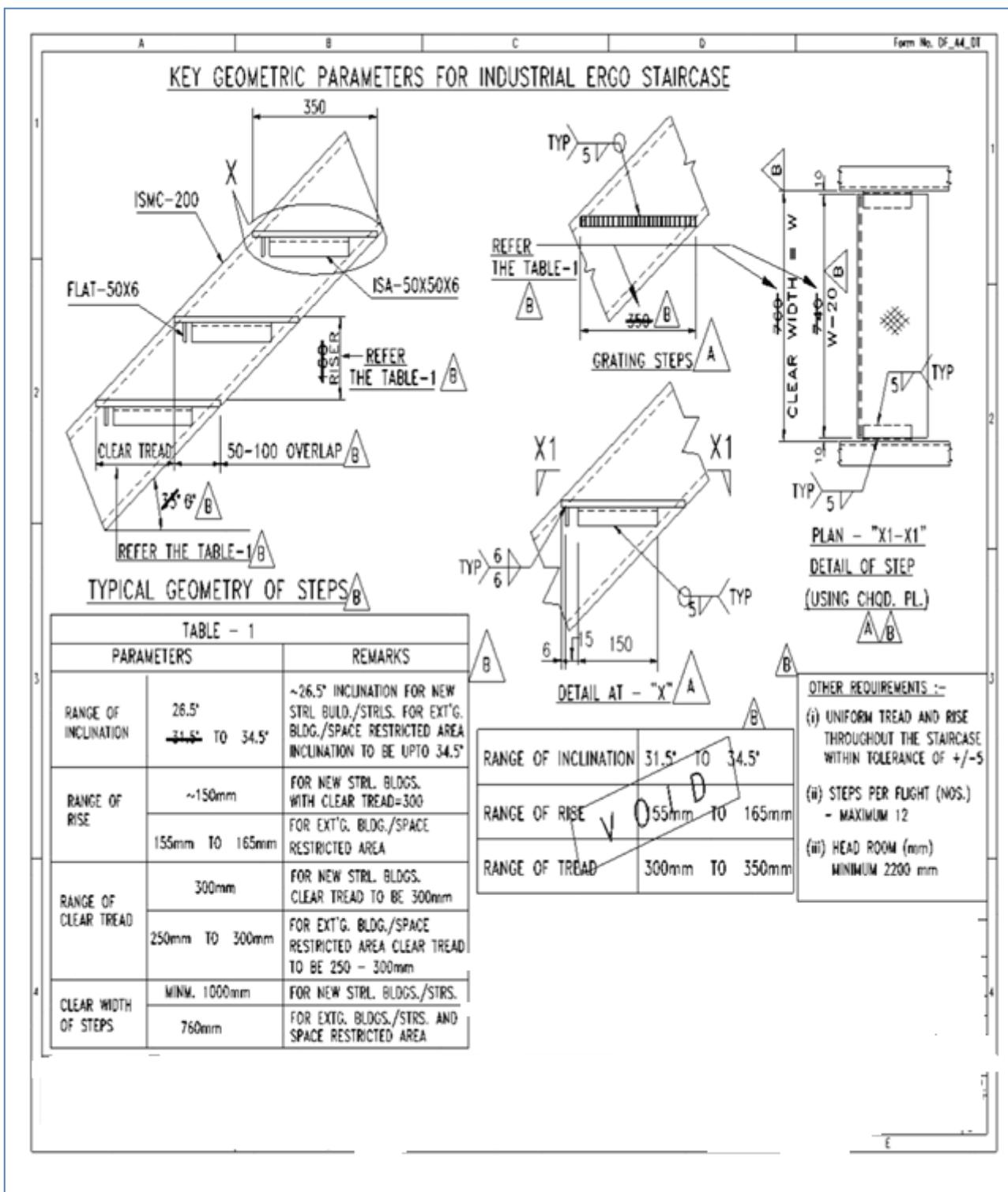
The diagram illustrates a step ladder with various dimensions labeled. A vertical line represents the height of the ladder. The 'CLEARANCE LINE' is a horizontal line at a distance 'Z' from the vertical line. The 'PITCH' is the angle between the vertical line and the ladder's rungs. The 'ANGLE' is the total angle from the vertical line to the top of the ladder. The 'HAND RAIL' is shown at the top. Dimension 'R' is the rise of each step, 'T' is the tread width, 'Z' is the clearance, 'X' is the horizontal distance from the vertical line to the center of the steps, and 'Q' is the depth of the steps.

Fig.2- Rises & Treads of step ladders



**Fig.4- Rung ladder with cage**

Typical Geometrical parameters for steps for staircases are to be as per Standard Drawing shown below. As per site feasibility similar other staircases may be used for construction.



ix) Safe working platforms

Working platforms are the parts of structures upon which people stand while working. A wide range of appropriate capacity & stable mobile access equipment like man lifters, scissor lifts, Mechanized climbers, including mobile elevating work platforms (MEWPs), suspended cradles, mast climbing work platforms (MCWPs), appropriate rope access technique /system are to be used for carrying persons with tools & tackles for height work. As well as being adequately

supported and provided with guard rails or barriers, working platforms should be:

- a) Wide enough to allow people to move back and forth safely and to use any equipment or material necessary for their work at that place and in any case, at least 600 mm wide;
- b) Free of openings and traps through which people's feet could pass, causing them to trip, fall or be injured in any other way;
- c) Constructed to prevent materials from falling. There shall be toe boards or similar protection at the edge of the platform, The platform itself should be constructed to prevent any object which may be used on the platform from falling through gaps or holes, causing injury to people working below. For scaffolds, a platform without any gap shall be provided. If MEWPs or cradles are used and they have meshed platform floors, the mesh should be fine enough to prevent materials, especially nails and bolts, from slipping through; and
- d) Kept free of tripping and slipping hazards. Where necessary, provide handholds and footholds. Keep platforms clean and tidy. Do not allow mud to build up on platforms.

In case of non-availability / justified non suitability of above, it is to be made possible to work from the existing structure and to use a scaffold & working platform. In case of justified non suitability of above, boatswain's chairs or seats, rope ladders and rope access equipment can be used.

Those using mobile and suspended access equipment should be trained and competent to operate it. They should learn emergency and evacuation procedures so that they know what to do, for example, if the power to the platform fails, or fire breaks out in the building being worked on. With many pieces of equipment, more than one person will be needed to ensure safe operation.

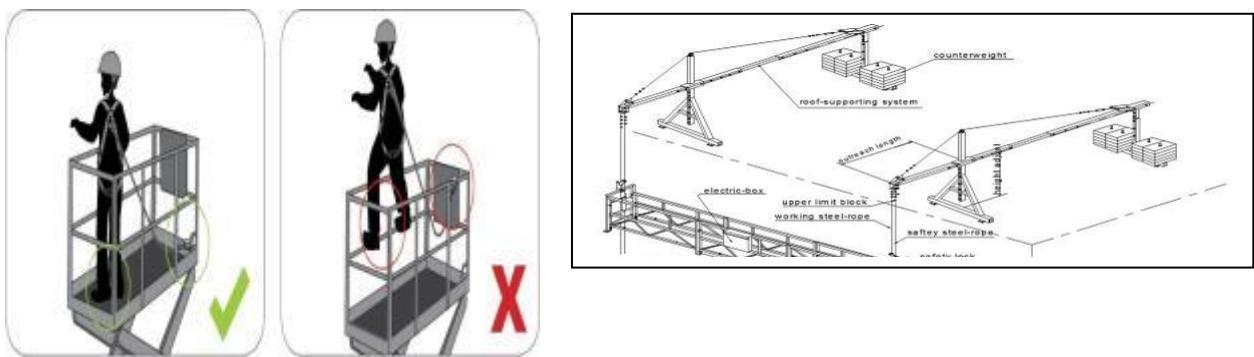
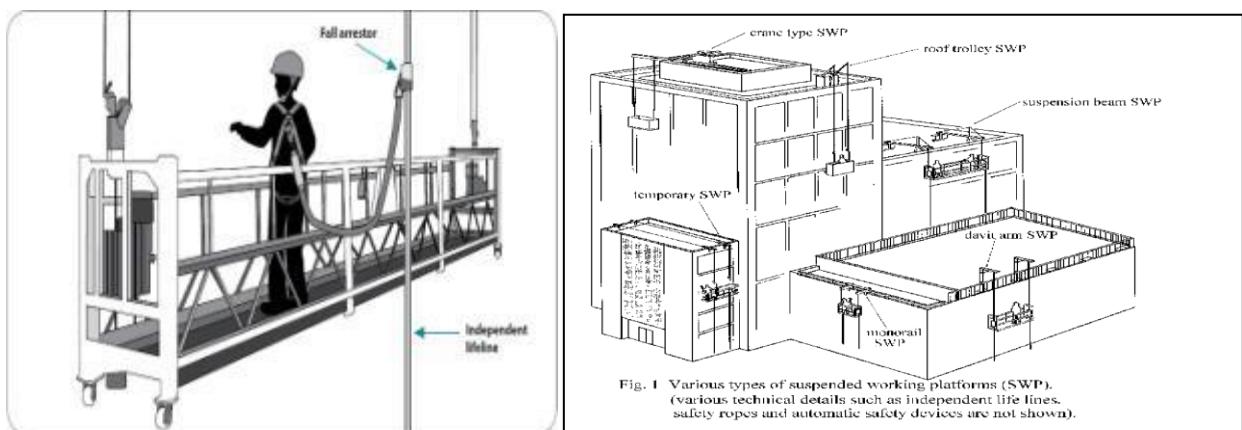
Before work starts check that:

- a) A handover certificate is provided by the installer. The certificate should cover how to deal with emergencies, operate, check and maintain the equipment, and state its safe working load;
- b) Equipment is installed, modified and dismantled / removed only by competent specialists;
- c) There is a current report of thorough examination for the equipment;
- d) Area of the site where people may be struck by the platform or falling materials have been barricaded;
- e) Systems are in place to prevent people within the building being struck by the platform as it rises or descends and prevent the platform coming into contact with open windows or similar obstructions which could cause it to tip;
- f) Supports are protected from damage (for example, by being struck by passing vehicles or by interference from vandals);
- g) The equipment can be protected from adverse weather. High winds can tilt platforms and make them unstable. Establish a maximum safe wind speed for operation and do not work when there is lightening. Storms and snow falls can

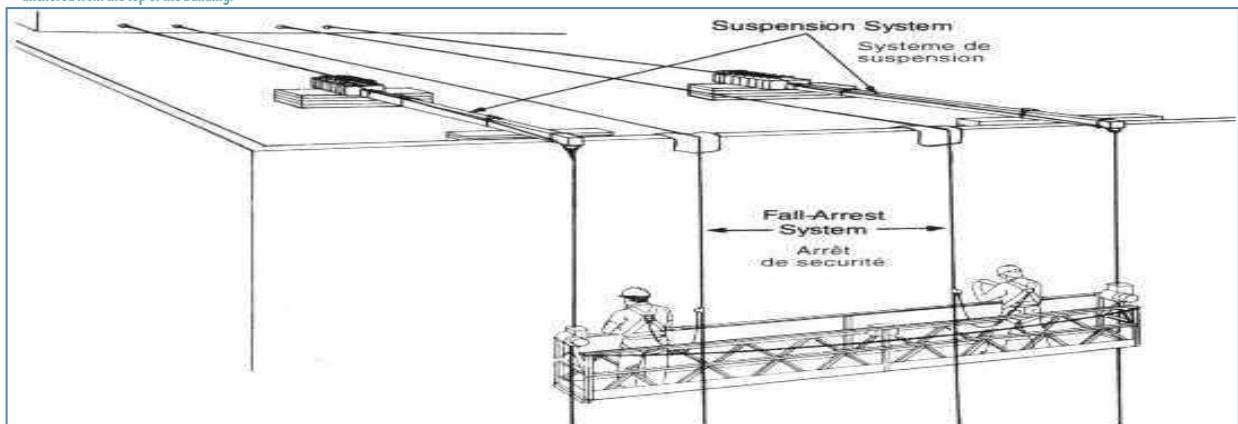
also damage platforms, so they should be inspected before use after severe weather.

At the end of each day check that:

- The platform is cleared of tools and equipment;
- All power has been switched off and, where appropriate, power cables have been secured and made dead;
- The equipment is secured where it will not be accessible to vandals or trespassers;
- Notices are attached to the equipment warning that it is out of service and must not be used. Check the shift report for warnings of malfunction etc.



A suspended scaffold is mainly used for performing work on the sides of buildings. Workers should be protected by a personal fall arrest system with an independent vertical lifeline anchored from the top of the building.



x) Boatswain's chairs/seats

Boatswain's chairs and seats can be used for light, short-term work. They should only be used where it is not practicable to provide a working platform. In general, use a chair which consists of a seat with a back, a central suspension point and a carrying point for tools.

Whether a chair or seat is used, the user should be attached to the suspension system by a harness and lanyard to protect against falls. See also the general advice about mobile and suspended access equipment.

The Boatswain Chairs shall be operated as per the manufactures and its competent installer's guidelines.

xi) Rope access techniques

Rope access system is a safe method of working at height, where ropes and associated equipment are used to gain access to and egress from the workplace, and to be supported at it.

Industrial rope access techniques is a specialized techniques for which IRATA International Code of practice for Industrial rope access is to be followed. Only specialized agency following the IRATA rope access guidelines are to be engaged.

Reference Standard Source: www.irata.org, www.petzl.com

The detailed planning, management, guidelines, risk mitigation & equipment etc, to be prepared based on IRATA International Code of Practice before its use.

This technique can be used for inspection and some short-term light-duration construction work and other work etc. It should only be used where access from a working platform is not practicable. Check that:

- a) The equipment is erected under the supervision of a competent person and then a pre-check is carried out;
- b) Anyone using the technique has been expertly trained and is competent;
- c) Safe descent does not depend upon a single suspension point. Wherever possible the main rope and safety rope should be attached to separate suspension points;
- d) All the equipment are checked carefully before each use and maintained to a high standard;
- e) Any tools which are needed for the work are attached to the operator with suitable ropes or chains, so that they cannot be dropped; and Where a risk of dropped tools or falling materials remains the area beneath the work should be fenced off or protected by fans, covered walkways or similar.

For all the above system, stable, firm, adequate anchoring points / locations of a structure to be identified and used. The anchoring points & anchorage capacity shall be as per number of persons accessing with the system.

For each person the anchoring capacity is to be 2000 Kg. For multiple person,

the capacity is to be increased correspondingly. The system is to be adopted only when a competent agency already practicing the system is being involved. The anchorage point & its capacity is to be approved by competent & qualified Engineer of the executing department performing & supervising the job, in consultation with the installer of the rope access system.

3.5 Roof work

Structural roof work is the most hazardous activity of construction operations. The most common accidents to the roof workers are fall from the edge of roofs, fall through openings in roofs, falls through fragile roof materials. Most accidents happen to roof workers while carrying out maintenance and cleaning job on roofs. To undertake roof work safely, worker and site supervisor must require knowledge and experience along with proper engineering and appropriate approach.

Before the job begins, a safe system of work must be planned. General precautions as mentioned under **Clause-3.2** must be adopted to reduce the risk of a worker falling. However, the specific precautions to be taken will depend on the type of roof and the nature of the work to be undertaken.

- i. The executing officer, departmental safety officer and the in-charge of the shop where the roof sheet is being changed, shall visually inspect the site, identify the potential hazards (like weak purlins, exposure to heat or chemicals and thick layer of dust), chalk out the appropriate strategies and inform all concerned about the work plan details including a safe means of access to the sheet roof top.
- ii. No person shall be allowed to stand, walk or do any work or go for any purpose on a GC, GP or AC sheet roof, where there may be danger of the sheet giving way (breaking) due to the weight of the person.
- iii. No person shall be allowed to walk on the centre of the sheets. He shall walk only on purlins (i.e. the line of the protruding hook tops)
- iv. Movement of persons shall be restricted from the point of climbing to the roof top via the shortest safe approach to the point of work.
- v. Suitable and sufficient safety devices and safe means of access like ladders, which must have length to project at least one meter above the lower end of the roof, duck ladders, access boards and crawling boards securely supported and fixed, shall be provided.
- vi. The workman shall work on suitable movable frames or ladders made of bamboo, wood, aluminium or similar material, which shall span at least between two purlins (so that his weight is not on the sheet) and this frame/ladder shall be anchored to a purlin or other fixed structure. The full body harness with double lanyard of the worker shall be tied to the frame/ladder suitably and securely. Use of crawling boards shall be encouraged.
- vii. If any damaged or cracked sheet is found, then the same shall be reported to the EA / In-charge and the sheet shall be changed under supervision of his representative.
- viii. Wherever possible, suitable and sufficient parapet wall or railing, toe guards or any other equally effective device to prevent the person from falling shall

be provided. Where railings cannot be provided, holding nets shall be provided.

- ix. Safety full body harness with double lanyard having ISI mark shall be used.
- x. Normally use of a drilling machine shall not be allowed on a sheet roof. In exceptional cases where their use is unavoidable, the drilling shall be carried out under supervision of a competent person with specific permission of the Executing Officer.
- xi. It is advisable not to allow the workers to carry their mobile sets to the roof.
- xii. Where transparent sheets are fixed there should be guard fencing around the same or suitable netting should be provided below the sheets spreading from purlins to purlins.
- xiii. Life line or fixed fall protection system (angles) should be provided for fixing lanyards.
- xiv. In respect of electrical lines, the following precautions shall be taken :
 - a) Three core flexible cable conforming to appropriate Indian Standard shall be used.
 - b) Connection shall be provided by a competent person, with proper earthing.
 - c) All plugs, sockets, etc, shall conform to appropriate Indian Standard and earthing shall remain continuous.
 - d) The switch board shall conform to the provisions of the Indian Electricity Rules.

Care shall be taken to see that the cables are not damaged by sharp edges of the sheets and shall be kept in such a way that nobody stumble upon or get entangled with them.

- xv. Loose materials like nuts, bolts, hooks and tools shall be kept in a box which shall be kept safely away from the edges of the roof. Care shall be taken to prevent fall of objects like old/new hooks, nuts and bolts.
- xvi. Not more than two new sheets shall be lifted at a time from ground. The lifting shall be done by means of manila ropes and pulleys. The persons receiving the sheets at roof top shall essentially wear full body harness with double lanyard suitably tied to a firm structure. Till the sheets are fixed, they shall be tied down for avoiding any accidental fall. No loose sheet shall be left on the roof top at the end of the shift.
- xvii. Dismantled sheets shall not be thrown down from top. They shall be lowered to the ground by means of manila ropes and pulleys, and shall be stacked on ground properly before the workmen leave the site.
- xviii. Dismantling of old sheets shall start from ridge downwards while laying of new sheets shall start from bottom end to the ridge, unless otherwise required as per site conditions. Both dismantling of old sheets and fixing of new sheets shall be done row by row.
- xix. The contractor shall deploy a supervisor, experienced in the job, to be present at site 100% of the time to ensure compliance to the rules and

safety procedures by the workers from the time of mobilization for work to the time last worker leaves the workplace.

- xx. Workers should not be allowed on the roof at the time of high wind, rain and when lightning striking, inclement weather or insufficient light.
- xi. Emergency rescue procedures are in place if there is a risk of a fall and someone needs to be rescued
- xii. No access is permitted to fragile roofs and that such roofs are covered off and warning signs are placed where persons can gain access
- xiii. Where work is required on a steep roof where the slope exceeds 35 degrees, do not stand on the roof. A steep pitched roof is an inappropriate surface to stand on due to the likelihood of sliding. Perimeter guard rails and catch platforms are also insufficient measures to protect workers on such roofs. In these circumstances, roof workers need a systems to prevent sliding and to prevent falls from the perimeter

Use one or more of the following systems in such circumstances :

- a) Aerial access equipment, such as a cherry picker;
- b) A work positioning system, such as a travel restraint or industrial rope access system; and
- c) A scaffold platform, located at the roof edge and a roof ladder.

xxiv. Any openings or holes in roofs are clearly identified and have edge protection such as guard railing placed around them.

 xxv. Where roof work is going to take longer than a few hours, ensure edge protection is installed such as perimeter guard railing and/or scaffolding where this is feasible.

 xxvi. Where minor roof tasks of short duration (less than a couple of hours) are to be undertaken and there is an increased risk of a fall due to either weather conditions, a sloping roof or access is required near a potentially fragile section – then higher order safety measures need to be considered and used where reasonably practicable. In such a situation, apply one or more of the measures below where feasible until the risk of a fall is minimised:

- a) If weather is the only factor increasing the risk of a fall, where possible wait until conditions improve before commencing or finishing a job.
- b) Where feasible, undertake the work from an elevating work platform such as a cherry picker or scissor lift. Where possible, consider scheduling jobs requiring such a device together to reduce any hire costs.
- c) If work is required near a fragile section install either edge protection around it (e.g. barriers or guard railing) or install safety mesh underneath it before commencing work.
- d) If an elevating work platform cannot be used or is not reasonably practicable in the circumstance, use a travel restraint system if one can be used safely. (Note: a person using a travel restraint device must not

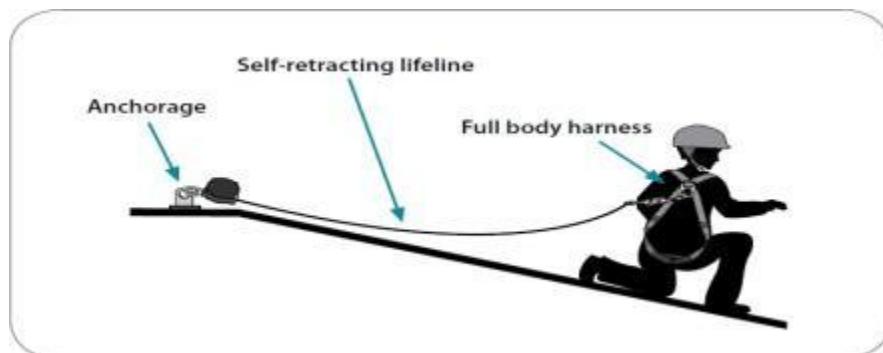
be able to approach an edge where a fall is possible. These systems are not designed for the impact loads that occur in the event of a fall.)

- e) If a non-fragile sloping roof is stable and other measures cannot be used, use a specially designed roof ladder in combination with a fall arrest system to do the task.
- f) If the risk of a fall is still significant using other safety measures consider installing a catch platform or safety net to catch anyone who may fall.
- g) Scaffolding is not usually considered reasonably practicable for many small jobs, however, if none of the measures or in combination, then the task may require the installation of some kind of scaffolding. If for some reason scaffolding is not able to be installed, then the task is probably too dangerous to undertake. Contact Work Safe Victoria or a consultant for advice in this instance.

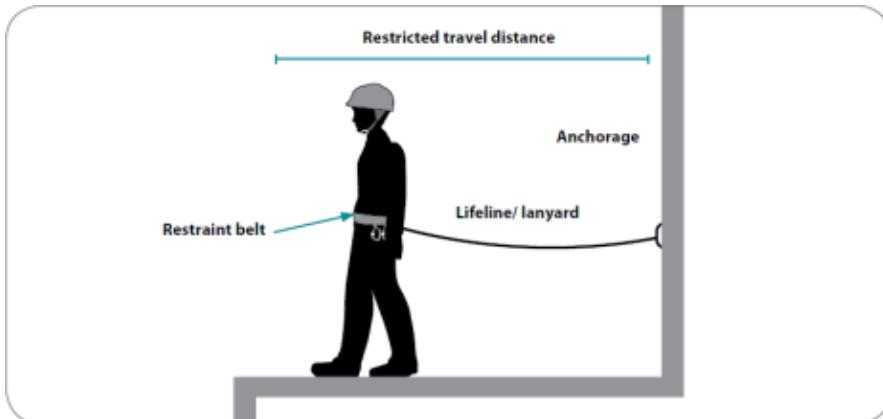
Following visuals are self explanatory:



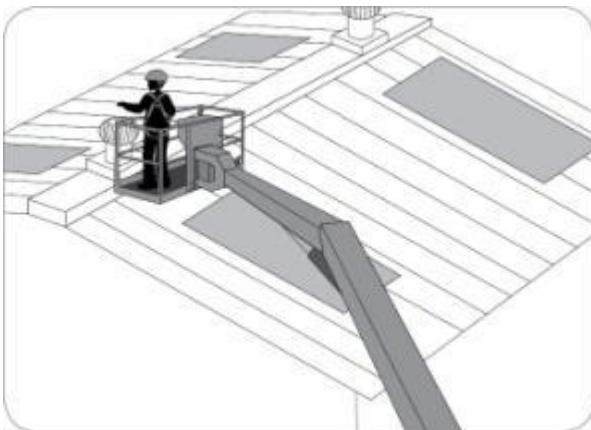
Unprotected openings are severe hazards and must be covered



An example of personal fall arrest system for roof works.



The travel restraint system prevents the user from reaching the open side.



Use of MEWP to eliminate the need for workers to stand on fragile roof surfaces.



**DANGER
Fragile Roof**

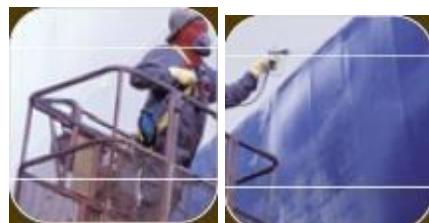


**Roof Access for
Authorised
Personnel Only**

Warning signs to be fixed at points of access to fragile roofs

3.6 Side Sheeting of High -Rise Structures / Buildings during/after construction

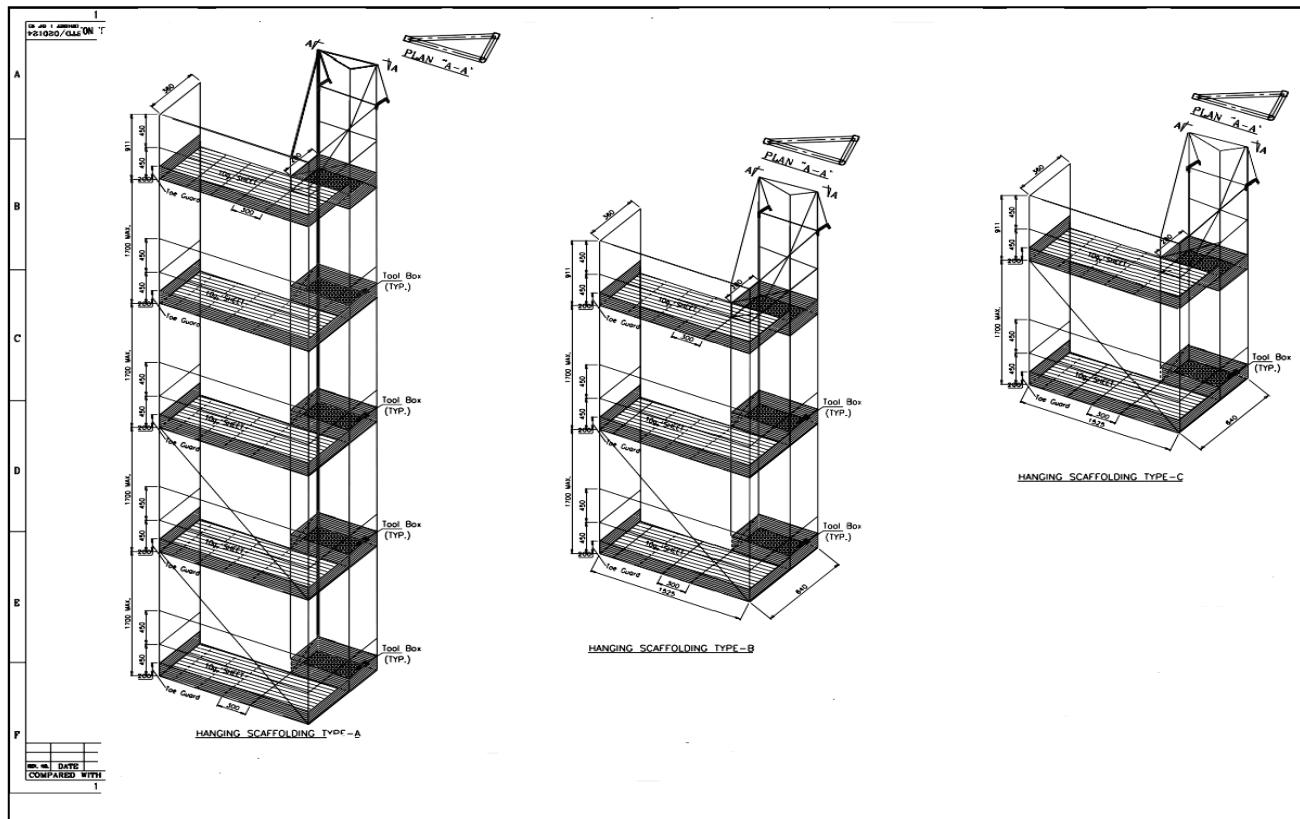
For sheeting at height, high rise man lifter may be used. Side sheeting at height may also be performed as per following procedures/precautions and requirements. The general standards as outlined in this standard are to be followed as applicable.



Sheeting work are to be done with cordless gun depending upon availability & site requirements. MEWP /man lifters are to be used for access. In case of non-availability of one or both of the above following procedure to be followed.

i) Working Cage

Working lift cage shall be as per standard drawings given under and of good structural construction, sound material and adequate strength.



2

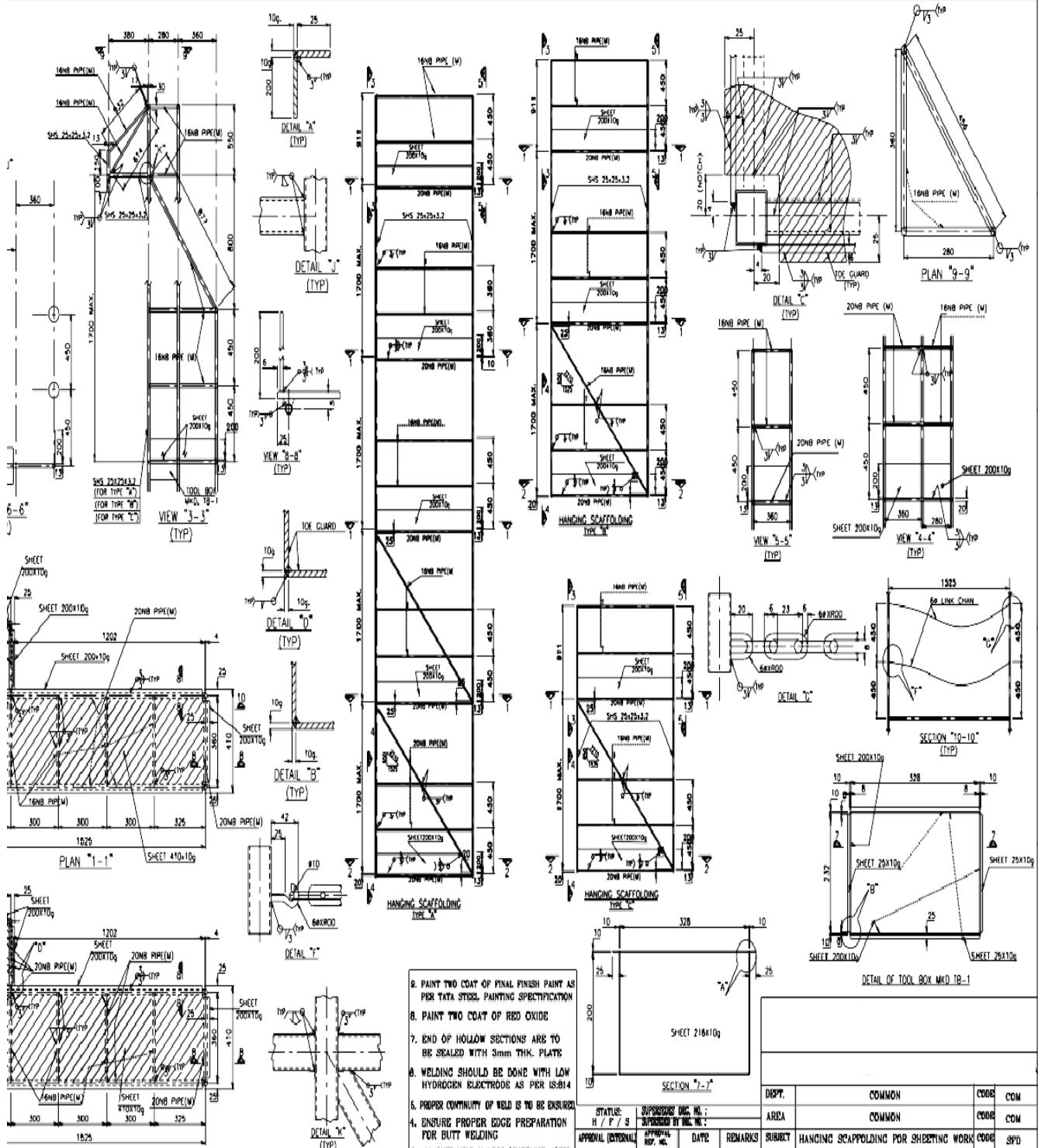
3

DO NOT SCALE, ASK IF IN DOUBT

8

7

FORM NO. UU_A1_U1



For fixing self-taping screws cordless self-taping screw machine, rivet guns are to be used etc. In case of non-availability of Cordless self-taping screw machine, screw / rivet guns following procedures / measures / precautions / requirements are to be followed. This is one of suggested safe methods. Similar / Other safe methods may also be used as per site feasibility.

ii) Safe method for anchoring the screw machine, rivet gun, sheet cutter etc. While working at height

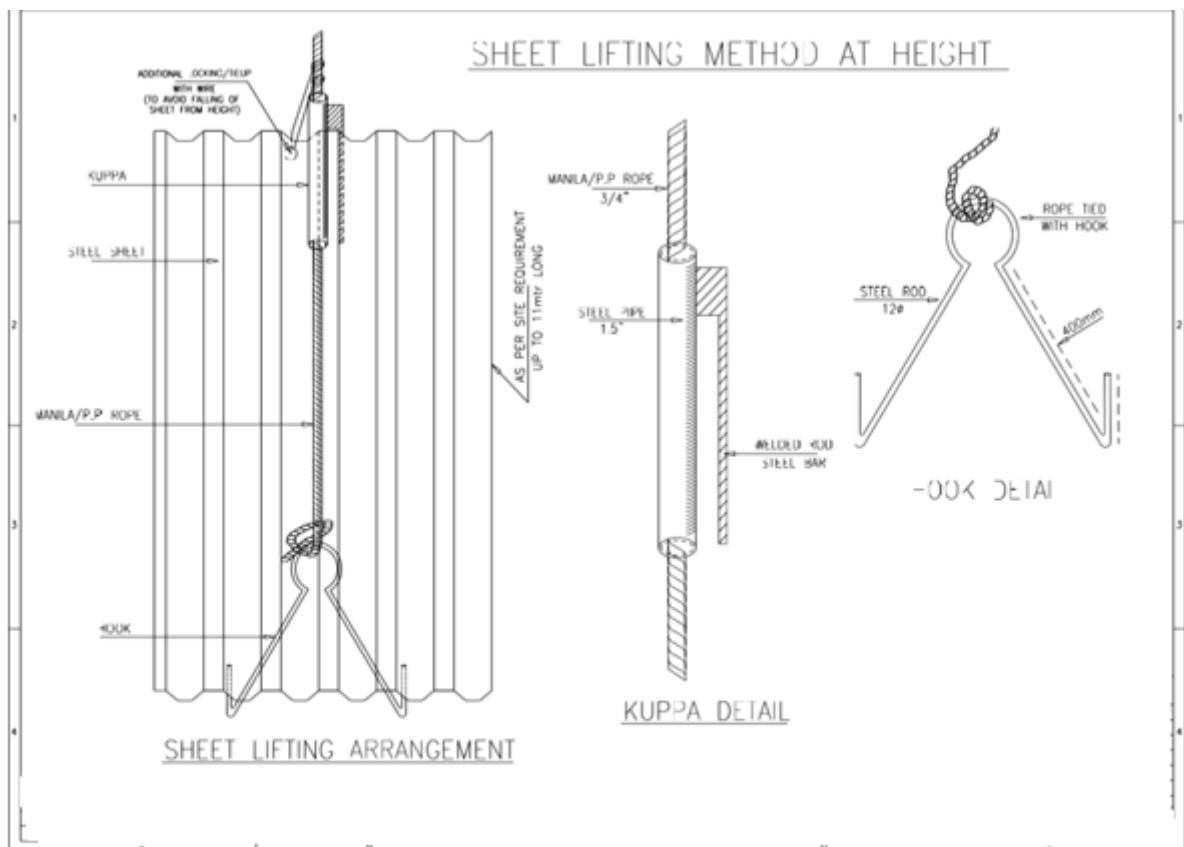
- a) Fix a Jubilee Clamp of a reputed make on the machine. Tighten the clamp to

the extent the clamp holds on the machine firmly.(Refer sketch-01)

- b) Another arrangement is to be made with a GI wire tied around the machine as additional anchoring support.(Refer sketch-02)
- c) A 10/12 mm dia PP Rope(s) is to be anchored firmly to this clamp by means of Self Locking Hook with item no (1) and (2). (Refer Sketch-02)
- d) In case of Rivet Gun, Sheet Cutter, A 8/10 mm dia. PP rope attached with self locking hook is to be fastened with the Nut/Ring welded to the Rivet Gun, Sheet Cutter. (Refer Sketch-03)
- e) The other side of this PP Rope(s) will be anchored to the firm structure by using Self Locking Hook tied firmly to it. (Refer sketches-02 & 03)
- f) The electrical extension fitted with 3 No, 5 Amp socket arrangement with electrical safety devices (like on/off switch, indicator lamp, fuses, appropriate length, size and type of wire etc.). The extension box should be box type with lid to prevent water ingress during rain. All machines should be connected to this board hanging with the scaffolding by Plastic top (plug).- (Refer Sketch-04).Earth continuity test should be done.

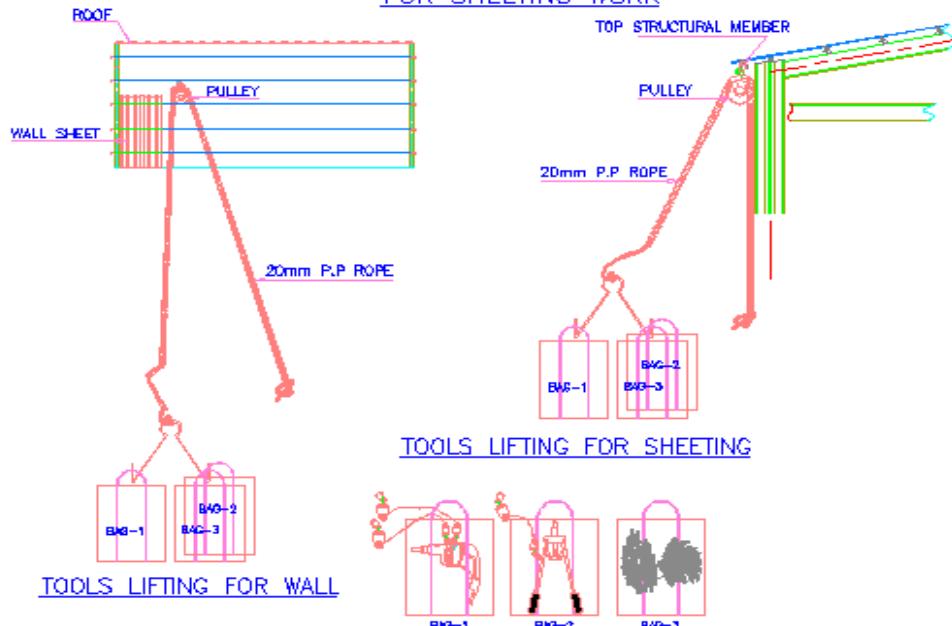
iii) Safe method for lifting the screw machine and other tools etc. to working height

- a) Each machine such as Screw Machine, Rivet Gun, Sheet Cutter etc. each to be placed in Separate appropriate bags. The small portion of the open end of the PP rope, provided with the machine, is to be hung outside the bag to facilitate holding while fixing to structure.
- b) These bags to be lifted to the required height by means of Rope and Pulley system used for lifting of machine.
- c) When this bags reach the required height, the open end of the PP rope tied to the machine is to be anchored first to the structure above by means of self-locking hook.
- d) After anchoring the machine to the structure the machine is taken out from the bag for use.
- e) The same system has to be followed for lifting machines by all the people working at different levels of the portable scaffolding.
- f) When the machine is not in use, it is to be hung with the full body harness of the person with the 3rd latch provided with the machine or else it is to be kept in the covered box provided in the portable scaffolding.
- g) While lowering the Screw Machine, Rivet Gun, Sheet Cutter etc. the machines are to be placed in the bag first and then only the two safety hooks are to be untied from the structure.
- h) Now the bags are to be lowered sequentially to all levels of the portable scaffolding for collecting the machines and materials and finally lowering down to ground by rope and pulley system.

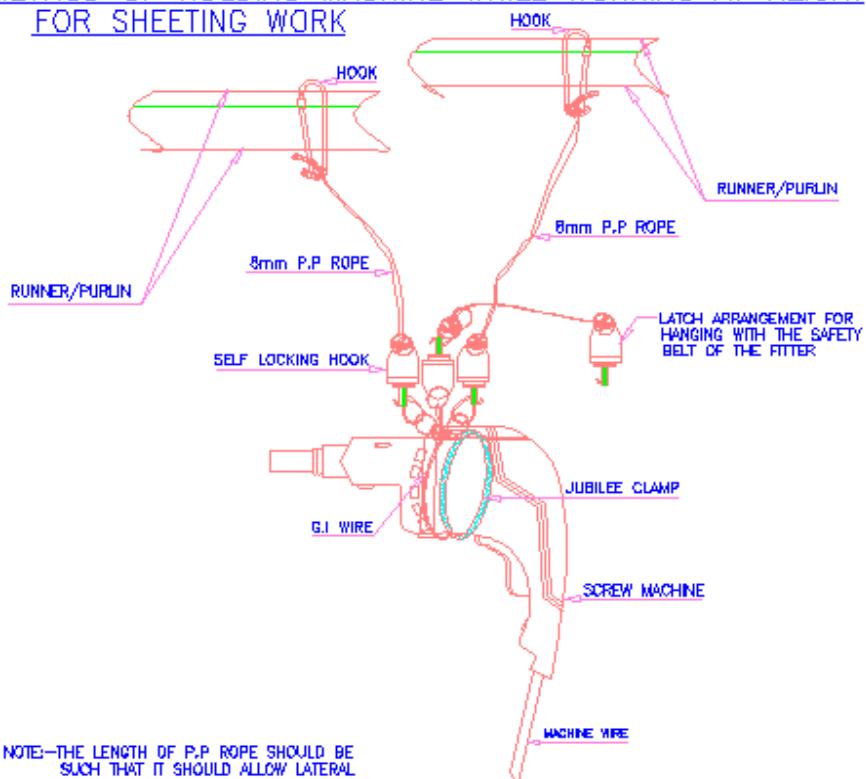


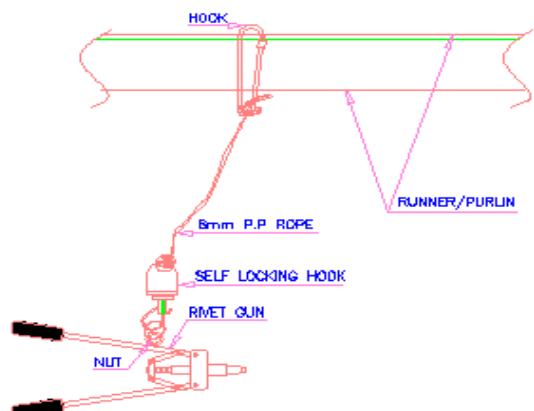
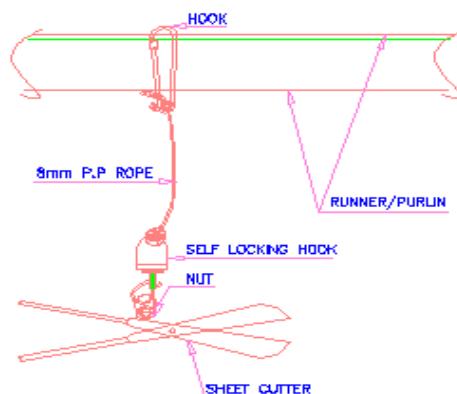
Sheet lifting arrangement

SKETCH-01

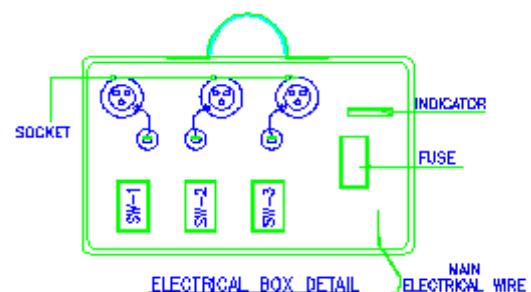
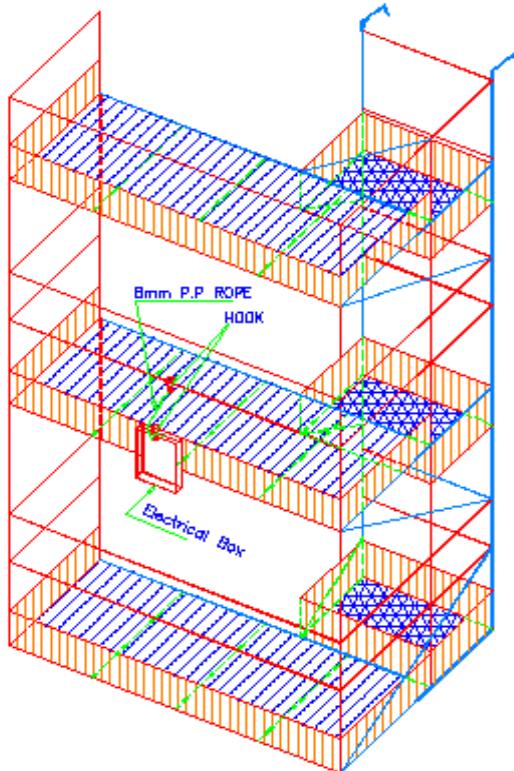
SAFE METHOD OF HOLDING TOOLS & TACKLES LIFTING WHILE WORKING AT HEIGHT FOR SHEETING WORKSAFE METHOD OF HOLDING MACHINE WHILE WORKING AT HEIGHT FOR SHEETING WORK

SKETCH-02



SKETCH-03SAFE METHOD OF HOLDING SHEET CUTTER & RIVET GUN WHILE WORKING AT HEIGHT FOR SHEETING WORK

NOTE:-THE LENGTH OF P.P ROPE SHOULD BE
SUCH THAT IT SHOULD ALLOW LATERAL
MOVEMENT OF THE SHEET CUTTER & RIVET GUN.

SKETCH-04ARRANGEMENT FOR ELECTRICAL BOX WITH HANGING SCAFFOLD FOR SHEETING WORK

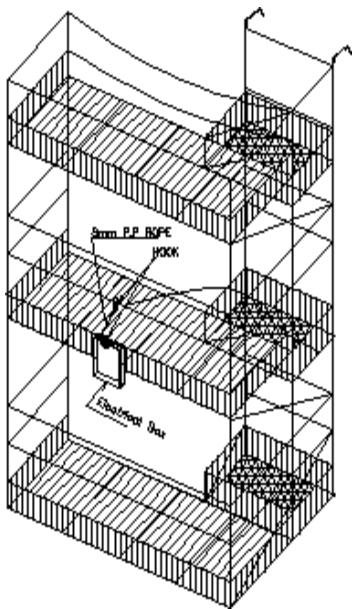
iv) Procedure for side & louvre sheeting work-specially at corner portion

a) Vertical Sheeting work

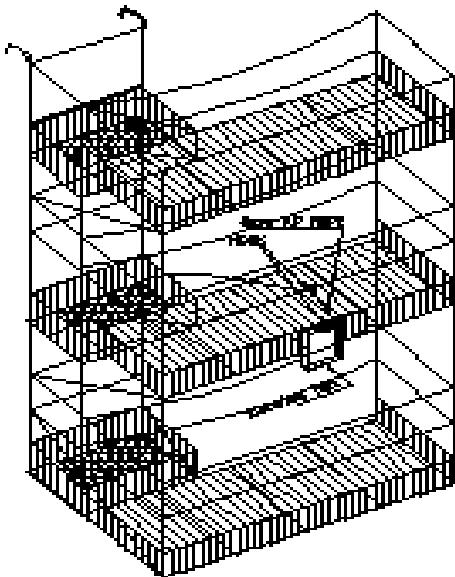
- The procedure has been prepared considering that the staircase is complete.
- The sheeting work is to start from bottom to top and from left to right corner. In case, the building has louvre, the sheeting area below the louvre is to be completed first and then it is to be done in the next upper level. For the right corner position of the sheeting , a new cage is to be fabricated similar to the existing cage but with hook / anchorage arrangement at left side so that the right side area of the cage is available for sheeting work.
- In the process of sheeting at the right corner of the building, two suitable notches are to be cut at top most location (with 10 mm clearance wrt hook section) in the sheet above the side runner, for fixing cage with left side hook / anchorage arrangement.
- All tools and tackles must be inspected thoroughly inspected on daily basis before use such PP rope, pulley block, latches of pulley blocks, hanging scaffolds, man lifter / Genie for welding and any damage, sheet cutter, rivet gun etc., Any violation is not acceptable.

b) Fixing of rope pulley arrangement for cage lifting / anchorage

- All workmen is to use staircase only for going to the desired floor where the sheeting is to be done. If the building has louvre, the people has to go to the floor just below the louvre.
- Fix a suitable length of standard ladder with handrail and anchoring hook. After positioning of the ladder, tie ladder with $\frac{3}{4}$ inch rope to avoid slippage on either direction at two places.
- Provide life line for fixing fall arrestor system..
- For fixing rope pulley arrangement for lifting the cage, the workmen must use safety belt and fall arrestor system as protection to fall from height.
- The rope pulley arrangement for lifting the cage is to be fixed in the firm structure of the building just above the cage anchorage point. Check that the side runners are properly bolted or erected before fixing the rope pulley block.
- Use 10 mm dia. (minimum) sling with D-shackle (cap 2T) for fixing the hook of rope pulley block.
- $\frac{1}{2}$ " dia. wire rope in the rope pulley for lifting cage.

**Cage with Right Handed Hook**

(for normal sheeting work)

**Cage with Right Handed Hook**

(For right hand corner sheeting work)

c) Lifting of the cage

- Provide guy rope of 3/4" dia. PP rope in the cage.
- Lift the cage with above arrangement to the point i.e. side runner where it is to be hung. In case of building with louvres, fix the cage to the side runner just below the louvre.
- Lock both the hooks / hanger arms of the cage by tying with ¾" dia. PP rope with the side runner to avoid slippage in any direction.
- Tie the cage at two intermediate locations with firm structure with ¾"dia PP rope.
- Keep rope pulley arrangements intact till the sheeting work is completed for one vertical line.

d) Approach from ladder to cage.

Workmen going into cage must use all PPE with safety belt. While going into the cage, it is to be ensured that he anchors both the lanyards onto a firm structure.

e) Fixing rope pulley arrangement for sheet lifting

The rope pulley arrangement for lifting the sheet is to be provided in the centre sheet lifting area provided in the cage and is to be fixed with the firm structure by the side of the cage lifting arrangement. Check that the side

runners are properly bolted or erected before fixing the rope pulley block.

- Another rope pulley arrangement is to be provided for sheet lifting. It will be similar to cage lifting arrangement with a firm structure of the building just above the cage anchorage point in line with the area provided in the cage for sheet lifting through it. Check that the side runners are properly bolted or erected before fixing the rope pulley block.
- Use 10 mm dia. (minimum) sling with D-shackle (cap 2T) for fixing the hook of rope pulley block.
- $\frac{1}{2}$ " dia. wire rope in the rope pulley for lifting cage.

f) Lifting of the sheet

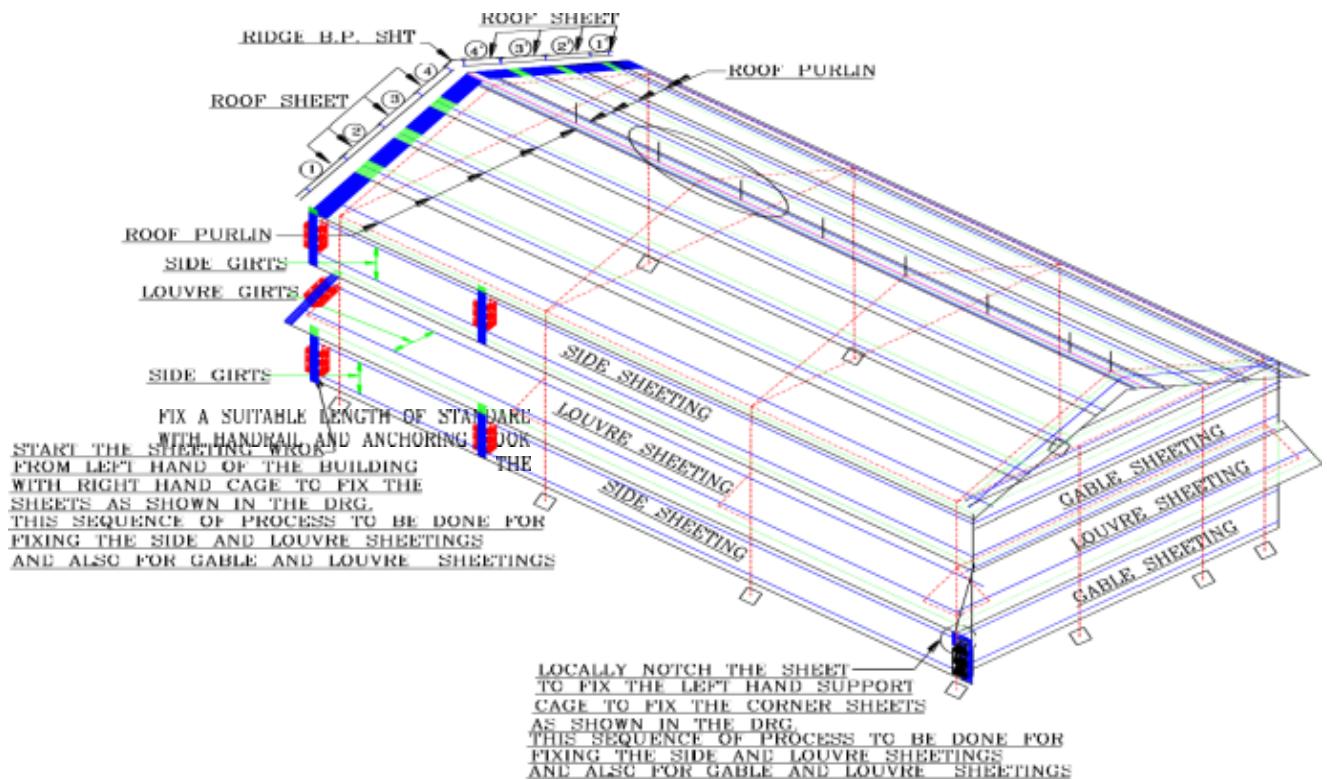
- The sheet lifting device must be fool proof.
- The sheet is to be lifted from inside the cage through the sheet lifting area.
- All people must be alert.
- 1 " dia. PP rope is to be used for sheet lifting
- The PP rope and all other tools and tackles must be inspected thoroughly before use.
- Provide guy rope of 3/4" dia. PP rope must be used to control the movement.
- Sheet lifting must be stopped before the start of rain or storm.

g) Sheeting work

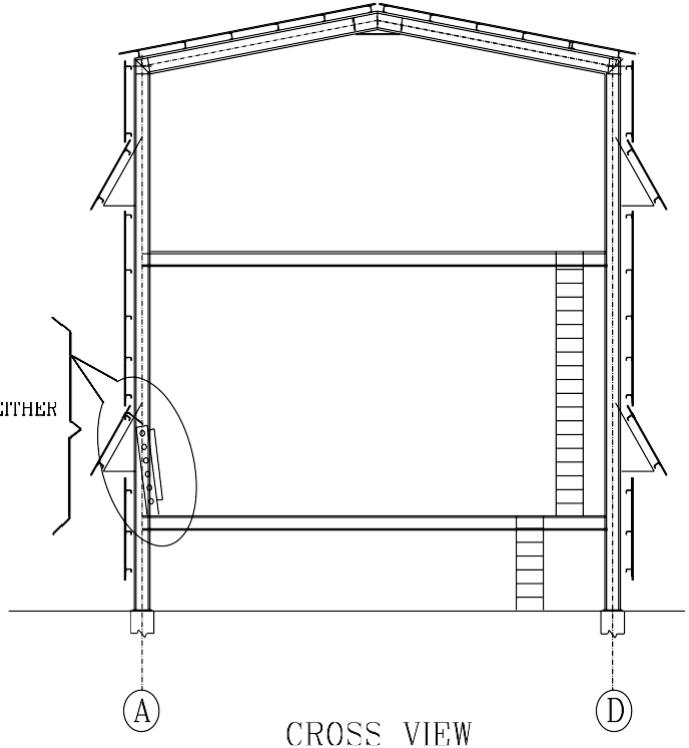
When one vertical line of sheeting work is completed line, all the rope pulley arrangements cage and sheets are to be lowered down for fixing next new location side wide. Repeat the above set of process for the new location sheeting.

h) Right Corner sheeting

- Repeat the above process for cage / sheet fixing and lifting methods for corner sheeting also.
- Right corner of the building, Cut two suitable notches (as required for fixing the arms / hook of the cage + 10 mm clearance, depth up to the side runner) are to be cut at top most location (with 10 mm clearance wrt hook section) in the sheet above the side runner, for fixing cage with left side hook / anchorage arrangement.
- Continue sheeting and flushing work accordingly.



POSITIONING OF THE LADDER, TIE
WITH 3/4" P.P ROPE TO AVOID SLIPPAGE ON EITHER
DIRECTION AT TWO PLACES. PROVIDE LIFELINE
FOR FIXING FALL ARRESTOR SYSTEM OR.
USE ROPE LADDER WITH FALL ARRESTOR
PROPERLY TIED AT BOTTOM AND TOP LEVEL
WITH FIRM STRUCTURE.



i) Inclined / louvre sheeting

- Repeat the above process for cage / sheet fixing and lifting methods for corner sheeting also.

- Right corner of the building, Cut two suitable notches (as required for fixing the arms / hook of the cage + 10 mm clearance, depth up to the side runner) are to be cut at top most location (with 10 mm clearance wrt hook dimension of section used.) in the sheet above the side runner, for fixing cage with left side hook / anchorage arrangement.
- Continue sheeting and flushing work accordingly.

References:

1. Tata Steel Limited Safety Standard on 'Working at Height & Continuous fall protection'
2. IPSS: 1-11-003-19 'Safety procedure for Roof sheet changing'
3. IPSS: 1-11-005-19 'Safety procedure for Working at Height by Contractor employees'
4. NSC Manual on Construction Safety
5. OSHA 3146-05R 2015 'Fall protection in construction'
6. IS 3696 (Part 1 & 2), 1987 "Safety code for Scaffolds & Ladders"

ANNEXURE-I

(Clause 4.0)

CHECKLIST OF REQUIREMENTS/PRECAUTIONS FOR WORKING AT HEIGHT**Steel Plant**

1. Name of Department executing the job: _____
2. Name of Departmental representative(s): _____
3. Name (s) of Contractor's supervisor(s) : _____
4. Name of Contractor
5. Exact location of work
6. Brief description of work
7. No. of persons deployed for the job.
8. Names of persons deployed to do the job at height
9. No. of persons issued height passes : ..
10. Ref No. of height .passes issued
- .11. All persons have been imparted training for working at height by Safety Engineering Department : Yes / No

12. Head of Operation Deptt has been informed of this job : Yes / No
13. Shut down of following operating equipment have been obtained

EOT Crane	:	Yes/No.
Belt conveyor	:	Yes/No.
Gas Lines	:	Yes/No.
Bus bars	:	Yes/No.
Pusher car	:	Yes/No.
_____	:	Yes/No.

14. Checking of scaffoldings/ladders : Yes/No.
Done and found with required Strength
15. Availability & Usage of full body harness ensured : Yes/No.
16. Usage of protective helmets : Yes/No.
Ensured.

- 17 Provision of lifeline/ anchorage points : Yes/No.
18. Provision of safety nets for arresting Fall of personnel : Made / Not necessary
19. Weather is clear to do the job (outdoor work) : Yes/No
- 20 Underneath area barricaded : Yes/No
21. Illumination is adequate to do the job (indoor work) : Yes/No
- 22 Safety Signage's provided : Yes/No
23. Satisfactory house-keeping condition : Yes/No
 (Sharp objects, redundant cables & structurals, slippery objects like. oils and lubricants do not exist and shall not be allowed in the working-area)
24. Job to be started only after ensuring Compliance to all checklist points Special remarks
 a) This checklist is valid for today only.
 b) Job to start only after compliance to all checklist points
25. Safety Talk imparted and record kept : Yes/ No

Inspected the site and permitted to start the work.

Signature :	Contractor or His authorized Representative	Executing officer	Safety officer
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Name: _____

Designation: _____

Contact/ Mobile No. _____

Date: _____ Time: _____

ANNEXURE-II**FALL ARREST SYSTEM CHECKLIST**

Sl. No.	Question	Y/N
Anchorage Points		
1	Do workers know appropriate anchorage points for each task that requires a fall- arrest or restraint system?	
2	Are all anchorage points capable of supporting at least 2000 kilograms per person attached and supervised by a qualified person?	
3	Are all anchorage points for body harnesses located at shoulder height and are anchorage points for self-retracting lifeline systems located overhead?	
4	Are anchorage points independent of the working surface?	
5	Can a worker move from one station to another or climb up and down without exposure to a fall?	
6	If the lifeline, lanyard, or self-retracting lifeline is not permanently attached to an anchorage point at the elevated work area, is the first worker up or the last worker down protected while climbing and traversing?	

Vertical Lifelines	
1	Does the lifeline have a minimum breaking strength of 2000 kilograms)?
2	Is the lifeline protected from abrasive or cutting edges?
3	Does the system provide fall protection as the worker connects to and releases from the lifeline?
4	Is the lifeline arranged so workers never have to hold it for balance? (A lifeline should never be used for balance.)
5	Is the vertical segment integrated with the horizontal segment to provide continuous fall protection?

Horizontal Lifelines	
1	Has the entire horizontal lifeline system been designed and approved by a qualified person?
2	Have the anchorages to which the lifeline is attached been designed and evaluated specifically for a horizontal lifeline?
3	Has the designer of the system approved the number of workers who will be using it?
4	Is the rope or cable free from signs of wear or abrasion?
5	Does the rope or cable have the required initial sag?
6	Have the workers been warned about potential falls?
7	Have the clearances been checked?
8	Is the hardware riding on the horizontal lifeline made of steel? (Aluminum is not permitted because it wears excessively.)

Sl. No.	Question	Y/N
Fall Arresters (Rope Grabs)		
1	Is the fall arrester compatible with the lifeline on which it is to be installed or operated?	
2	Is the fall arrester in operational condition?	
3	Is the fall arrester equipped with a changeover lever that allows it to become a stationary anchor on the lifeline?	
4	Is the fall arrester equipped with a locking mechanism that prevents unintentional opening of the device and subsequent disengagement from the lifeline?	
5	Is the fall arrester's "up" direction marked properly so the equipment can be attached to the line correctly?	
6	Is the fall arrester included in a regular maintenance program?	
Lanyards		
1	Is the lanyard length as short as necessary and in no cases greater than 6 feet (1.8 meters)?	
2	Are manually adjustable lanyards used when it is desirable to be able to take slack out of the lanyard?	
3	Have you prohibited tying of knots from the lanyard to the lifeline? (Mechanical rope grabs or fall arresters must be used.)	
4	Are double lanyards provided ?	
Retractable Lifeline (RL)		
1	Are workers properly trained to use an RL?	
2	Is the RL under a regular maintenance and inspection program?	
3	Is the end of the cable properly spliced? (thimble eye, Flemish eye-spliced, and swaged fitting/ferrule?)	
Body Harnesses		
1	Are full-body harnesses selected for a particular job equipped with all necessary attachment points (for fall arresting, work positioning, descent control, rescue, or ladder fall-protection systems)?	
2	Are body harnesses inspected regularly for wear, abrasion, broken stitching, and missing hardware?	
3	Have workers been instructed in the use and care of body harnesses/body belts?	
Other Considerations		
1	Has the free-fall distance been considered so that a worker will not strike a lower surface or object before the fall is arrested?	
2	Have pendulum-swing fall hazards been eliminated?	
3	Have safe methods to retrieve fallen workers been planned?	
4	Is all of the fall-arrest equipment free of potential damage from welding, chemical corrosion, or sandblasts?	
5	Are all components of the system compatible according to the manufacturer's instructions?	

Sl. No.	Question	Y/N
6	Have employees been properly trained in the following issues? – Manufacturer's recommendations, restrictions, instructions, and warnings – Location of appropriate anchorage points and attachment techniques – Problems associated with elongation, method of use, inspection, and storage	
7	Are all regular inspections performed by trained inspectors?	
8	Are written reports maintained?	
9	Is adequate method of rescue of persons working at height worked out depending on the situation before starting of job? Is it documented?	
10	Are person trained at carryout identified method of rescue?	
11	Are names of rescuers are displayed at site and communicated to all concerned?	

SUPPORTS SYSTEM & PROCEDURE CHECKLIST

Sl. No.	Question	Y/N
Anchorage / support fixing Points		
1	Do location of the anchoring / support fixing points inspected for proper location of the support system?	
2	Do the new support system for access/lifting system like winch, pully, climber system, rope access system, cradles/cages etc. as per manufactures EOM?	
3	In case of other support system, whether sketches are in line with Standard Drawings / method / procedure defined in the safety standards?	
4	Whether the life line posts are adequately & rigidly connected to the supports?	
Sheeting work		
1	Whether the schemes for roof sheeting work access system ready?	
2	Whether sheet lifting system in line with the sketches shown in the safety standard?	
3	Whether the sheeting cages are as per the Standard Drawings?	
4	Whether the lifting system for tools, tackles, & screw machines is in line with the sketch shown in this standard?	
5	Whether the sheet fixing process is in line with the procedure defined in this standard?	
6	Whether the sheet lifting is in line with the standard drawings?	
Painting Work		
1	Whether the existing ladders /staircases are adequate and inspected for wellness?	
2	Suitability of a option of various methods or system studied?	

Sl. No.	Question	Y/N
Anchorage / support fixing Points		
1	Structural support for winch, pulleys system, lifeline supports for fall arrestor etc. are in line with the sketches shown in this standard?	
2	Do capacity of winches, pulleys, d-shackles & slings /steel wire rope ascertained for not less than 5000 Kg?	
3	Do steel wire rope / sling as life line for fall arrestor, suspended parallel to hanging cages/cradles?	
4	Do all sketches, drawings, photographs, pictorials, etc. of this standard have been studied for their applicability as per site needs?	

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	WORKING IN CONFINED SPACE	Doc. No: SG/03 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

Objective of this guideline is to provide the safe work practices required for Confined Space entry and to protect personnel from the hazards of entering & performing jobs in Confined spaces.

Some of the hazards frequently encountered in the confined spaces are:

- 1.1 Oxygen deficiency/ enrichment
- 1.2 Presence of toxic, flammable or asphyxiating gases
- 1.3 Entry/ liberation of hazardous material/ gases/ water during work
- 1.4 Presence of rotating equipment
- 1.5 Need to work in cramped or un-natural postures
- 1.6 Dusty environment
- 1.7 Tripping hazards
- 1.8 Inadequate illumination
- 1.9 Fire/ explosion
- 1.10 Electric Shock
- 1.11 Hot environment

2. Scope

This guideline applies to all Works and project sites of Iron & Steel companies

3. Procedure

3.1 Definitions

i) Confined Space

A confined space has limited means for entry or exit. It is not designed for continuous occupancy. It is so configured that an employee/ employees can enter and perform only the assigned work in the space within a designated time and is having one or more hazards listed above.

Examples of confined spaces are: pits, excavations, cable tunnels, sewers, vessels, storage tanks, gas holders, inside pipelines, cyclones, dust catchers, electrostatic precipitators, scrubbers, bunkers, silos, bins, ducts, hopper, sumps, equipments like Mills, large Fan, blast furnace proper, hot blast stove, stacks, dedusting system, WGHR,BLT equipment, torpedo ladles etc.

- ii) LEL: Lower explosive limit
- iii)LOTO: Lock out Tag out
- iv)TLV- TWA : Threshold Limit Value – Time Weighted Average

3.2 Precautionary Steps

For safe working inside a confined space, the following must be ensured:

- i) A cross functional team should identify all the confined spaces in the plant/projects areas and assign an identification number.
- ii) The owner department/ Executing Authority shall prepare a Safe Work procedure/ protocol after detailed Hazard Identification & Risk Assessment or Job Safety Analysis (JSA) in conjunction with Safety Officer.
- iii) The site arrangement for safe working must be inspected by Safety officer, owning department and Executing Agency before the workmen are allowed to enter the space.
- iv) Before start of work, safety talk to be imparted to the workmen by the safety officer / executing authority on the various hazards associated with the job along with the precautionary measures to be taken and records to be maintained.
- v) Entry permit, as in **ANNEXURE-I**, will be signed by all the above representatives and finally approved by the concerned HOD/ Section In-charge of the owning/ executing Authority.
- vi) Noticeable cautions sign “Notice - Confined Space Entry Permit Required for Entry.” shall be displayed. Barricades and signs shall be put up to warn and prevent unauthorized access to the work area where confined work is in progress.
- vii) Ensure that the confined space is thoroughly free of all hazardous or corrosive substance such as gases, all kinds of fumes, chemicals, muck and solid wastes, etc. Also, it must be free from decaying vegetation and animal waste that may release Methane gas.
- viii) For clearing of smeared containments muck, solid waste etc, a safe procedure to be included in the protocol.
- ix) It shall be ensured that the confined space is completely isolated from the connected system with blank plates having correct size, material of construction and appropriate pressure rating wherever necessary and separated from all the utility systems such as inert gases, fuel gases, steam, water and other fluid connections.
- x) Ensure that either natural or mechanical ventilation is provided to the confined space. It must also be adequate to remove fumes generated during various activities. A responsible person from the concerned department must ensure the adequacy of ventilation and rescue arrangements.

- xi) Ensure that all the moving parts of equipment inside the confined space are adequately guarded and the power supply disconnected with LOTO.
- xii) Ensure adequate illumination inside the confined space. All portable illumination system shall be up to 24 Volt only. (Ref 36A of Factories Act 1948).
- xiii) Ensure that all the portable electrical equipment used in a confined space are either grounded or double insulated or equipped with earth leakage cut out safety system. In case there is a likelihood of presence of explosive fumes or gases, all the electrical devices used must be of a type approved for such application.
- xiv) A calibrated multi gas detector (CO, O₂, LEL) shall be made available with the working people for continuous monitoring of working inside the confined space (with ventilation off) to check for:
 - a) Oxygen deficiency and Oxygen enriched atmosphere
 - b) Presence of toxic substances, wherever applicable
 - c) Explosive concentration, wherever applicable
- xv) It shall be ensured that all gaseous, toxic and explosive components are well within the prescribed limit before allowing the people to go inside. [Ref 36.2(a) of Factories Act 1948]
- xvi) Continuous monitoring shall be used when the activity inside the confined space can alter atmospheric conditions or there is a known activity-taking place outside the space during the entry that has direct potential to alter the atmospheric conditions inside the space. Periodic monitoring (not more than 2 hours apart) shall be done in the cases when the condition inside the confined space is not likely to be altered because of the work inside the confined space and/or activities being carried out in the surrounding space.
- xvii) If the workmen are using oxygen consuming equipment (torches, burners etc) ensure that the confined space is continuously provided with sufficient air to maintain minimum Oxygen concentration of 19.0% to 23% by volume.
- xviii) A designated supervisor of the executing agency must be deputed outside the confined space whose sole responsibility will be to watch the safe execution of work, sound an alarm and render assistance immediately, if required.
- xix) There must be a suitable means of voice communication between the workmen inside the confined space and the Supervisor outside. If for some reason, it is not possible to use a voice communication device, a proper signaling system shall be established between the workmen inside and the Supervisor.
- xx) Ensure that the persons working in a confined space are provided with adequate personal protective devices such as Safety Harness, gas masks, breathing apparatus, gas detector/ personal sampler with alarm facility, etc as per requirement. [Ref Section 36.2(b) of Factories Act 1948]
- xi) According to the nature of work and the risk involved due to presence of toxic gases and fumes, the working spell shall be interrupted by rest periods during which the person shall come out and breathe in open air. The maximum allowable spell of work shall be recorded clearly in the protocol.

- xxii) A person who has already worked for 8 hours in a confined space, must not be allowed to work further on the same day.
- xxiii) If the person working inside is wearing a full body Harness with double lanyard, care must be taken to ensure that he is anchored with lifeline and proper arrangements so that he can be pulled out and rescued immediately in case of emergency. Provision of rescue team shall be kept ready for dealing with such incidents.
- xxiv) In case of gas cutting and welding in a confined space, ensure that all the hoses are free from leaks. Compressed gas bottles/cylinders are forbidden inside a confined space. The gas torches should be lighted outside the confined space and the space must be tested for explosive atmosphere each time before a lighted torch is taken inside. [Ref Section 37.4 of Factories Act 1948]
- xxv) As far as practicable all confined space job are to be planned during day light hour.
- xxvi) Whenever combustion type equipment is used in a confined space, ensure that the exhaust gases are vented outside.
- xxvii) Ensure that the warning notices/ caution boards are displayed outside the confined space at appropriate visible locations.
- xxviii) Each time a man goes in or comes out of the confined space, a proper record with their signature must be maintained at site by the supervisor/ executing Authority.
- xxix) After the completion of the work, men and material must be removed from the confined space and permit to work shall be returned by the representative of the executing agency to the designated officer of the owning department.
- xxx) Emergency plan: To deal with any serious and imminent danger to workers inside a confined space, appropriate emergency procedures should be formulated and implemented according to the nature of the confined space, the risks involved and the nature of an emergency rescue .

xxxi) Assigned Duties:

- a) Authorized entrant

Authorized entrants are required to:

- Know space hazards, including information on the means of exposure such as inhalation or dermal absorption, signs of symptoms and consequences of the exposure;
- Use appropriate personal protective equipment properly;
- Maintain communication with attendants as necessary to enable them to monitor the entrant's status and alert the entrant to evacuate when necessary;
- Exit from the permit space as soon as possible when:
 - ✓ Ordered by the authorized person;
 - ✓ He or she recognizes the warning signs or symptoms of exposure;
 - ✓ A prohibited condition exists; or

- ✓ An automatic alarm is activated.
- Alert the attendant when a prohibited condition exists or when warning signs or symptoms of exposure exist.

b) Attendant

The attendant is required to:

- Remain outside the permit space during entry operations unless relieved by another authorized attendant;
- Perform non-entry rescues when specified by the employer's rescue procedure;
- Know existing and potential hazards, including information on the mode of exposure, signs or symptoms, consequences and physiological effects;
- Maintain communication with and keep an accurate account of those workers entering the permit space;
- Order evacuation of the permit space when:
 - ✓ A prohibited condition exists;
 - ✓ A worker shows signs of physiological effects of hazard exposure;
 - ✓ An emergency outside the confined space exists; and
 - ✓ The attendant cannot effectively and safely perform required duties.
- Summon rescue and other services during an emergency;
- Ensure that unauthorized people stay away from permit spaces or exit immediately if they have entered the permit space;
- Inform authorized entrants and the entry supervisor if any unauthorized person enters the permit space; and
- Perform no other duties that interfere with the attendant's primary duties.

References:

1. IPSS:1-11-006-14 'Guidelines for Working in a Confined Space'
2. Safe Work in confined space'- Published by Occupational Safety & Health Branch., Deptt. of Labour, Govt. of Hongkong
3. Tata Power Co. Ltd. 'Confined Space Entry Procedure' standard
4. Tata Steel Limited 'Working in Confined Space' standard
5. OSHA 3138-01R 2004 " Permit required Confined Space"

ANNEXURE-I**PERMIT-TO-WORK FOR WORKING IN CONFINED SPACE**

(For working in a confined space containing toxic/ inflammable/ explosive gases/ vapors/ chemicals. Valid only for 1-day)

Warning: Working in a confined space is hazardous. Special precautions must be taken)

A. GENERAL (TO BE FILLED IN BY EXECUTING AUTHORITY)

1. Brief description of job: _____
2. Exact location & name of equipment/confined _____
Space where work is to be done _____
3. Executing Deptt. _____ Name of agency _____
4. Name, designation & Contact No. of Executive _____

5. All contractor workers taken safety induction training from Safety Engineering Department (SED)? _____
6. Name & designation of observer provided exclusively to keep a watch over persons working inside: _____
7. Adequate system of communication provided between persons working inside and observer? Y/N
8. The personnel entering confined space will use:
 i) Breathing apparatus Y/N
 ii) Safety Harness Y/N
9. Any Fuel Gas & Oxygen cylinders not kept inside the confined space. Yes/
No

Name: _____ Signature: _____ Designation: _____

Date: _____ Time: _____ Contact No. _____

B. ELECTRICAL ACTIONS TAKEN

1. Have all equipment connected with Sl.No. 2 been shutdown, fuses removed, earthed and caution tags displayed? ____(YES/ NO)

ELECTRICAL SHUT DOWN NO. _____

2. Are low voltage lamps (24 V) provided at site? ____(YES/ NO)

Name: _____ Signature: _____ Designation: _____

Date: _____ Time: _____ Contact No. _____

C. OPERATIONAL ACTIONS TAKEN (TO BE FILLED BY OWNER/ OPERATION DEPTT)

1. Confined space been depressurized and ventilated by opening Manholes, bleeders etc? _____

2. Confined space has been physically isolated by blank plates so as to prevent ingress of toxic gas/ vapors/ chemicals? _____

3. Artificial ventilation provided? _____ (YES/ NO)

4. Have adequate numbers of breathing apparatus & oxygen resuscitating equipment been kept at site? Specify quantities of each.
-

5. Name the toxic gases/ vapors/ chemicals expected to be present.
-

6. Have all equipment, connected with Sl. No. 2 been shutdown/ depressurized?
-

7. Have any special arrangements been made like provision of fire extinguishers, clear water supply for chemical accidents, oxygen resuscitation equipment, fire brigade, ambulance etc._____

8. Any other safety measure taken. _____

Name: _____ Signature: _____ Designation: _____

Date: _____ Time: _____ Contact No. _____

D. MEASUREMENT OF TOXIC, EXPLOSIVE GASES & OXYGEN CONCENTRATION (TO BE FILLED BY ENERGY/FUEL MANAGEMENT DEPTT)

1.What is the concentration of toxic gases (For details , refer 2nd schedule of Factories Act, 1948) - (shall be below 50 % of TLV-TWA)
: _____

2.Is the confined space checked for explosive mixture and found safe?
(LEL reading shall be zero) _____

3. What is the concentration of Oxygen in the space and is it safe to undertake the job? (safe limits 19-23%) _____

Name: _____ Signature: _____ Designation:_____

Date: _____ Time: _____ Contact No. _____

E. ISSUANCE OF PERMIT-TO-WORK (TO BE FILLED BY OWNER/ OPERATION DEPTT)

In view of the above safety measures taken, permit to work for the equipment at Sl. No. 2 is hereby issued. The executing personnel should use all relevant PPE's like BA Sets, Air line, Full Body Harness, Life line etc.:

This permit is valid for Dt: _____ from _____ Hrs to _____ Hrs

Name: _____ Signature: _____ Designation:_____

Date: _____ Time: _____ Contact No. _____

(To be signed by an Executive)

CAUTION /WARNING/ DANGER



WARNING

- Provide caution board that vessel entry is in progress.
- Remove gas-cutting torch when not in use from confined space.



CAUTION

Gas cylinder / welding machine shall never be taken in confined space



CAUTION

Isolation of confined spaces by simply closing of isolation valves shall not be accepted for man entry purpose.



CAUTION

Oxygen should not be used to ventilate the Confined Space

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	Permit to Work (Operation & Maintenance)	Doc. No: SG/04
		Rev no. : 00 Effective Date : 14.10.2019

1. Objective

A permit-to-work system is a formal written system used to control certain types of work [as mentioned in Sl. No. 3.2 (i)] that are potentially hazardous. A permit-to-work is a document which specifies the work to be done and the precautions to be taken and form an essential part of safe systems of work for many operational & maintenance activities being carried out in industrial organisations. This guideline elaborates the procedure for obtaining the permit before the start of work & its return after completion of work.

2. Scope

This guideline is applicable to all the areas/ shops in the steel industry.

3. Procedure

3.1 Definitions

LOTO: Lock Out Tag Out system whereby the energy source is locked out for preventing inadvertent switching and tagged out for alerting people about work in progress.

3.2 The Jobs where Permit to Work is required

- i) The Permit to work is to be obtained for carrying out work like repair, replacement, modification, maintenance (including whitewashing, cleaning & painting), inspection, etc, which are hazardous in nature or at hazardous locations or involving multiple agencies and which expose the men and material to risk due to any one or more of the following:
 - a) Work on electrically operated equipment.
 - b) Work on pipelines/equipments handling chemicals, acid, gases, steam, water, oil, etc, at normal/ below/ above atmospheric pressure and temperature.
 - c) Work on or in the vicinity of moving machines/equipments/gas prone areas/ high tension lines/ bare conductors.
 - d) Work in confined spaces.
 - e) Demolition and excavation.
 - f) Connection and interfacing between new and old units.
 - g) Work at height.
 - h) Any other equipment/ location/ area which may be associated with hazards.
- ii) Permit to work may or may not involve shutdown of the equipment. Electrical shutdowns, if needed, shall, however, be issued in accordance with Indian Electricity Rules. This will be obtained by the issuing authority of the owner department.

3.3 Procedure for Obtaining Permit to Work

- i) An authorized representative of the executing department shall obtain "Permit to Work" from the owner department in writing by applying on the format given at **APPENDIX**. The permit to work shall be issued by the issuing authority of the owner department or a competent person authorized by him.
- ii) The above Format shall be filled in and signed by all the concerned persons in triplicate, preferably carbon copies. The first copy shall be for the record of the person seeking the permit while the second copy shall be for record of the person issuing the permit and third copy of Electrical Isolation (whenever required). LOTO (Lock Out Tag Out) to be followed, wherever the facility permits.
- iii) An E- Permit to Work system may be suitably devised on an IT based / SAP platform based application which may be customized as per the 'Permit to Work' guideline. It will replace the manual system of work permit with enhanced safety and other features of an IT based system. In the new e-permit system, one can raise, process, approve and execute the permits online. Inherent benefits of going digital will introduce many interlocks in the present manual permit system. Also, it will enhance the review, analysis and tracking of the various aspects of work permit system like keys, people working, agencies involved, isolation done etc.
- iv) Order of sequence to be followed for issuance of Permit to Work.
 - a) Agency/ Person seeking Permit to Work shall approach the owner of the equipment (Operation) with duly filled form in Triplicate.
 - b) The Owner/ Operation Department will approach electrical for taking Power Isolation (Where ever required).
 - c) Owner (Operation) will inspect the equipment/ area and give final clearance/ issue permit to the seeker.
- v) Before issuing the Permit to Work, the following shall be ensured by the issuing authority
 - a) The equipment shall have to be stopped and put out of operation wherever necessary by the issuing authority/ owner department.
 - b) "Caution" tags and "Men at Work" tags shall have been placed at conspicuous and vulnerable locations by the issuing authority.
 - c) Red flags, barricades, stoppers, earthing bars (with clearance of electrical department), etc. shall have to be placed at vulnerable locations by the concerned authority.
 - d) For air, gas, steam, hydraulic fluids, acid, chemicals, water, etc, valves will be closed or a blank shall be provided wherever necessary by the owner department. Valves shall be put in locked position, wherever such provisions exist and the key shall have to be kept in safe custody of a person as decided by the competent person of the owner department.
 - e) Electrical fuses shall have to be removed and kept in the safe custody of issuing authority.
 - f) Sample analysis of gas/air shall have to be done.
 - g) All concerned personnel/ agencies who are likely to be affected by the work/

shutdown shall have to be communicated about the work, stoppage of equipment, etc. by the owner department.

- h) All persons in the vicinity shall have to be informed by the issuing department.
- i) The details about the likely hazards and precautions to be taken shall have been explained or given in writing by the owner department to the person seeking permission to work.
- j) Relevant job protocol to be prepared by the job coordinator with distinct no. and date.
- vi) After ensuring the compliance of above points the person issuing the "Permit to Work" shall sign the form(s) as a token of having granted the Permission to Work.
- vii) The person taking permit to work shall adhere to all safety precautions, including those in job protocols, and provide adequate supervision in order to do the job safely and without damage to equipment.
- viii) Permit to work shall be valid for the date of issue only limited to the period specified in the format. However for long duration shut down, the validity of permit may be increased depending upon site condition and discretion of HOD.
- ix) A Work Permit Register shall be maintained by the owner department and electrical department, where the detailed records of all "Permits to Work" issued by the department shall be entered chronologically.
- x) In case of multiple agencies seeking shutdown on same equipment, separate Permit to Work form should be filled by each agency as per the aforementioned procedure. "Multiple Shutdown" seal in Red Color to be put on the form for identification.
- xi) Work permit may be displayed prominently at the site.

3.4 Return / Withdrawal of Permit to Work

- i) After the job is completed and it is ensured that the material including red flags, barricades, stoppers, earthing bars, etc, have been removed and the men at work have vacated the site, the person who had obtained the permit to work or the person authorized by him shall offer the first copy of the "Permit to Work" form to the issuing authority or in his absence to the authorized person of the owner department (see Format at [APPENDIX](#)) as a token of having completed the work and handing over of the premises back to the owner department.
- ii) The issuing authority/ authorized representative of the owner department on receiving the first copy of Form from executing authority shall personally verify the safety aspects of men and machines before accepting the premises/equipment for operation/service. The owner department will then approach electrical for energizing the equipment and obtained his signature (whenever applicable). Acceptance shall be recorded, signature affixed on all the copies, 2nd copy will be retained by the owner department and First copy will be returned to the executing authority.
- iii) In case the job is not completed in the same shift or on scheduled time and is completed after the working hours of the issuing authority, the permit to work shall be returned to the authorized person or the competent person authorized by the issuing authority. The authorization including the name, designation and

contact no. of the authorized person for receiving the work permit form and for putting the equipment into operation shall be clearly written in the shift log book and work permit register by the person who granted the permit to work. Besides, the details of authorized person shall be recorded on the format while granting permit to work.

- iv) Any equipment or apparatus on which permit to work has been issued, shall not be normalized/switched on until all shutdowns issued under particular equipment have been duly returned and cancelled. However, due to exigencies such as loss of the permit to work, the equipment shall be normalized only after a certificate to the effect that it is safe to normalize the equipment, is issued by an authority higher than the requisitioning/ executing authority.

References:

1. IPSS 1-11-007-14 : Procedure for Permit to Work
2. Safety Manual of SAIL
3. Tata Steel's Work Permit safety standard

FORM NO._____

APPENDIX

[Clause 3.3 (i) & 3.4 (i)]

**FORMAT FOR REQUISITION, PERMISSION AND RETURN/WITHDRAWAL
OF PERMIT TO WORK**

(NAME OF THE PLANT) _____

REQUISITION

- i) Equipment/ Location/ Area on which job is to be undertaken _____
- ii) Date : _____
Duration From : _____ To: _____ (Hrs.)
- iii) Job(s) to be carried out _____
- iv) Deptt./ Agencies involved in the job _____
- v) Whether Electrical/ Operation Shutdown is required? Yes / No
- vi) If yes, please specify the nature of shutdown _____

Executing Authority

Signature & Date _____

Name & Designation _____

Contact Mobile NO. _____

PERMISSION

I have verified/ inspected the area , ensured adherence to the points mentioned overleaf and found safe for work.

Required shutdown
given

Permit to Work is granted
to Executing Authority

Signature _____

Signature _____

Name & Designation _____

Name & Designation _____

Contact No. & Date _____

Date _____

Department _____

Contact No._____

(Shutdown giving Authority)
(Electrical)

Representative of Owner Dept..
Operation)

RETURN / WITHDRAWAL

The above job is over. All agencies, men and materials have been removed from worksite Equipment/ Location/ Area may be used for normal operation.	I have checked / inspected the area before clearing the shutdown.	I have checked the position as stated alongside and I accept the above Area/ Location/ Eqpt. for service/ operation
--	---	---

Signature:_____ Signature: _____ Signature:_____

Name & Designation: ____ Name & Designation: ____ Name & Designation :____

Time & Date :_____ Time & Date :_____ Time & Date :_____

Department:_____

(Executing Authority/
Authorized representative)

(Shutdown
clearing authority)
(Electrical)

(Issuing Authority/ Authorized
Representative of Owner Deptt.)

CHECK POINTS BEFORE GRANTING PERMISSION

(Write "Yes", "No" or "Not required" as applicable)

- i) Whether the job protocol exists? _____
- ii) Have cautions board/tags been displayed at conspicuous places? _____
- ii) Have fuses/ Breakers/ Isolators been removed?

- iv) Has earthing been done? _____
- v) Have hydraulic/air/gas/steam/acid valves been closed? _____
- vi) Has emergency key of valves been put in safe custody? _____
- vii) Has gas/air sample analysis been done? _____
- viii)
 - a) Whether the deptts./ sections/ individuals likely to be affected have been communicated about the job/ shutdown? _____
 - b) If yes, which department/ section/ individuals have been informed

- ix)
 - a) Have associated hazards & precautionary measures Yes/No
been explained to executing agency?
 - b) Have all personnel/ agencies in near vicinity been informed? Yes/No
 - c) Any other precautions taken? If yes, details _____
- x) Has concerned plant/equipment been put out of
operation/ switched off? Yes/No

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	ILLUMINATION AT WORKPLACE	Doc. No: SG/05 Rev no : 00 Effective Date : 14.10.2019

1.0 Objective

Proper illumination at workplace is important to ensure safe working by the employees. The quicker and easier it is to see a hazard, the more easily it can be avoided. The types of hazard present at work therefore determine the lighting requirements for safe operation. Hazards of poor lighting are eye strain / discomfort, mis-judgment of position/ shape, human fatigue, poor health etc. This guideline provides basic information for ensuring 'Illumination or lighting at Workplace'.

2.0 Scope

The safety guideline is applicable to all the areas/ shops in the steel industry.

3.0 Procedure

3.1 Definitions

Lux: unit for measurement of Illuminance. It is the luminous flux that strikes a unit area. 1 Lux = 1 Lumen/ Sq. Metre

Foot Candle: 1 Foot Candle = 1 Lumen/ Sq. Ft = 10.752 Lux

Maintenance Factor (MF): the ratio of the average illuminance on the working plane after a certain period of use of a lighting installation to the initial average illuminance obtained under the same conditions for the installation. It takes account of all losses including lamp lumen maintenance.

3.2 Assessing lighting at the workplace

It is important that lighting in the workplace:

- i) Allows people to notice hazards and assess risks.
- ii) Is suitable for the environment and the type of work (for example, it is not located against surfaces or materials that may be flammable).
- iii) Provides sufficient light (illuminance on the task).
- iv) Allows people to see properly and discriminate between colours, to promote safety.
- v) Does not cause glare, flicker or stroboscopic effects.
- vi) Avoids the effects of veiling reflections.
- vii) Does not result in excessive differences in illuminance within an area or between adjacent areas.
- viii) Is suitable to meet the special needs of individuals.
- ix) Does not pose a health and safety risk itself.

- x) Is suitably positioned so that it may be properly maintained or replaced, and disposed of to ensure safety.
- xi) Includes, when necessary, suitable and safe emergency lighting.

3.3 Illumination levels at different areas of the workplace

The lighting system inside and outside plant units are designed based on the desired illumination levels recommended by IS and the practices followed in industries, architectural arrangement, building dimensions including mounting height, environmental considerations, ease of maintenance and reliability of the lighting distribution network.

The illumination system shall be designed as per IS: 3646-1992. Reputed makes shall be used. The level of illumination, type of fittings, maintenance factor to be considered is as given below:

Area	Lux level	Type of Light Fittings & Lamps	MF
Control rooms	300	Decorative mirror optic luminaire for recessed mounting with energy efficient CFL 2x36W of Philips type FBS 450/236 M2 HF (with MASTER PL-L 36W/840/4P ICT lamp) OR equivalent.	0.75
Electrical rooms having PCC, PDB, CMCC without false ceiling	200	Surface mounted / Suspended luminaires suitable for T5 lamps 2x28 W of Philips type TPS 814/228 D8 HF/ TPH 824/228 I HF (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent.	0.7
Electrical rooms having IMCC, VFD panels, PLC with false ceiling	200	Decorative mirror optic luminaire for recessed mounting with energy efficient T5 lamps 2x28W of Philips type TBS 669/228 D6 HF (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent.	0.7
Offices, Conference rooms without false ceiling	300	General purpose batten luminaire with energy efficient T5 lamps 2x28W of Philips type TMS 122/228 E HF with GMS 122/228 Reflector (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent.	0.75
Offices, Conference rooms with false ceiling	300	Decorative mirror optic luminaire for recessed mounting with energy efficient T5 lamps 2x28W of Philips type TBS 669/228 D6 HF (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent.	0.75
Battery Room	100	General purpose batten luminaire with energy efficient T5 lamps 2x28W of Philips type TMS 122/228 E HF with GMS 122/228 Reflector (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent.	0.6

Area	Lux level	Type of Light Fittings& Lamps	MF
Transformer Room	100	General purpose batten luminaire with energy efficient T5 lamps 2x28W of Philips type TMS 122/228 E HF with GMS 122/228 Reflector (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent.	0.6
Civil Staircases of plant buildings	100	General purpose batten luminaire with energy efficient T5 lamps 2x28W of Philips type TMS 122/228 E HF (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent.	0.6
Staircases (steel) of plant complex and cable tunnels / cellars/ Overhead cable galleries	70	Industrial well-glass integral type luminaire suitable for 70W HPSV lamps of Philips type HPK 105 1XSON – I 70 W OR equivalent.	0.6
Pump house	200	Industrial well-glass integral type luminaire suitable for 70W HPSV lamps of Philips type HPK 105 1XSON – I 70 W OR equivalent.	0.6
Flood lighting	70	Weather proof non integral type (integral type in case of high mast) flood light fittings suitable for 1x250/400W HPSV lamps of Philips type SNF 114 250/400W wide beam /narrow beam as per requirement OR equivalent.	0.5
Main Technological/ Operational areas like Casting Bays, Fan buildings, Sinter Machine platforms, BF Cast House etc.	200	High bay/Medium bay integral type light fittings suitable for 400W /250W HPSV lamps of Philips type HPK 225 SON 250/400W wide beam /narrow beam as per requirement OR equivalent.	0.6
Platforms near technological structures like Stoves, BF platforms, MND area, screens, crushers, weigh feeder platforms, wind boxes etc.	150	Industrial well-glass integral type luminaire suitable for 70W HPSV lamps, of Philips type HPK 105 1XSON – I 70 W OR equivalent.	
Conveyor Houses / conveyor gantries / junction houses	100	Industrial well-glass integral type luminaire suitable for 70W HPSV lamps, of Philips type HPK 105 1XSON – I 70 W OR equivalent.	0.6
Toilets	100	General purpose batten luminaire with energy efficient T5 lamps 1x28W of Philips type TMS 122/128 HF (with MASTER high efficiency TL5-28W/840 lamp) OR equivalent.	0.6

Area	Lux level	Type of Light Fittings& Lamps	MF
Area	Lux level	Type of Light Fittings& Lamps	MF
Street light Fittings	As per table below	Street light luminaire suitable for 150/250 W HPSV lamps of Philips type SGP 401/SON T 150/250 W OR equivalent.	
Areas having acid vapours	As required	Vapour proof light fittings	0.6

3.4 Area Lighting

Classification	Type of road	Av. Lux level	Type of illumination	MF
Group - A1	Important traffic road carrying fast traffic	30	Cut off / semi cut off	0.6
Group - A2	Main road carrying mixed traffic	15	Cut off / semi cut off	0.6
Group - B1	Secondary road with considerable traffic	8	Cut off / semi cut off or non cut off	0.6
Group - B2	Secondary road with light traffic	4	Cut off / semi cut off or non cut off	0.6

3.5 Portable Electric Light

For lighting inside a chamber, tank etc., no lamp or light other than **flame proof** construction be used in case any flammable gas, fume, dust is likely to be present. No portable electric light or electric appliances of voltage exceeding **24 volts** shall be permitted for use inside the chamber, Tank etc.

3.6 Regular Monitoring & Maintenance

Monitoring of illumination level at different locations of the workplace should be done at regular intervals. Maintenance should include:

- i) Cleaning lamp/ luminaires.
- ii) Repairing and replacing damaged or ineffective lamps/ luminaires.
- iii) Maintaining emergency lighting (proper cleaning, repairing, replacing and disposal).
- iv) Disposing of lamps/ luminaires safely.

References:

1. IS 3646 (Part 2): 1992 'Code of practice for Interior illumination'
2. CIBSE (Chartered Institution of Building Services Engineers, London) Code for lighting.

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	LANCE CUTTING	Doc. No: SG/06 Rev no. : 00 Effective Date : 14.10.2019

1 **Objective**

This safety guideline aims to ensure safety during lance cutting to prevent hazards like explosion, fire, burn & fumes of un-burnt gases.

2 **Scope**

This safety guideline is applicable for all sectors of Iron & Steel Industry.

3 **Procedure**

3.1 **Necessary Documentation**

3.1.1 **Safety Requirement / Precautions**

Before starting the job at site, all the safety requirements like safety helmet, safety goggle, face shield, overhaul, hand gloves, safety shoes, anklets, fire/ flame proof jacket, suitable fire extinguishers shall be decided as per the need of the area/ site by the executing agency in association with safety officer and contractor. These shall be documented.

3.1.2 Since lance Cutting is a Hazardous Activity, workers must leave their personal mobile phones prior to proceeding to the work site(s) to avoid getting distracted to respond to phone calls which may lead to accidents.

3.2 **Safety Talk**

Before commencement of work in each shift, all workers shall be given a safety talk by executing officer or his representative and this shall be recorded by the person in a register. The safety talk shall cover potential hazards like fire / explosion, fume of un-burnt gases.

3.3 **Execution of Work**

3.3.1 **Pre-Requisites for carrying out Lance Cutting Work**

- i. Before carrying out lancing, make thorough inspection of the work place and ensure that it is safe for lancing operations. Area where lance cutting work is to be carried out shall be cordoned off with rope and flag.
- ii. The executing officer, safety officer and in-charge of the shop, where the lancing work is to be carried out, shall inspect the site, identify the potential hazards like heat, chemical, fire, gases, etc.
- iii. No person shall be allowed to stand, walk or do any work or go for any other purpose near cordoned off area.
- iv. During lance cutting operations safe distance shall be maintained by lance cutter so that spark coming out from the cutting does not reach the cutter.

- v. As Lance cutting operation produces sparks which can travel long distances, inflammable material shall not be stored in the vicinity of lance cutting operation.
- vi. Examine whether the job of lance cutting can be done outside. If not, remove all the combustible material to a safe distance of at least 6m.
- vii. If combustible material cannot be removed, cover it with non combustible coverings.
- viii. A valve along with pressure gauge on the Oxygen pipe line from where tapping for lance cutting is taken shall be provided.
- ix. Identification mark shall be provided for the oxygen tap-off pipe line.
- x. Standard Operating Practices (SOPs) related to lance cutting shall be displayed near the work place.
- xi. Initially the lance pipe shall be ignited with the help of a burn bamboo or fire wood.
- xii. During lance cutting lance pipe is to be kept on stand and proper angle for cutting to be maintained, so that sparks/liquid metal shall not fall towards lancer/cutter.
- xiii. Lance pipe shall not be used for cleaning human body parts.
- xiv. For lancing pipes involving the use of higher diameter, the pipeline shall be provided with a regulation valve for maintaining pressure.
- xv. Lance pipe must be changed after 70 to 75% consumption of its length.

3.4 Selection of Pipes & Hoses

- 3.4.1 Lance pipe [6mm to 52mm] shall have thread arrangement at both ends and shall be connected to Oxygen gas supply properly [by tightening the socket]. Lance pipe shall conform to IS : 10577-1982.
- 3.4.2 Minimum length of the lance pipe inside the hose shall be 200 to 300 mm and clamped by tightening thread & socket. Hose shall conform to IS: 447-1988

Reference:

1. IPSS: 1-11-016-12 : Safety Procedure for Lance Cutting by Regular/ Contractor Workers
2. SAIL Plant Safety Manual

CHECK LIST (For Lance cutting operation)

1	Whether the area where lance cutting work is to be carried out shall be cordoned off with rope and flag.	Yes/No
2	Whether identification mark is there in O2/gas supply line.	Yes/No
3	Whether the supply line [O2/gas] is fitted with pressure gauge near the valve from where supply is obtained.	Yes/No
4	Is there any leakage observed around valve.	Yes/No
5	Whether end of supply line a head valve is properly clamped with rubber hose.	Yes/No
6	Whether any leakage observed in rubber hose.	Yes/No
7	Is rubber hose connected with nipple with clamp having threaded socket at other end.	Yes/No
8	Whether the length of nipple ahead rubber hose to threaded socket at other end is around 600 mm.	Yes/No
9	Whether the lance pipe used for lance cutting having thread at both the end.	Yes/No
10	Is there any flammable material near the lance cutting operation	Yes/No
11	Whether lance pipe is kept on stand during lance cutting operation.	Yes/No
12	Whether the burnt bamboo or jute is used for lighting the lance pipe at the beginning.	Yes/No
13	Whether the cutter is at a safe distance from the object so that sparks coming out during lancing shall not reach to the cutter.	Yes/No
14	Whether lance pipe is changed after 70% consumption of its length.	Yes/No
15	Whether fire extinguisher are there near the work place.	Yes/No
16	Whether safety goggle or face shield is being used by the lance cutter.	Yes/No
17	Whether blue drill is being used by cutter.	Yes/No
18	Whether hand gloves is being used by cutter.	Yes/No
19	Whether safety shoe and anklet is being used.	Yes/No
20	Whether cotton clothes are put by cutter.	Yes/No

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	GAS CUTTING & GAS WELDING	Doc. No: SG/07
		Rev no. : 00 Effective Date : 14.10.2019

1. Objective

The objective of this safety guideline is to provide measures to prevent working person and surrounding from the hazards like fire, explosion, burn and fumes of unburnt gases while performing gas cutting or heating by gas and gas welding jobs.

2. Scope

- 2.1 This Safety guideline is applicable while carrying out gas cutting or heating by gas and gas welding work at site during fabrication, maintenance and manufacturing jobs in Iron & Steel industry.
- 2.2 The scope does not cover arc welding work.

3 Procedure

3.1 Definitions

- 3.1.1 For the purpose of safety guideline, the definitions given in IS 818 shall apply.
- 3.1.2 Confined Space: A confined space has limited means for entry or exit. It is not designed for continuous occupancy. It is so configured that an employee/ employees can enter and perform only the assigned work in the space within a designated time and is having one or more hazards listed in SG-03: Safety guideline for 'Working in Confined Space'.

- 3.2 The activity of gas cutting or heating by gas and gas welding work involves following preliminary actions to avoid accidents:

- i. Checking / cleaning transportation of gas cutting set or unit and all other equipment concerned.
- ii. Fixing of gas cutting set.
- iii. Checking of leakage from different fittings.
- iv. PPEs needed to carry out job.
- v. Precautions to be taken during back fire.
- vi. Dismantling of set
- vii. Work permission by site In-charge/Section in-charge before start of the work.
- viii. Ascertaining qualification/training of gas cutter
- ix. Joining of hoses.
- x. Fire fighting arrangements.
- xi. After completion of the job, the cylinders, hose pipe, torch, cables, spatters, etc. are to be properly removed and kept at designated place. Area to be cleaned and waste matter removed.
- xii. Being a routine and hazardous job SMP for the same needs to be enforced.

3.2.1 General Requirements

- i. Work permit shall be issued to working agency before start of gas cutting/welding, by the authorized person of the department.
- ii. If the gas cutting/welding job is to be carried out at height (more than 2 meters) from ground level/in confined space/gaseous hazardous area/ near electrical installation, separate entry permit/work permit should be obtained from authorized agency. Electrical cables/ wires if any below the cutting area shall be properly guarded / protected from falling spatters.
- iii. Falling of spatters from height must be prevented. For this a metal trough should be used and spatters should be collected in a trough at the point of generation. Moist ceramic cloth may also be used wherever required. In case of problem in preventing of all the spatters falling down at the area below the site of hot work the area has to be barricaded. No cylinders should be kept in the barricaded area. Proper covering of the knob, valves etc of the cylinders adjacent to the barricading, must be ensured.
- iv. After completion of the job, the cylinders, hose pipe, torch, cables, spatters, etc. are to be properly removed and kept at designated place. Area to be cleaned and waste matter removed.
- v. After completion of the job, the work permit shall be returned by working agency and the receiving authority of owner department shall enter the form in the original along with the white copy.
- vi. Always use seamless tubing for connections with cylinder. All cracked hoses are to be scraped and removed from the site.
- vii. Test the area for flammables before welding and cutting when the atmosphere is vulnerable to such hazards.
- viii. Workers must leave their personal mobile phones prior to proceeding to the work site(s) to avoid getting distracted to respond to phone calls which may lead to accidents.

3.3 Fire Prevention and Protection

- i. All gas cylinders should be kept with safety protective caps when not in use.
- ii. It should be ensured that before starting the job surrounding area of the work side should be made free of fire hazard.
- iii. Employees engaged on working, cutting or heating by gas and gas welding work/ other hot jobs should be trained and capable to use fire equipments in case of any fire emergency.
- iv. Adequate fire fighting provision to be made available close to each area of cutting and other hot job.
- v. Emergency telephone number should be made available and displayed at work site by concerning agencies.

- vi. Objects to be cut or heated/ welded shall be moved to a designated safe location or, if the objects to be cut, or heated cannot be readily moved, all movable fire hazards in the vicinity shall be taken to a safe place, or otherwise protected.
- vii. If the object to be cut or heated/ welded cannot be moved and if all the fire hazards cannot be removed, positive means shall be taken to confine the heat and slag, and to protect the immovable fire hazards from them.
- viii. No cutting or heating/ welding shall be done where the application of flammable paints or the presence of other flammable compounds, or heavy dust concentrations creates a hazard.
- ix. Suitable fire extinguishing equipment shall be immediately available in the work area and shall be maintained in a state of readiness for instant use.
- x. When the cutting or heating/ welding operation is such that normal fire prevention precautions are not sufficient, additional personnel shall be assigned to guard against fire while the actual cutting, or heating operation is being performed, and for a sufficient period of time after completion of the work to ensure that no possibility of fire exists. Such personnel shall be instructed as to the specific anticipated fire hazards and how the firefighting equipment provided is to be used.
- xi. When cutting or heating/ welding is performed on walls, floors, and ceilings, since direct penetration of heat transfer may introduce a fire hazard to an adjacent area, the same precautions shall be taken on the opposite side as are taken on the side on which the welding is being performed.
- xii. For the elimination of possible fire in enclosed spaces as a result of gas escaping through leaking or improperly closed torch valves, the gas supply to the torch shall be positively shut off at some point outside the enclosed space whenever the torch is not to be used or whenever the torch is left unattended for a substantial period of time, such as during the lunch period. Overnight and at the change of shifts, the torch and hose shall be removed from the confined space. Open end fuel gas and oxygen hoses shall be immediately removed from enclosed spaces when they are disconnected from the torch or other gas-consuming device. In no case a gas cutting torch should be kept in gas release condition when not in use.
- xiii. Except when the contents are being removed or transferred, drums, pails, and other containers, which contain or have contained flammable liquids, shall be kept closed. Empty containers shall be removed to a safe area apart from hot work operations or open flames.
- xiv. Drums, containers, or hollow structures which contains toxic or flammable substances shall, before cutting, or heating is undertaken on them, either be filled with water or thoroughly cleaned of such substances and ventilated and tested.

- xv. Before heat is applied to a drum, container, or hollow structure, a vent or opening shall be provided for the release of any built-up pressure during the application of heat.
- xvi. Flash back arrester is to be provided in oxygen and fuel line at both ends.

3.4 Execution

The following points shall be strictly adhered to, while carrying out gas cutting or heating/ welding job:

3.4.1 Preparation

- i. Gas cutting set shall be properly cleaned / checked and kept in a special trolley for transportation.
- ii. Nozzle shall be used as per job specification.
- iii. Nozzle shall be cleaned by proper method. Before using it, ensure that the hoses are clear (no jamming is there).
- iv. Clamps shall be used for joining hoses whenever required.
- v. Ensure non-return valve on Dissolved Acetylene (DA) cylinders.
- vi. Ensure proper fire fighting arrangements at work place where job is to be carried out.
- vii. Opening key must be hung on DA cylinder all the time during work.
- viii. DA cylinder shall be in vertical and Oxygen cylinder shall be in horizontal position during work, with proper fixing arrangement.
- ix. Provision of flash back arrestor as per IS : 11006-1984 (Specification of flashback arrestor / flame arrestor) shall be ensured in the welding / gas cutting sets on the oxygen and fuel gas line in the regulator as well as nozzle side to avoid flashback.
- x. LPG / BCG Cylinders should not be exposed to heat.
- xi. Wet gunny bags may be used along the LPG cylinder,
- xii. All cylinders shall be stored at a safe distance, of not less than 10 metre from all operations which result in excessive heat.

3.4.2 Work Place Inspection

- i. Moving machinery near work vicinity.
 - a) Proper shutdown shall be taken before carrying out job in such areas.
- ii. Gas prone area
 - a) All gas lines are to be inspected and proper precaution shall be taken. Proper shut down shall be taken before carrying out the job.
 - b) Air sampling shall be done before start of the work and at regular intervals.
 - c) Proper fire fighting arrangement must be made before start of the work.

iii. Oily / Grease area

- a) Area shall be cleaned by proper method & or shall be covered by non-combustible material before start of the work.

3.4.3 Execution in Specific Area

- i. Cutting/ Welding Jobs at Height: SG-02: Safety guideline for working at height shall be applicable.
- ii. Cutting/ Welding Job in Confined Space: SG-03: Safety guideline for Working in Confined Spaces shall be followed.
- iii. Cutting Job For Dismantling Of Old/Existing Structure
 - a) Structure which has to be cut shall be tied with wire rope and care has to be taken that no one is just above the cut point to avoid swing, after cutting job is over. Use of manila rope is strictly prohibited.
 - b) Cutting job shall be carried out in presence of experienced personnel/supervisor/site in-charge.

3.4.4 Transporting, moving, and storing compressed gas cylinders

- i. Valve protection caps shall be in place and secured.
- ii. When cylinders are hoisted, they shall be secured on a cradle, sling board, or pallet. They shall not be hoisted or transported by means of magnets or choker slings.
- iii. Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dropped, struck, or permitted to strike each other violently.
- iv. When cylinders are transported by powered vehicles, they shall be secured in a vertical position.
- v. Valve protection caps shall not be used for lifting cylinders from one vertical position to another
- vi. Unless cylinders are firmly secured on a special carrier intended for this purpose, regulators shall be removed and valve protection caps put in place before cylinders are moved.
- vii. A suitable cylinder trolley, chain, or other steadyng device shall be used to keep cylinders from being knocked over while in use. Such cylinders are not considered to be "in storage."
- viii. When a job is finished, when cylinders are empty or when cylinders are moved at any time, the cylinder valve shall be closed.
- ix. Compressed gas cylinders shall be secured in an upright position at all times except, if necessary, for short periods of time while cylinders are actually being hoisted or carried.
- x. Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of 3.0 m.

3.4.5 Placing cylinders

- i. Cylinders shall be kept far enough away from the actual welding or cutting operation so that sparks, hot slag, or flame will not reach them. When this is impractical, fire resistant shields shall be provided.
- ii. Cylinders shall be placed where they cannot become part of an electrical circuit. Electrodes shall not be struck against a cylinder to strike an arc.
- iii. Fuel gas cylinders shall be placed with valve end up whenever they are in use. They shall not be placed in a location where they would be subject to open flame, hot metal, or other sources of artificial heat.
- iv. Cylinders containing oxygen or acetylene or other fuel gas shall not be taken into confined spaces.

3.4.6 Treatment of cylinders

- i. Cylinders, whether full or empty, shall not be used as rollers or supports.
- ii. No person other than the gas supplier shall attempt to mix gases in a cylinder. No one except the owner of the cylinder or person authorized by the owner, shall refill a cylinder. No one shall use a cylinder's contents for purposes other than those intended by the supplier.
- iii. No damaged or defective cylinder shall be used.

3.4.7 Use of fuel gas

The employer shall thoroughly instruct employees in the safe use of fuel gas, as follows:

- i. Before a regulator to a cylinder valve is connected, the valve shall be opened slightly and closed immediately. (This action is generally termed "cracking" and is intended to clear the valve of dust or dirt that might otherwise enter the regulator.) The person cracking the valve shall stand to one side of the outlet, not in front of it. The valve of a fuel gas cylinder shall not be cracked where the gas would reach welding work, sparks, flame, or other possible sources of ignition.
- ii. The cylinder valve shall always be opened slowly to prevent damage to the regulator. For quick closing, valves on fuel gas cylinders shall not be opened more than 1-1/2 turns. When a special wrench is required, it shall be left in position on the stem of the valve while the cylinder is in use so that the fuel gas flow can be shut off quickly in case of an emergency. In the case of manifold or coupled cylinders, at least one such wrench shall always be available for immediate use. Nothing shall be placed on top of a fuel gas cylinder, when in use, which may damage the safety device or interfere with the quick closing of the valve.
- iii. Fuel gas shall not be used from cylinders through torches or other devices which are equipped with shutoff valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold.
- iv. Before a regulator is removed from a cylinder valve, the cylinder valve shall always be closed and the gas released from the regulator.

- v. If on opening a fuel gas cylinder, leak is detected around the valve stem, the valve shall be closed and gland nut to be tightened. If this action does not stop the leak, the use of the cylinder shall be discontinued, and it shall be properly tagged and removed from the work area. In the event that fuel gas should leak from the cylinder valve, rather than from the valve stem, and the gas cannot be shut off, the cylinder shall be properly tagged and removed from the work area. If a regulator attached to a cylinder valve effectively stops a leak through the valve seat, the cylinder need not be removed from the work area
- vi. The cylinder valve shall always be opened slowly to prevent damage to the regulator. For quick closing, valves on fuel gas cylinders shall not be opened more than 1-1/2 turns. When a special wrench is required, it shall be left in position on the stem of the valve while the cylinder is in use so that the fuel gas flow can be shut off quickly in case of an emergency. In the case of manifold or coupled cylinders, at least one such wrench shall always be available for immediate use. Nothing shall be placed on top of a fuel gas cylinder, when in use, which may damage the safety device or interfere with the quick closing of the valve.
- vii. Fuel gas shall not be used from cylinders through torches or other devices which are equipped with shutoff valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold.
- viii. Before a regulator is removed from a cylinder valve, the cylinder valve shall always be closed and the gas released from the regulator.
- ix. If on opening a fuel gas cylinder, leak is detected around the valve stem, the valve shall be closed and gland nut to be tightened. If this action does not stop the leak, the use of the cylinder shall be discontinued, and it shall be properly tagged and removed from the work area. In the event that fuel gas should leak from the cylinder valve, rather than from the valve stem, and the gas cannot be shut off, the cylinder shall be properly tagged and removed from the work area. If a regulator attached to a cylinder valve effectively stops a leak through the valve seat, the cylinder need not be removed from the work area

3.4.8 Fuel gas and oxygen manifolds

- i. Fuel gas and oxygen manifolds shall bear the name of the substance they contain in letters at least 1-inch high which shall be either painted on the manifold or on a sign permanently attached to it.
- ii. Fuel gas and oxygen manifolds shall be placed in safe, well ventilated, and accessible locations. They shall not be located within non ventilated spaces.
- iii. Manifold hose connections, including both ends of the supply hose that lead to the manifold, shall be such that the hose cannot be interchanged between fuel gas and oxygen manifolds and supply header connections. Adapters shall not be used to permit the interchange of hose. Hose connections shall be kept free of grease and oil.
- iv. When not in use, manifold and header hose connections shall be capped.
- v. Nothing shall be placed on top of a manifold, when in use, which will damage the manifold or interfere with the quick closing of the valves.

3.4.9 Hose

- i. Fuel gas hose and oxygen hose shall be easily distinguishable from each other. The contrast should be made by different colors (Red for LPG/DA and black for Oxygen) Oxygen and fuel gas hoses shall not be interchangeable. A single hose having more than one gas passage shall not be used.
- ii. All hose in use, carrying acetylene, oxygen, natural or manufactured fuel gas, or any gas or substance which may ignite or enter into combustion, or be in any way harmful to employees, shall be inspected at the beginning of each working shift. Defective hose shall be removed from service.
- iii. Hose which has been subject to flashback, or which shows evidence of severe wear or damage, shall be tested to twice the normal pressure to which it is subject, but in no case less than 300 psi. Defective hose, or hose in doubtful condition, shall not be used and be removed from site.
- iv. Hose couplings shall be of the type that cannot be unlocked or disconnected (Use Jubilee clamp) by means of a straight pull without rotary motion.
- v. Boxes used for the storage of gas hose shall be ventilated.
- vi. Hoses, cables, and other equipment shall be kept clear of passageways, ladders and stairs.
- vii. Gas hoses and cable should not be allowed to touch each other and must have a minimum distance of 250mm between them, so that any heat or spark from the cable should not cause any fire in the gas hose.

3.4.10 Torches

- i. Clogged torch tip openings shall be cleaned with suitable cleaning wires, drills, or other devices designed for such purpose.
- ii. Torches in use shall be inspected at the beginning of each working shift for leaking shutoff valves, hose couplings, and tip connections. Defective torches shall not be used and be removed from site.
- iii. Torches shall be lighted by friction lighters or other approved devices, and not by matches or from hot work.
- iv. Nozzle mixing cutting torches shall be used.

3.4.11 Regulators and gauges

Oxygen and fuel gas pressure regulators, including their related gauges, shall be in proper working order while in use.

3.4.12 Oil and grease hazards

Oxygen cylinders and fittings shall be kept away from oil or grease. Cylinders, cylinder caps and valves, couplings, regulators, hose, and apparatus shall be kept free from oil or greasy substances and shall not be handled with oily hands or gloves. Oxygen shall not be directed at oily surfaces, greasy clothes, or within a fuel oil or other storage tank or vessel.

3.5 Protective clothing

3.5.1 General requirements

Employees exposed to the hazards created by cutting or brazing or heating/ welding operation shall be protected by personal protective equipment in accordance with the requirements. Appropriate protective clothing required for any welding operation will vary with the size, nature and location of the work to be performed.

3.5.2 Specified protective clothing. Protective means which may be employed are as follows:

- i. Except when engaged in light work, all welders should wear flameproof gauntlet gloves. The welding gloves should be dry and free from holes and grease.
- ii. Flameproof aprons made of leather, or other suitable material may also be desirable as protection against radiated heat and sparks.
- iii. Cotton clothing should be used while performing any gas cutting/welding. Outer clothing such as jumpers or overalls should be reasonably free from oil or grease.
- iv. Sparks may lodge in rolled-up sleeves or pockets of clothing, or cuffs of overalls or trousers. It is therefore recommended that sleeves and collars be kept buttoned and pockets be eliminated from the front of overalls and aprons. Trousers or overalls should not be turned up on the outside.

Note: For heavy work, fire-resistant leggings, high boots, or other equivalent means should be used.

- v. In protection work a sheet metal screen in front of the worker's legs can provide further protection against sparks and molten metal in cutting operations.
- vi. Shoulder covers made of leather or other suitable materials should be worn during overhead welding or cutting operations. Leather skullcaps may be worn under helmets to prevent head burns.

3.6 Ventilation and Protection in Cutting or Heating/ Welding

3.6.1 Mechanical ventilation. For purposes of this section, mechanical ventilation shall meet the following requirements:

- i. Mechanical ventilation shall consist of either general mechanical ventilation systems or local exhaust systems.

General mechanical ventilation shall be of sufficient capacity and so arranged as to produce the number of air changes necessary to maintain welding fumes and smoke within safe limits.

- ii. Local exhaust ventilation shall consist of freely movable hoods intended to be placed by the welder or burner as close as practicable to the work. This system shall be of sufficient capacity and so arranged as to remove fumes and smoke at the source and keep the concentration of them in the breathing zone within safe limits.
- iii. Contaminated air exhausted from a working space shall be discharged into the open air or otherwise clear of the source of intake air.

- iv. All air replacing that withdrawn shall be clean and respirable.
- v. Oxygen shall not be used for ventilation purposes, comfort cooling, blowing dust from clothing, or for cleaning the work area.

3.6.2 Cutting or Heating/ Welding in Confined Spaces

- i. Either general mechanical or local exhaust ventilation meeting the requirements of clause 3.5.1 shall be provided whenever welding, cutting, or heating is performed in a confined space.
- ii. When sufficient ventilation cannot be obtained without blocking the means of access, employees in the confined space shall be protected by air line respirators , and an employee on the outside of such a confined space shall be assigned to maintain communication with those working within it and to aid them in an emergency.

3.6.3 Cutting or Heating/ Welding of metals of toxic significance

- i. Welding, cutting, or heating in any enclosed spaces involving the metals specified in this subsection shall be performed with either general mechanical or local exhaust ventilation meeting the requirements of clause 3.6.1:
 - a) Zinc-bearing base or filler metals or metals coated with zinc-bearing materials.
 - b) Lead base metals
 - c) Cadmium-bearing filler materials
 - d) Chromium-bearing metals or metals coated with chromium-bearing materials
- ii. Welding, cutting, or heating in any enclosed spaces involving the metals specified in this subdivision shall be performed with local exhaust ventilation in accordance with the requirements of clause 3.6.1, or employees shall be protected by air line respirators:
 - a) Metals containing lead, other than as an impurity, or metals coated with lead-bearing materials;
 - b) Cadmium-bearing or cadmium-coated base metals;
 - c) Metals coated with mercury-bearing metals;
 - d) Beryllium-containing base or filler metals. Because of its high toxicity, work involving beryllium shall be done with both local exhaust ventilation and air line respirators
- iii. Employees performing such operations in the open air shall be protected by filter-type respirators. Except that employees performing such operations on beryllium-containing base or filler metals shall be protected by air line respirators.
- iv. Other employees exposed to the same atmosphere as the welders or burners shall be protected in the same manner as the welder or burner.

3.6.4 General Cutting or Heating/ Welding

- i. Welding, cutting, and heating, not involving conditions or materials described in clauses 3.6.2 and 3.6.3 may normally be done without mechanical ventilation or respiratory protective equipment, but where, because of unusual physical or atmospheric conditions, an unsafe accumulation of contaminants exists, suitable mechanical ventilation or respiratory protective equipment shall be provided.

- ii. Employees performing any type of welding, cutting, or heating shall be protected by suitable eye protective equipment.

3.7 Cutting or Heating/ Welding in Way of Preservative Coatings

- 3.7.1 Before welding, cutting, or heating is commenced on any surface covered by a preservative coating whose flammability is not known, a test shall be made by a competent person to determine its flammability. Preservative coatings shall be considered to be highly flammable when scrapings burn with extreme rapidity.
- 3.7.2 Precautions shall be taken to prevent ignition of highly flammable hardened preservative coatings. When coatings are determined to be highly flammable, they shall be stripped from the area to be heated to prevent ignition.
- 3.7.3 Protection against toxic preservative coatings:
 - i. In enclosed spaces, all surfaces covered with toxic preservatives shall be stripped of all toxic coatings for a distance of at least 4 inches from the area of heat application, or the employees shall be protected by air line respirators.
 - ii. In the open air, employees shall be protected by a respirator

- 3.7.4 The preservative coatings shall be removed a sufficient distance from the area to be heated to ensure that the temperature of the un-striped metal will not be appreciably raised. Artificial cooling of the metal surrounding the heating area may be used to limit the size of the area required to be cleaned.

3.8 Precaution to be taken in case of Back Fire

- i. Fold the oxygen pipe tightly.
- ii. Close DA cylinder.
- iii. Allow Oxygen to flow till fire gets extinguished
- iv. Close Oxygen cylinder

3.9 Necessary Documentation

- i. Work permission from concerned department/site in-charge or site clearance is absolutely necessary before start the of work (Please refer SG- 04: Safety guideline for Permit to work).
- ii. Check list of Job Safety Analysis for gas cutting job.
- iii. A copy of SG- 02: Safety guideline for working at height.
- iv. A copy of SG-03: Safety guideline for working in confined space.
- v. A copy of SG- 16: Safety guideline for Fire safety.

3.10 Record

- i. Concerned Sectional In-charge shall maintain record of work permits for Hot Job for at least one year.
- ii. Record for Incident/Accident is to be maintained at the department and is also available at Safety Department for at least five years
- iii. Ensure if all persons left the place. They are informed not to return / restart work without a fresh permit.

iv. Monitoring & Reviewing

Frequency	Mechanism	Record	Responsibility
Daily	Inspection of work permit issue	Record of work Permit	All Contractors, Consultant Contractors

3.11 **PPE'S to use:** Gas cutter must wear safety goggles, cotton clothing, long hand gloves on both the hands, full body harness.

3.12 Training & Medical Test

- i. Medically fit and trained person shall be allowed to carry out gas cutting job.
- ii. Special training must be imparted to individuals.
- iii. Appropriate regular medical test shall be carried out to individuals from time to time.
- iv. Permission from Registered Medical Practitioner shall be taken for individuals to carry out jobs at height [fitness certificate].

3.13 The methods in regard to setting the equipment, lighting the torch, re-lighting the torch, closing the system, guidelines for conducting quarterly tests:

3.13.1 Setting up the Equipment

Adhere to the following steps when setting up oxy-fuel equipment:

- i. **Step 1:** When not in use, compressed fuel-gas cylinders must be secured in the upright position with cylinder valve protector caps in place. **Reason:** Cylinder valves can easily be knocked off, rapidly releasing the fuel gas and discharging the cylinder.
- ii. **Step 2:** Before installing a regulator on an oxygen or fuel cylinder, inspect the regulator valves and the cylinder valves for oil or contaminants. Do not use dirty components. Check the cylinder valves for leaks around the valve packing glands. Also check the cylinder valve threads for damage. **Reason:** Oil and grease in the presence of oxygen can cause an explosion. Dirt and foreign matter can prevent the regulator and the cutting equipment from working properly. Loose cylinder valves or fittings allow leaks.
- iii. **Step 3:** Standing to one side of the valve nozzle, crack the cylinder valves. (If the cylinder must be opened in a confined space, do this carefully.) **Reason:** This technique will blow any dirt out of the nozzle without injuring the operator.
- iv. **Step-4:** Release the tension on the regulator by adjusting the screw counterclockwise. Attach the regulator to the cylinder. Do not over-tighten the regulator compression nuts at the cylinder valves. **Reason:** This technique prevents damage to the regulator diaphragm and to the regulator valve seat. Also, this will not give the operator a "full system" of gases before he or she can check the hose and torch. Over-tightening pulls the threads on both the regulator valves and the cylinder valves, eventually causing leaks.

- v. **Step-5:** Open the oxygen cylinder valve slowly, standing on one side of the regulator and the gauge. **Reason:** This technique limits the risk of explosions and injuries to the operator. These accidents typically occur in the front or the back of the regulator and the gauge.
- vi. **Step-6:** Fully open the oxygen cylinder valve. Reason: The oxygen valve tightly seals when it is fully open or fully closed, but may leak when it is in an intermediate position.
- vii. **Step-7:** Open the fuel-gas cylinder valve. (Acetylene cylinder valves should not be opened more than 3/4 turn. Other cylinder valves may be opened fully.) **Reason:** The fuel-gas cylinder valve (other than acetylene) tightly seals when it is fully open or fully closed, but it may leak when it is in an intermediate position.
- viii. **Step-8:** Attach the hose to the regulator. If the hose is new or has been out of service, purge it for five seconds for every 50 feet (15 meters) of hose. **Reason:** Purging removes contaminants from the hose, ensuring that it does not contain an explosive mixture of residual fuel gas and air.
- ix. **Step-9:** Check the seating surfaces and the O-rings of the torch. Assemble the torch. **Reason:** This technique reduces the risk of leaks that could cause a fire.
- x. **Step 10:** Check the orifice of the nozzle. If it is blocked, clean it only with a nozzle cleaning tool. Do not rub the cutting or heating tip on any soft material (such as wood) to clean the tip. **Reason:** Cleaning the nozzle removes any obstructions, a prime cause of backfires.

3.13.2 Lighting the Torch

Adhere to the following steps when lighting the torch:

- i. **Step-1:** Open the fuel-gas valve on the torch. Then set the fuel-gas cylinder regulator to the recommended pressure: not more than 30 psi (205 kPa) for fuel gas, and less than 15 psi (105 kPa) for acetylene. Close the torch fuel-gas supply valve, then the fuel-gas cylinder valve. Watch the regulator pressure gauges. If the pressure drops, check for leaks in the assembly. If the pressure remains constant, reopen the fuel-gas cylinder valve slowly. **Reason:** These techniques set the correct pressure, check for leaks, and purge the line of any explosive gas mixtures.
- ii. **Step 2:** Open the oxygen valve on the torch. Then set the oxygen cylinder regulator to the recommended pressure per the tip manufacturer's tip chart, but not to exceed 80 psi (550 kPa). Close the torch oxygen supply valve, then the oxygen cylinder valve. Watch the regulator pressure gauges. If the pressure drops, check for leaks in the assembly. If the pressure remains constant, reopen the oxygen cylinder valve slowly. **Reason:** These techniques set the correct pressure, check for leaks, and purge the lines of explosive gas mixtures.

- iii. **Step 3:** Open only the torch fuel-gas valve to a high flow rate. Light the torch with an approved spark lighter. **Reason:** A high flow of fuel gas cuts down on smoke. Lighting only fuel gas reduces the risk of flashback.
- iv. **Step 4:** Reduce the gas flow until the flame starts to smoke. Open the oxygen valve on the torch slowly to get the desired flame. **Reason:** This technique sets the correct flow of fuel gas and oxygen for the torch tip. If less heat is required for heating, welding, or brazing, change the tip. Do not reduce the pressure or the flow of either fuel gas or oxygen.

3.13.3 Re-Lighting the Torch

Adhere to the following steps when re-lighting the torch:

- i. **Step -1:** Always re-purge the system by opening and re-closing the fuel gas torch valve. **Reason:** This technique removes any explosive mixtures that may have accumulated in the system.
- ii. **Step -2:** Re-purge the oxygen line by opening and re-closing the oxygen torch valve. **Reason:** This technique removes any explosive mixtures that may have accumulated in the system.
- iii. **Step -3:** Open only the torch fuel-gas valve to a high flow rate. Light the torch with an approved spark lighter. **Reason:** A high flow of fuel gas cuts down on smoke. Lighting only fuel gas reduces the risk of flashback.
- iv. **Step -4:** **Step 4:** Reduce the gas flow until the flame starts to smoke. Open the oxygen valve on the torch slowly to get the desired flame. **Reason:** This technique sets the correct flow of fuel gas and oxygen for the torch tip. If less heat is required for heating, welding, or brazing, change the tip. Do not reduce the pressure or the flow of either fuel gas or oxygen

3.13.4 Closing the System

Adhere to the following steps when closing the system:

- i. **Step -1:** Close the oxygen valve on the torch first. Then close the fuel-gas valve on the torch. Reason: If the oxygen valve leaks, the system may backfire. If the fuel-gas valve leaks, the flame will not go out. Either situation indicates that the equipment is defective and requires immediate repairs before continuing use.
- ii. **Step -2:** Close both cylinder valves. Release the hose pressure by opening the torch valves and allowing gas to escape from the system. Reason: This technique prevents leaks and fires. It also prepares the equipment for the next start-up.
- iii. **Step -3:** Close both regulator valves by releasing the tension on the regulator screw.

- iv. **Step -4:** When the regulator screw is turned counterclockwise, the valve is closed, and when turned clockwise, the valve is opened. **Reason:** This technique prepares the equipment for the next start-up.

3.13.5 Guidelines for Conducting Quarterly Tests

Use the following guidelines for quarterly testing of specific parts of oxy-fuel equipment.

i. Regulators and Gauges

- a) Visually inspect for damage all components of fuel-gas and oxygen regulators, including the following:
 - compression nipples and nuts
 - filter screens in the inlet nozzles
 - gauges
 - regulator adjusting screws
- b) Attach the fuel-gas and the oxygen regulators to inert gas or oil-free air systems for testing. Use transition test nipples for testing.
- c) Release regulator-adjusting screws counterclockwise. Then open the cylinder valve and verify that the high-pressure gauge is operating properly. If no inert gas or air flows through the regulator when the cylinder valve is opened, the regulator adjustment valve is in good condition and the regulator diaphragm is not damaged.
- d) Block with a valve the outlet nozzle of the regulator using a plug or hose.
- e) Adjust the regulator-adjusting screw clockwise until the low-pressure gauge indicates a normal operating pressure. Use soapy water to inspect the regulator and gauge connections for leaks.
- f) Close the cylinder valve, and watch the gauges for a drop in pressure. A drop in pressure indicates a leak. Reopen the cylinder valve, and check the low-pressure gauge for any slight drop in pressure (needle creep). Gauge needle creep greater than 2 to 3 psi (14 to 20 kPa) indicates that the diaphragm is damaged.

ii. Hoses

- a) Visually inspect each length of hose for burns, worn areas, decay, and other defects. If defects are found those could cause leaks, remove the hose from the system.
- b) Pressurize each length of hose, and run it through a water vat to check for leaks. Use inert gas or oil-free air for this test at a pressure sufficient to indicate leaks, typically between 15 and 80 psi (103 and 550 kPa). Any length of hose that cannot be tested in the water vat must be tested with soapy water. Replace any length of hose that has leaks.

iii. Combination Reverse-Flow Check Valves and Flame Arresters

- a) Visually inspect each check valve/arrester to verify that the inlet nozzle is free of oxidation, burns, and other defects.
- b) Visually inspect each check valve/arrester by using reverse-flow pressure in the outlet nozzle to verify that the check valve is sealing. For this test, either blow through the unit or use inert gas or oil-free air at a pressure between 1 and 10 psi(7 and 70 kPa), sufficient to close the check valve.
- c) Replace, but do not repair, defective check valves/arresters.
- d) Between inspections and tests, if the units have significant backfires or flashbacks, remove the check valve/arrester for additional inspections and tests.

iv. Cutting Torches and Mixing Chambers

- a) Visually inspect for damage to all components of each torch and mixing chamber, including the following:
 - the O-rings on the torch
 - the seating surface in the mixing chamber
 - the cutting tip seating surface in the torch head
- b) Test the complete system, including cutting torches and mixing chambers, by following the instructions for setting up the system, lighting the torch, and re-lighting the torch as stated in earlier attachments

References:

1. IPSS 1-11-017-12:Safety Procedure for Gas Cutting by Regular/ Contractor Workers
2. IS: 818 – 1888 ‘Code of Practice for Safety and Health for Welding and Gas Cutting’
3. SAIL Plant Safety Manual

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	ARC WELDING & ARC CUTTING	Doc. No: SG/08 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

The objective of this safety guideline is to provide safe working procedure while carrying out electrical arc welding & cutting jobs in iron & steel industry and prevent from major hazards like electrocution, fire, explosion and metal fumes.

2. Scope

2.1 The scope covers safety aspects during arc welding and arc cutting operations while taking up fabrication, maintenance and manufacturing jobs etc. in iron & steel industry.

2.2 The scope does not cover gas welding and gas cutting or heating through gas.

3. Procedure

3.1 General Requirements

- i. The procedure has to be implemented by all departmental Heads with the help of their authorized representative at work place and is also applicable to Contractor's employees.
- ii. Work permit shall be issued to working agency before start of arc welding/ arc cutting by the authorized person of the department
- iii. If the cutting/welding job is to be carried out at height (more than 2 meters) from ground level/in confined space/gaseous hazardous area/ near electrical installation, separate entry permit/work permit should be obtained from authorized agency. Electrical cables/ wires if any below the cutting area shall be properly guarded/ protected from falling spatters.

Falling of spatters from height must be prevented. For this a metal trough should be used and spatters should be collected in a trough at the point of generation. Moist ceramic cloth may also be used wherever required. In case of problem in preventing of all the spatters falling down at the area below the site of hot work the area has to be barricaded. No cylinders should be kept in the barricaded area. Proper covering of the knob, valves etc of the cylinders adjacent to the barricading must be ensured.

- iv. After completion of the job, the cables, spatters, etc. are to be properly removed and kept at designated place. Area to be cleaned and waste matter removed.
- v. After completion of the job, the work permit shall be returned by working agency and the receiving authority of owner department shall enter the form in the original along with the white copy.

- vi. Test the area for flammables before welding and cutting when the atmosphere is vulnerable to such hazards.
- vii. Workers must leave their personal mobile phones prior to proceeding to the work site(s) to avoid getting distracted to respond to phone calls which may lead to accidents.

3.1.1 **Fire Prevention and Protection**

- i. Relevant clauses covered in SG-16: 'Safety guideline for Fire Safety' shall be followed.
- ii. It should be ensured that before starting the job surrounding area of the work side should be made free of fire hazard.
- iii. Employees engaged on welding and cutting jobs should be trained and capable to use fire equipments in case of any fire emergency.
- iv. Adequate fire fighting provision to be made available close to each area of welding, cutting and other hot job.
- v. Emergency telephone number should be made available and displayed at work site by concerning agencies.
- vi. When practical, objects to be welded or cut shall be moved to a designated safe location or, if the objects to be welded or cut cannot be readily moved, all movable fire hazards in the vicinity shall be taken to a safe place, or otherwise protected.
- vii. If the object to be welded or cut cannot be moved and if all the fire hazards cannot be removed, positive means shall be taken to confine the heat, sparks, and slag, and to protect the immovable fire hazards from them.
- viii. No welding or cutting shall be done where the application of flammable paints or the presence of other flammable compounds, or heavy dust concentrations creates a hazard.
- ix. Suitable fire extinguishing equipment shall be immediately available in the work area and shall be maintained in a state of readiness for instant use.
- x. When the welding or cutting operation is such that normal fire prevention precautions are not sufficient, additional personnel shall be assigned to guard against fire while the actual welding or cutting operation is being performed, and for a sufficient period of time after completion of the work to ensure that no possibility of fire exists. Such personnel shall be instructed as to the specific anticipated fire hazards and how the firefighting equipment provided is to be used.
- xi. When welding or cutting is performed on walls, floors, and ceilings, since direct penetration of sparks or heat transfer may introduce a fire hazard to

- an adjacent area, the same precautions shall be taken on the opposite side as are taken on the side on which the welding is being performed.
- xii. Except when the contents are being removed or transferred, drums, pails, and other containers, which contain or have contained flammable liquids, shall be kept closed. Empty containers shall be removed to a safe area apart from hot work operations.
 - xiii. Drums, containers, or hollow structures which have contained toxic or flammable substances shall, before welding or cutting is undertaken on them, either be filled with water or thoroughly cleaned of such substances and ventilated and tested.
 - xiv. Before heat is applied to a drum, container, or hollow structure, a vent or opening shall be provided for the release of any built-up pressure during the application of heat.

3.2 Arc Welding and Cutting

3.2.1 Manual Electrode Holders

- i. Only manual electrode holders which are specifically designed for arc welding and cutting, and are capable of safely handling the maximum rated current required by the electrodes, shall be used.
- ii. Any current-carrying parts passing through the portion of the holder which the arc welder or cutter grips in the hand, and the outer surfaces of the jaws of the holder, shall be fully insulated against the maximum voltage encountered to ground.

3.2.2 Welding Cables and Connectors

- i. All arc welding and cutting cables shall be of the completely insulated, flexible type, capable of handling the maximum current requirements of the work in progress, taking into account the duty cycle under which the arc welder or cutter is working.
- ii. Only cable free from repair or splices for a minimum distance of 3.0 m from the cable end to which the electrode holder is connected shall be used, except that cables with standard insulated connectors or with splices whose insulating quality is equal to that of the cable are permitted.
- iii. When it becomes necessary to connect or splice lengths of cable one to another, substantial insulated connectors of a capacity at least equivalent to that of the cable shall be used. If connections are effected by means of cable lugs, they shall be securely fastened together to give good electrical contact and the exposed metal parts of the lugs shall be completely insulated.
- iv. Cables in need of repair shall not be used and removed from site. When a cable, other than the cable lead, becomes worn to the extent of exposing

bare conductors, the portion thus exposed shall be protected by means of rubber and friction tape or other equivalent insulation.

3.2.3 Ground Returns and Machine Grounding

- i. A ground return cable shall have a safe current carrying capacity equal to or exceeding the specified maximum output capacity of the arc welding or cutting unit which it services. When a single ground return cable services more than one unit, its safe current-carrying capacity shall equal or exceed the total specified maximum output capacities of all the units it serves.
- ii. Pipelines containing gases or flammable liquids, or conduits containing electrical circuits, shall not be used as a ground return.
- iii. Under any circumstances, no structure or pipeline shall be used as ground return.
- iv. The frames of all arc welding and cutting machines shall be grounded either through a third wire in the cable containing the circuit conductor or through a separate wire which is grounded at the source of the current. Grounding circuits, other than by means of the structure, shall be checked to ensure that the circuit between the ground and the grounded power conductor has resistance low enough to permit sufficient current to flow to cause the fuse or circuit breaker to interrupt the current
- v. All ground connections shall be inspected to ensure that they are mechanically strong and electrically adequate for the required current.

3.2.4 Safety Devices

- i. RCBO (Residual Current Breaker Overload)/ RCCB (Residual Current Circuit Breaker) shall be provided at the incoming side of welding machine.
- ii. VRD (Voltage reducing device) shall be provided at the outgoing / secondary side of welding machine in order to keep the open circuit voltage in safe range (between 8 to 10 V). These safety devices is to be used while doing the welding job in the following areas:
 - a) Confined spaces like inside vessels, storage tank, tunnels etc.
 - b) Wet or damp location
 - c) Hot and Humid conditions
 - d) Working at heights

The safety device may not be used for the general fabrication jobs done at the shop floor & the area which is not hazardous as mentioned above. This safety device reduces the hazard of high voltage present at the welding electrodes only and does not replace the existing safe working practices during electrical arc welding. The device shall be installed as per the guidelines given by the supplier.

3.2.5 Operating Instructions

Employers shall instruct employees about the safe means of arc welding and cutting as follows:

- i. When electrode holders are to be left unattended, the electrodes shall be removed and the holders shall be so placed or protected that they cannot make electrical contact with employees or conducting objects.
- ii. Hot electrode holders shall not be dipped in water; to do so may expose the arc welder or cutter to electric shock.
- iii. When the arc welder or cutter has occasion to leave work or to stop work for any appreciable length of time, or when the arc welding or cutting machine is to be moved, the power supply switch to the equipment shall be opened.
- iv. Any faulty or defective equipment shall be reported to the supervisor.

3.2.6 Shielding

All arc welding and cutting operations shall be shielded by noncombustible or flameproof screens which will protect employees, helpers and other persons directly looking at the arc.

3.2.7 Employee Protection

Where welding or cutting operations are being performed in areas where it is possible for molten slag to come in contact with other employees, those employees shall be protected from being burned by providing overhead protection, by barricading the impact area, or other effective means.

3.3 Protective clothing

3.3.1 General Requirements

Employees exposed to the hazards created by welding, cutting, or brazing operations shall be protected by personal protective equipment in accordance with the requirements. Appropriate protective clothing required for any welding operation will vary with the size, nature and location of the work to be performed.

3.3.2 Specified protective clothing. Protective means which may be employed are as follows:

- i. Except when engaged in light work, all welders should wear flameproof gauntlet gloves. The welding gloves should be dry and free from holes and grease.
- ii. Flameproof aprons made of leather, or other suitable material may also be desirable as protection against radiated heat and sparks.

- iii. Cotton clothing should be used while performing any gas cutting/welding. Outer clothing such as jumpers or overalls should be reasonably free from oil or grease.
- iv. Sparks may lodge in rolled-up sleeves or pockets of clothing, or cuffs of overalls or trousers. It is therefore recommended that sleeves and collars be kept buttoned and pockets be eliminated from the front of overalls and aprons. Trousers or overalls should not be turned up on the outside.

Note: For heavy work, fire-resistant leggings, high boots, or other equivalent means should be used.

- v. In protection work a sheet metal screen in front of the worker's legs can provide further protection against sparks and molten metal in cutting operations.
- vi. Shoulder covers made of leather or other suitable materials should be worn during overhead welding or cutting operations. Leather skullcaps may be worn under helmets to prevent head burns.

3.4 Ventilation and Protection in Welding and Cutting

3.4.1 Mechanical ventilation. For purposes of this section, mechanical ventilation shall meet the following requirements:

- i. Mechanical ventilation shall consist of either general mechanical ventilation systems or local exhaust systems. General mechanical ventilation shall be of sufficient capacity and so arranged as to produce the number of air changes necessary to maintain welding fumes and smoke within safe limits.
- ii. Local exhaust ventilation shall consist of freely movable hoods intended to be placed by the welder or burner as close as practicable to the work. This system shall be of sufficient capacity and so arranged as to remove fumes and smoke at the source and keep the concentration of them in the breathing zone within safe limits.
- iii. Contaminated air exhausted from a working space shall be discharged into the open air or otherwise clear of the source of intake air.
- iv. All air replacing that withdrawn shall be clean and respirable.
- v. Oxygen shall not be used for ventilation purposes, comfort cooling, blowing dust from clothing, or for cleaning the work area.

3.4.2 Welding and Cutting in Confined Spaces

- i. Relevant clauses of SG-03: 'Safety guideline for working in Confined space', shall be followed.

- ii. Either general mechanical or local exhaust ventilation meeting the requirements of clause 3.4.1 shall be provided whenever welding, cutting, or heating is performed in a confined space.
- iii. When sufficient ventilation cannot be obtained without blocking the means of access, employees in the confined space shall be protected by air line respirators , and an employee on the outside of such a confined space shall be assigned to maintain communication with those working within it and to aid them in an emergency.

3.4.3 Welding and Cutting of Metals of Toxic Significance

- i. Welding or cutting in any enclosed spaces involving the metals specified in this subsection shall be performed with either general mechanical or local exhaust ventilation meeting the requirements of clause 3.4.1:
- ii. Zinc-bearing base or filler metals or metals coated with zinc-bearing materials.
- iii. Lead base metals
- iv. Cadmium-bearing filler materials
- v. Chromium-bearing metals or metals coated with chromium-bearing materials.
- vi. Welding or cutting in any enclosed spaces involving the metals specified in this subdivision shall be performed with local exhaust ventilation in accordance with the requirements of clause 3.4.1, or employees shall be protected by air line respirators.
 - a) Metals containing lead, other than as an impurity, or metals coated with lead-bearing materials;
 - b) Cadmium-bearing or cadmium-coated base metals;
 - c) Metals coated with mercury-bearing metals;
 - d) Beryllium-containing base or filler metals. Because of its high toxicity, work involving beryllium shall be done with both local exhaust ventilation and air line respirators.
- vii. Employees performing such operations in the open air shall be protected by filter-type respirators. Except that employees performing such operations on beryllium-containing base or filler metals shall be protected by air line respirators.
- viii. Other employees exposed to the same atmosphere as the welders shall be protected in the same manner as the welder or burner.

3.4.4 Inert Gas Metal Arc Welding

Since the inert-gas metal-arc welding process involves the production of ultra-violet radiation of intensities of 5 to 30 times that produced during shielded metal-arc welding, the decomposition of chlorinated solvents by ultraviolet rays, and the liberation of toxic fuels and gases, employees shall not be

permitted to engage in, or be exposed to the process until the following special precautions have been taken:

- i. The use of chlorinated solvents shall be kept at least 200 feet, unless shielded, from the exposed arc, and surfaces prepared with chlorinated solvents shall be thoroughly dry before welding is permitted on such surfaces.
- ii. Employees in the area not protected from the arc by screening shall be protected by filter lenses. When two or more welders are exposed to each other's arc, filter lens goggles of a suitable type shall be worn under welding helmets. Hand shields to protect the welder against flashes and radiant energy shall be used when either the helmet is lifted or the shield is removed.
- iii. Welders and other employees who are exposed to radiation shall be suitably protected so that the skin is covered completely to prevent burns and other damage by ultraviolet rays. Welding helmets and hand shields shall be free of leaks and openings, and free of highly reflective surfaces.
- iv. When inert-gas metal-arc welding is being performed on stainless steel, the requirements of clause 3.5.3 shall be met to protect against dangerous concentrations of nitrogen dioxide.

3.4.5 General Welding and Cutting

- i. Welding or cutting jobs not involving conditions or materials described in clauses 3.4.2, 3.4.3, and 3.4.4, may normally be done without mechanical ventilation or respiratory protective equipment, but where, because of unusual physical or atmospheric conditions, an unsafe accumulation of contaminants exists, suitable mechanical ventilation or respiratory protective equipment shall be provided.
- ii. Employees performing any type of welding or cutting shall be protected by suitable eye protective equipment.

3.5 Welding and Cutting in Way of Preservative Coatings

- 3.5.1 Before welding or cutting is commenced on any surface covered by a preservative coating whose flammability is not known, a test shall be made by a competent person to determine its flammability. Preservative coatings shall be considered to be highly flammable when scrapings burn with extreme rapidity.
- 3.5.2 Precautions shall be taken to prevent ignition of highly flammable hardened preservative coatings. When coatings are determined to be highly flammable, they shall be stripped from the area to be heated to prevent ignition.
- 3.5.3 Protection against toxic preservative coatings:
 - i. In enclosed spaces, all surfaces covered with toxic preservatives shall be stripped of all toxic coatings for a distance of at least 4 inches from the area of heat application, or the employees shall be protected by airline respirators.

- ii. In the open air, employees shall be protected by a respirator.
- 3.5.4 The preservative coatings shall be removed a sufficient distance from the area to be heated to ensure that the temperature of the un-striped metal will not be appreciably raised. Artificial cooling of the metal surrounding the heating area may be used to limit the size of the area required to be cleaned.
- 3.6 Checking, Corrective & Preventive Action**
 Departmental HOD shall ensure implementation and regular compliance of above procedure through periodic interaction with manager/Operators/Contractors and review of work permits system records. In case of any deviation, corrective and preventive action shall be immediately undertaken.
- 3.7 RECORD**
- i. Concerned Sectional In-charge shall maintain record of work permits for Hot Job for at least one year.
 - ii. Record for Incident/Accident is to be maintained at the department and is also available at Safety Department for at least five years.
 - iii. Ensure if all persons left the place. They are informed not to return / restart work without a fresh permit.

Monitoring & Reviewing

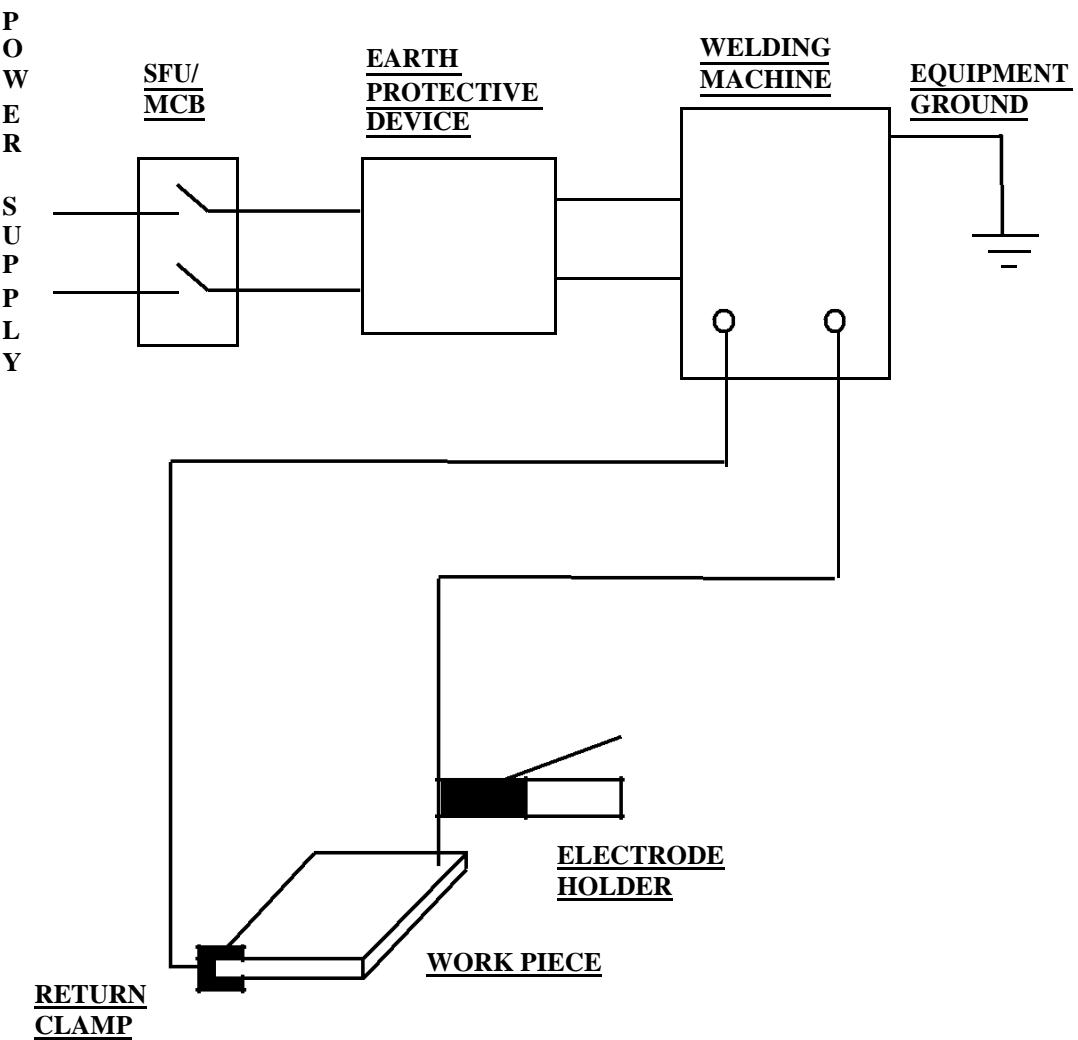
Frequency	Mechanism	Record	Responsibility
Daily	Inspection of work permit issue	Record of work Permit	All Contractors, Consultant Contractors

REFERENCE:

1. IPSS 1-11-020-15: Safety Procedure for Welding & Cutting
2. IPSS 1-11-017-12: Safety Procedure for Gas Cutting by Regular/ Contractor Workers

Electrical Circuit Diagram of Welding

NOTE- VRD Should be placed after the welding machine and before the electrode holder and return clamp



Checklist for Arc Welding and Cutting

Sl. No.	Points	Yes	No	NA
1.	Is work permit issued to working agency before start of the job?			
2.	Is the additional work permit issued to the agency if the job is to be carried out at height (more than 2 meter)/ confined space/ gaseous hazardous area/ near electrical installations?			
3.	Do all the manual transformer based welding machines contain manufacturer's name & detail technical specifications?			
4.	Are the falling of spatters from height prevented by proper barricading?			
5.	Are all welding & cutting cables completely insulated, flexible type and capable of handling the maximum current requirement of the work?			
6.	Are all the exposed portion of the cable protected by suitable rubber and friction tape or other equivalent insulation?			
7.	Are all frames of arc welding and cutting machines grounded properly?			
8.	Is the wesguard safety device put in place, where required?			
9.	Are the fire extinguishers available in the working area with readiness for use?			
10.	Is there proper ventilation system in place, when the welding & cutting job is performed in confined space?			
11.	Is the flammability test conducted if welding or cutting to be done on the surface covered by preserve coating?			
12.	Is the working area free from all inflammable materials?			
13.	Are all the work permits for hot job recorded?			
14.	Is there an arrangement for collecting spatters at the source?			
15.	Is IR (Insulation, Resistance) value of the welding machine > 2M-Ohm, measured with 500 Volt Megger?			
16.	Is the welding machine connected with separate circuit breaker or Switch Fuse Unit (SFU)?			
17.	Is the earth leakage protective device used?			

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	EQUIPMENT AND MACHINERY GUARDING	Doc. No: SG/09 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

This Safety guideline elaborates the requirement of equipment and machinery guarding to prevent injury due to rotating equipments, components flying out due to centrifugal force, body parts like hand/ finger or clothing getting caught in the rotating component etc.

2. Scope

This guideline is applicable to all the shops/ departments in Steel Industry.

3. Procedure

3.1 Types of equipments requiring safe guarding

- i) Guarding of mechanical power transmission equipments
 - a) Belt and pulley
 - b) Chain and sprocket
 - c) Couplings- Input/ output shafts
 - d) Flywheels/ Bull gears/ Open gears
 - e) Drive & Tail end of belt conveyor
 - f) Brakes and clutches.
 - g) Other projected parts
- ii) Guarding of equipments while at working site.
 - a) During lubrication
 - b) While online cleaning.
 - c) While condition monitoring and sampling.
 - d) Guarding of accessory equipments such as Exhaust fan, man cooler fan, pedestal fan, grinders etc.

3.2 Guards can be classified according to the nature of the job

i) Temporary Guards

- a) Where regular jobs are carried out near the rotating or projected part of equipment (as described in section 3.1).

- b) The guards must be designed such that it can easily be refitted/ Reposition. The large guards must be made from a number of sections and provide handles and locating points.
- c) The safety guard shall be in segment of convenient size, bolted/ hooked to fix the structure for easy removal during maintenance/ condition monitoring.

ii) Permanent Guards

- a) Where jobs are carried out one time near the rotating or projected part of an equipment (described in section 3.1).
- b) Materials generally used for construction of Guards:
Wire mesh, Metal sheet, transparent plastic sheet etc.

3.3 Construction of Guards

- i) The choice of material of construction is largely a matter of local preference based upon operating conditions, types of guards already installed.
- ii) Frame work / Railing of the safeguard :- Angles/ Flat, hollow structure, Pipe, rod etc can be used
- iii) Filler Material: - Wire mesh, perforated or solid sheet metal, high strength plastic.
- iv) If guards are located out door, painted or galvanized steel sheets to be used.
- v) Guards furnished with purchased equipments are desirable if they meet the general requirements of this standard.
- vi) Filler Dimensions- Wire mesh (Refer Fig 1)
'a' is the sides of square in wire mesh - 12 to 20 mm ($\frac{1}{2}$ in and $\frac{3}{4}$ in).
'b' is the minimum clearance between guard and machinery - 120mm (4 $\frac{3}{4}$ in). The wire diameter should be between 1.5mm to 3mm

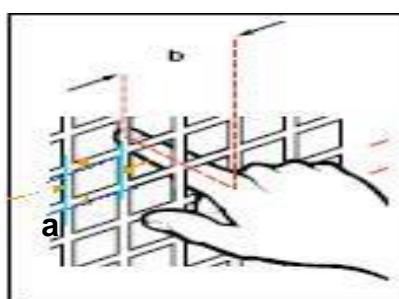


Figure – 1

Metal, transparent plastic sheet (Refer Fig 2)

Sheet thickness - 2 mm to 5 mm

Minimum clearance between safe guard and rotating machine- 120 mm

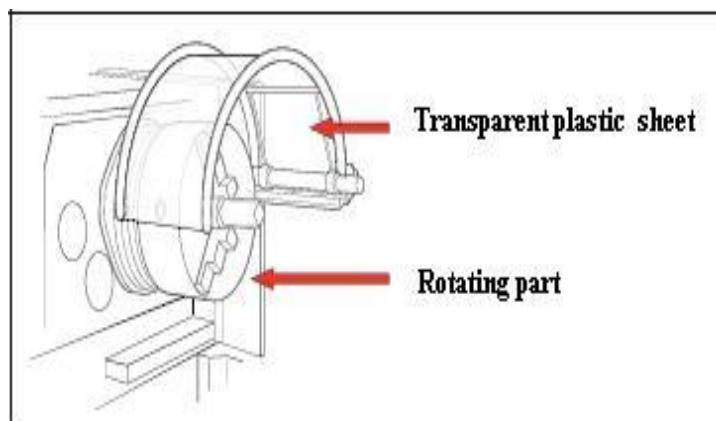


Figure 2

- vii) Transparent sheet shall be used on rotating equipment from where there is a chance of oil/ coolant splashing.
- viii) Framework dimension for

Square Hollow Section (SHS) – 25 X 25 X 2.5mm.

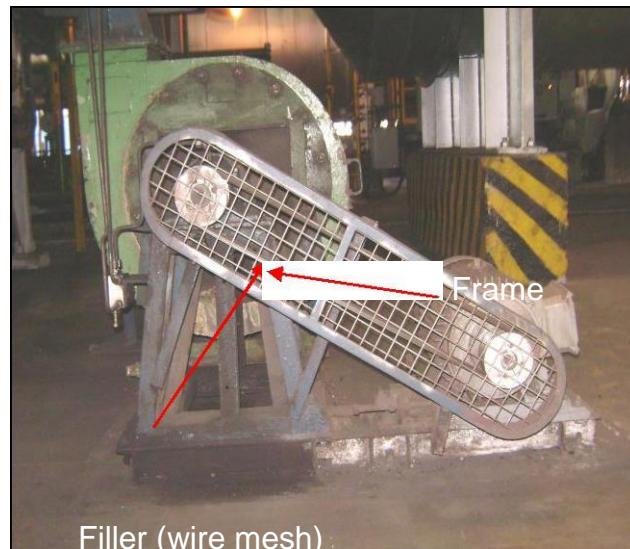
For Flat – 25 X 25 X 3.0 mm

For Angle – 25 X 25 X 3.15 to 45 X 45
X 3.15 mm.

Framework dimensions of higher sizes shall be considered as per requirement.

3.4 Equipments

- i) Belt and Pulley
 - a) All power transmission belts & pulleys shall be guarded fully.
 - b) All belts (Horizontal, vertical, inclined and overhead) above the floor or platform, shall be guarded for their entire length.
 - c) Metallic belt lacing or fasteners shall not be used in areas containing explosives or inflammable vapors.

**Figure :3**

- d) Unless the distance to the nearest fixed pulley, clutch, or hanger exceeds the width of the belt used, a guide shall be provided to prevent slip of the belt from the pulley on the side where insufficient clearance exists.
- e) Where there are overhanging pulleys on line, jack, or countershafts, with no bearing between the pulley and the outer end of the shaft, a guide to prevent the belt from running off the pulley should be provided.
- f) Where separate pulley guards are used and the belt does not require guarding, the guard should enclose the pulley so as to protect the run-in point of the belt. The guard should extend slightly above the top of the pulley.
- ii) Chain and sprocket: The safeguarding is similar as explained in section 3.4 i) (a) to (c).
- iii) Couplings– Input/output shafts- Couplings mounted at input or output shaft of the machine must be guarded by a stationary guard as explained in section 3.3.

Figure 4

iv) Flywheels/Bull gears/ open Gears

- a) Guards shall be provided on flywheel/ bull gear/ open gear as explained in section 3.3.
- b) When the upper rim of flywheel / bull gear/ open gear protrudes through a working floor it shall be enclosed entirely or surrounded by a guardrail and toe board.
- c) When flywheel/ bull gear/ open gear extends into pit or within 12 inches of floor standard toe board shall be provided.

v) Drive & Tail end of belt conveyor

- a) The tail end of a belt conveyor having rotating pulley must be guarded as explained in given diagram Fig. 5.

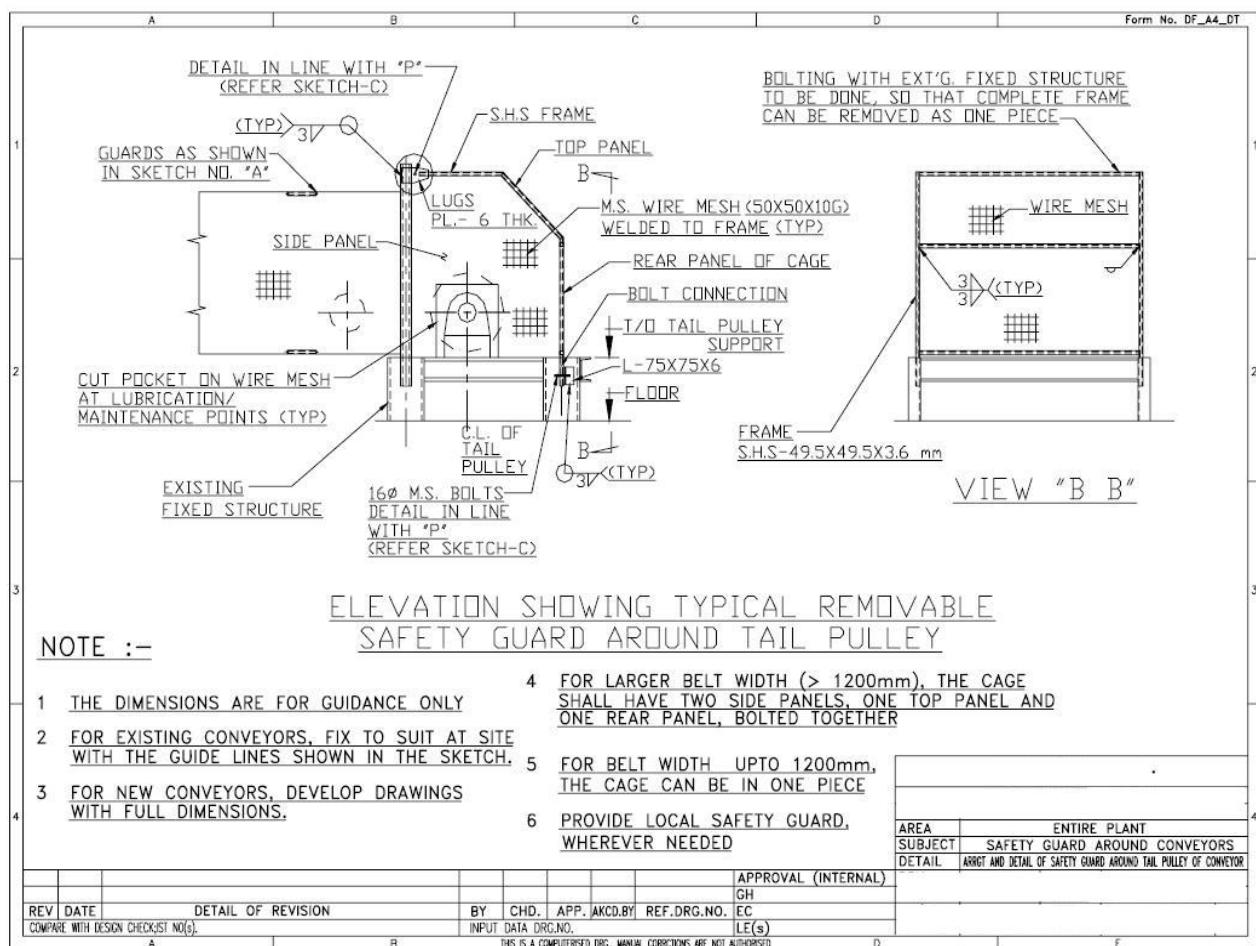


Figure5: Guarding of tail end pulley

vi) Brakes and clutches

Brakes and clutches mounted at input or output shaft of the machine must be guarded by a stationery guard as explained in section 3.3.

Figure -6

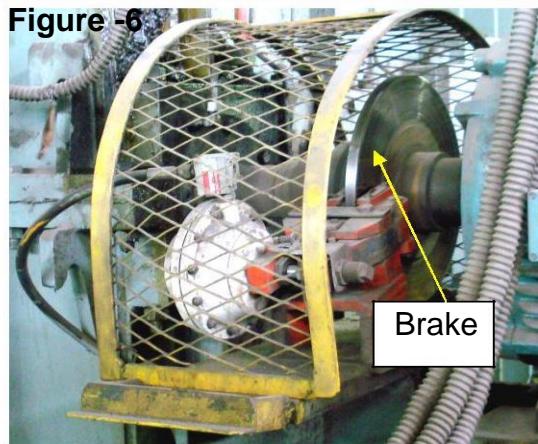


Figure- 7



vii) Other projected parts

This includes (Refer Figure- 7):

- Protruded parts of stationery structures in the walkway/ nearby the working area,
- Uncoupled shaft of gearbox / pulleys/ rolls.
- The guard shall be provided as explained in section 3.3.

3.5 At working site

i) Lubrication

If the lubrication point is near to the rotating equipment the guard and the lubrication facility shall be given as follows:

- The guards must be designed to reduce the need to remove them. For example provide access to tracking mechanisms in figure 8: (A) and greasing points (B).

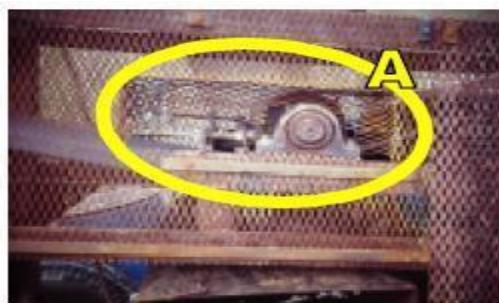


Figure- 8: Lubrication points

ii) Online cleaning / Condition Monitoring/ Sampling

- a) During online cleaning/ condition monitoring / sampling the rotating or projected part of an equipment must be guarded.
- b) The difficulties associated with frequent removal of guards and the continual stopping for cleaning purposes may be overcome by using hinged/ detachable guards which allow access.

Figure-9: Guarding at position of condition monitoring & sampling



3.6 Accessory equipments

i) Grinders

The associated risk of bench grinders, pedestal grinders, and portable grinder is fragmentation of an abrasive wheel.

The maximum wheel exposures for guards on two types of abrasive equipment: bench and pedestal grinders (90° exposure) and hand-held angle grinders (180° exposure) is illustrated in the figure10. The protective hood of a portable grinder must cover at least 120° of the wheel periphery.

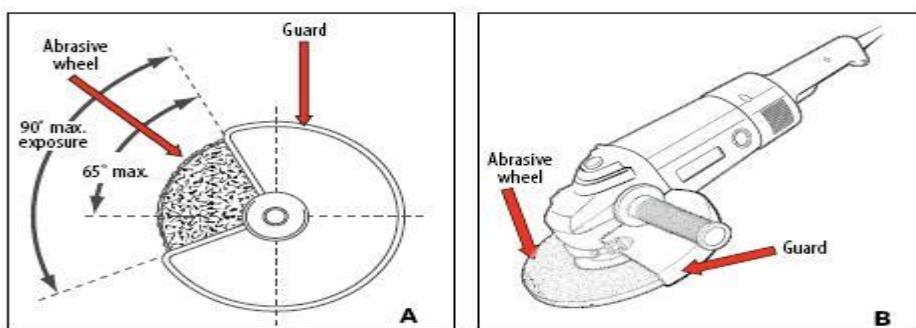


Figure -10

ii) Man cooler Fan/ Exhaust Fan/ Pedestal Fan

The Fan Must be guarded by a galvanized wire mesh. The dimension of wire mesh shall be between 4 to 8 mm and minimum clearance between fan and

guard shall be at least 15 mm.

3.7 Training

- i) All personnel whose job requires working in the vicinity of rotating/ moving part of equipment must be trained by an expert prior to starting of the job.
- ii) Safety precautions specific to the associated hazards of the equipment on/ near which the person is deployed, should be explained to him by an expert prior to starting of the job and to be displayed beside the equipment.

References:

- i) IPSS-1-11-025-16
- ii) www.osha.gov

EDUCATION AND TRAINING

1. Do operators and skilled trades workers have the necessary education and training in how to use the guards?

Yes No

2. Does the education include examples of workers in your workplace or elsewhere who might have lost their life or their limbs from lack of machine guarding?

Yes No

3. Have production workers and skilled trades workers been trained in where the guards are located, how they provide protection, and what hazards they protect against?

Yes No

4. Have production workers and skilled trades workers been trained in how and under what circumstances guards can be removed?

Yes No

5. Have workers been trained in the procedure to follow if they notice guards that are damaged, missing or inadequate?

Yes No

6. Do skilled trades workers have the necessary education and training in how to build the safety aspects of guards?

Yes No

Note – ‘Trade’ word can be removed from above format if required.

Machine guarding Checklist

The checklist attached below is a guideline for machine guarding

MACHINE GUARDING CHECKLIST

GUARDING REQUIREMENTS

1. Do the guards prevent workers' hands, arms, and other body parts from making contact with dangerous moving parts?
Yes No
2. Are the guards firmly secured and not easily removable?
Yes No
3. Do the guards ensure that no objects will fall into the moving parts or explode out?
Yes No
4. Do the guards permit safe, comfortable, and relatively easy operation of the machine?
Yes No
5. Can the machine be oiled or greased without removing the guard?
Yes No
6. Does the machine automatically shut down when the guard is removed?
Yes No
7. Can the existing guards be improved?
Yes No

MECHANICAL HAZARDS

The point-of-operation:

1. Is there a point-of-operation guard provided for the machine?
Yes No
2. Does it keep the operator's hands, fingers, body out of the danger area?

3. Is there evidence that the guards have been tampered with or removed?
Yes No
4. Could you suggest a more practical, effective guard?
Yes No
5. Could changes be made on the machine to eliminate the point-of-operation hazard entirely?
Yes No

Power transmission apparatus:

1. Are there any unguarded gears, sprockets, pulleys or flywheels on the apparatus?
Yes No
2. Are there any exposed belts or chain drives?
Yes No
3. Are there any exposed set screws, key ways, collars, etc.?
Yes No
4. Are starting and stopping controls within easy reach of the operator?
Yes No
5. If there is more than one operator, are separate controls provided?
Yes No

Other moving parts:

1. Are guards provided for all hazardous moving parts of the machine, including auxiliary parts?
Yes No

Annexure -1

Item	Specification
Square Hollow Section	38X38X3.2 mm
"	25X25X3.2 mm
"	49.5X49.5X3.6 mm
Acrylic Transparent Plastic sheet	130 mmX5mmX10m
Flat	MS Flat 25X3mm
Angle	MS25X25X3mm

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	Hydraulic System	Doc. No: SG/10
		Rev no. : 00
		Effective Date : 14.10.2019

1. Objective

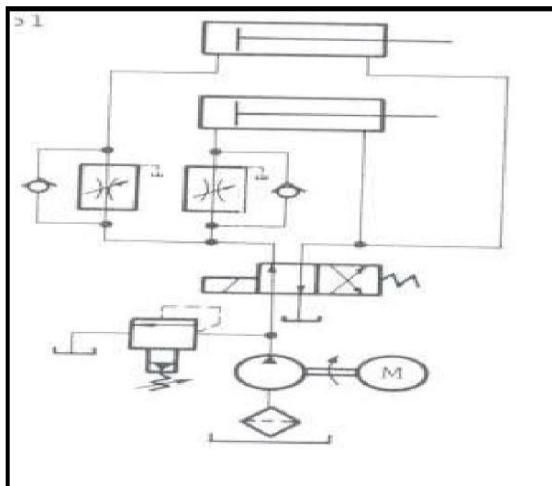
This Safety guideline has been framed for safe operation & maintenance of Hydraulic systems to protect against hazards such as burns from hot, high-pressure fluid, injection of fluid into the skin, fire hazards, bruises, cuts or abrasions from flailing hydraulic lines, injury of people due to unexpected movement of equipment, injury due to sudden release of residual pressurized oil, slippage due to oily floor area, electric shock from electrical motors/ AC solenoids etc.

2. Scope

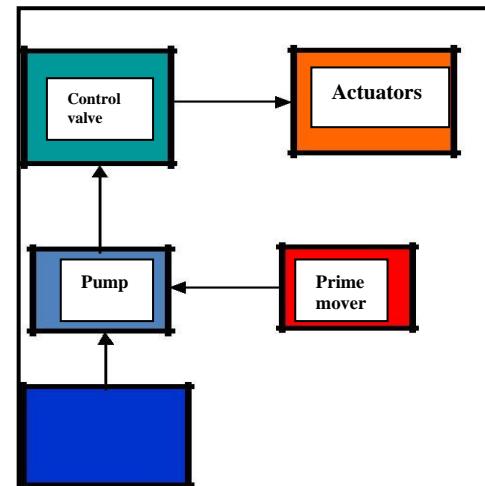
This guideline is applicable for hydraulic systems installations across all locations of Steel Industry in India. A typical hydraulic circuit diagram and block diagram are shown in Fig.- 1 and Fig.-2 respectively.

Note:

- Fire resistant hydraulic fluid to be considered in hydraulic system to be installed in fire prone area.
- In case the hydraulic system can not be located away from fire prone area flame proof system is to be considered.



Hydraulic circuit diagram
(Figure- 1)



RESERVIOR OIL

Block Diagram of a Typical
Hydraulic System **(Figure – 2)**

3. Procedure

3.1 General Safety Precautions during Pre-Start Up & maintenance of Hydraulic System

- Positive isolation procedure to be followed before start of any hydraulic work as per Positive Isolation Procedure enclosed in [Annexure-2](#).

- ii. Depressurize the system before start of work. Shut down/ Local Isolation may be taken, if required.
- iii. Never begin work on a hydraulic system until fully trained. Job to be carried out under supervision.
- iv. Never begin work on a hydraulic system without carrying out risk assessment.
- v. Carefully review the manuals on equipments before beginning work. Ask questions about anything you do not fully understand.
- vi. Read the Material Safety Data Sheet (MSDS) for chemicals used.
- vii. Use all required Safety equipment.
- viii. Never try to repair a part without having full knowledge about it.
- ix. Each hydraulic system must have a documented procedure of de-energizing and load locking. This should be known to all maintenance personnel.
- x. Document and practice de-pressurizing procedure in each of the circuit.
- xi. While testing the system after repair never stand close to the unit. Any component, pipe, hose, fitting may fail.
- xii. Before start of work, drain the pressure line through minimesh point upto the actuator.
- xiii. Drain the accumulator, if any, from drain valve and check oil pressure from minimess coupling provided in safety block or main pressure line after accumulator. (Refer Fig.- 3 and Fig.- 4). If pressure gauge is showing zero, then also bleed the accumulator with minimess hose for confirmation.
- xiv. During the tightening of pressurized lines hammering should not be done.
- xv. Tightening of Joints should be done in depressurized condition.
- xvi. In any of the hydraulic maintenance jobs, all other agencies working in that area should be well communicated about the hydraulic work and its effects.



FIGURE- 3: ARROW IN THE PICTURE IS SHOWING DRAIN VALVE



FIGURE- 4: ARROW IN THE PICTURE IS SHOWING MINIMESH POINT

- xvii. If working in the valve stand, then drain the valve stand from pressure line and service line A & B (before draining, must ensure load in the lowermost position or give packing/provide mechanical lock, so that actuator should not move in any condition). Take care in handling or working near hydraulic actuators
Starting the system after maintenance: Before starting the system, must ensure removal of all test hoses and proper tightening of all hydraulic pipes, hoses, SAE flanges & fasteners with proper seals/ "O" rings. Follow the procedure of removal of positive isolation (given in [Annexure-2](#)).
- xviii. N2 Charging: Cross check the condition of the bladder. If oil is coming out from bladder charging point, it means the bladder is damaged and needs to be changed. Accumulator should be in zero oil pressure condition. Pressure should read zero at minimess point of accumulator safety block. Pump should be off and positive isolated. In let valve should be closed and locked. Drain valve of accumulator should be open during charging.
- xix. Gas pressure must be discharged while attempting to dismantle an accumulator.
- xx. Replacement of components to be done after checking their rating and capability.
- xi. Minmess coupling to be checked for proper functioning before starting maintenance job. If pressure from minimess coupling is showing zero then oil has to be bleded to cross check the functioning of the minimess coupling.
- xxii. All hydraulic pipes and hydraulic cylinders should be tested at 1.5 times working pressure. All accumulators should be tested for its wall thickness and pressures as per Factories Act.
- xxiii. Do not use bare hand to check the hydraulic leakage; any fluid leakage through pinhole leakage can be injected into your skin. Use a card board or wooden piece to check leakages.
- xxiv. Hot work like gas cutting, welding should be avoided near hydraulic pipeline or near tank.
- xxv. Any modification being carried out in Hydraulic System Circuit should be approved by competent authority.

3.2 Reservoir/ Sump

- i. Do not weld on a hydraulic reservoir/sump without emptying the oil.
- ii. Ensure all vents (air breather & hatch plate) should be opened for any maintenance/ cleaning job to release entrapped gases.
- iii. Ensure no chocking of the air breather. Inspect and replace faulty breathers.

3.3 Pump

- i. Put off the motor power from MCC and lock out & Tag out. Obtain permit to work as per plant procedures.
- ii. Close the suction & delivery valve and lock out & Tag out.
- iii. Drain the pump casing and depressurize (ensure zero pressure).
- iv. Incase pump flange is opened, do not open all the bolts of flange at a time, loosen the flange joint first and ensure there is no entrapped oil.
- v. In case of pump change, handling of pump should be done with proper lifting/ placement tools.
- vi. Before start of motor, ensure correct direction of motor rotation.
- vii. Before installing a new pump, check pressure rating of pump. Its pressure rating should be higher than the required system pressure.
- viii. While changing of pumps, please ensure all fasteners & hoses have been properly tightened. Before start of pump, the pump casing must be filled with hydraulic oil. Ensure that the pressure compensator must be fully in open condition to start with (pressure should be zero), and then pressure should be set. Entrapped air to be released from delivery line. Flushing circuit for the pump, if available, should be kept on prior to switching on the pump.
- ix. Relief Valve Pressure should always be set 20-30 bar more than the Pump compensator setting.

3.4 Actuator (hydraulic cylinder/ motor)

- i. Removal of Old actuator. Ensure that the load attached to the actuator is mechanically secured.
- ii. De-pressurize the actuator, and then start loosening the hose pipe. After opening of 3-4 threads, shake the hose pipe for removing any residual pressure.
- iii. Start loosening of actuator mounting bolt. If actuator is heavy then hold with Crane or chain block. (**If actuator is a cylinder, then do not hold the cylinder from piston rod side because there is chance of rod coming out from cylinder barrel.**) Before lifting of actuator plug the port of actuator, because piston rod can come out because of self-weight.

3.5 Fixing of New actuator

- i. After removal of old actuator, place new actuator (If actuator is a cylinder, then do not hold the cylinder from piston rod side because there is chance of rod coming out from cylinder barrel.)
- ii. Secure the position rod to prevent extension of the rod while removal or fixing (by plugging the cylinder ports/ restraining by tying with ropes).
- iii. Fix the hose connection and leave the work place only after proper tightening & bleeding of entrapped air during cylinder trial.

- iv. Hydraulic Motor should always be started with casing filled with fluid.
- v. Ensure there is no pressure inside actuator, especially if there is pilot operated check valve or counter balance valve in the lines.
- vi. Never pressurize the bore end of double acting cylinder with rod end port plugged.
- vii. While closing the lines to differential double acting cylinders, close the bore end valves first and then the rod end valves. For opening the valves reverse sequence is to be followed.

3.6 Valves

Removal of old valve

- i. Ensure 100 % positive isolation & depressurization of P,T,A,B line before opening of any hydraulic valve.
- ii. Start cross loosening of valve bolts. After loosening of 3-4 threads; shake the valve for removal of locked pressure. If oil is not coming, then start loosening of valve.

Fixing of new valve

- iii. Before changing the valves, match the valve specification & port matching in case of stack mounted valves. If there is some mismatch, get comment from expert. (Because low pressure valve are also available in same mounting.)
- iv. After replacement of O-ring / valve, start tightening of valve mounting bolt (cross wise). Do not use too much long pipe for Allen key. In case bolts are required to be changed, bolts of same property class to be used.
- v. Pressure setting of pressure relief / reducing valve: First check pressure rating of pressure relief / reducing valve. Identify right measuring point in system by hydraulic circuit diagram. If valve is external drain type, drain must be connected to tank without any restriction. Slowly adjust the pressure.
- vi. Pressure relief valves incorporated into the hydraulic system will avoid pressure buildups during use. Keep these valves clean and test them periodically to ensure correct operation.
- vii. While working on spring loaded valves take precaution to ensure that no spring back action takes place.
- viii. All direction control valves should be marked to identify the solenoid responsible for forward or backward motion of actuator.

3.7 Hoses & fittings

- i. Before replacing hoses, depressurize the system as per positive isolation procedure ([Annexure-2](#)). Check the hose or hoses to be replaced by twisting or squeezing them to see if the pressure has been relieved, or by another method suitable to the hose being used. If pressure is still in the hose or hoses, take appropriate measures to relieve the pressure before loosening the fittings. Care to be taken that replacement of hose should be with hoses with same size and specifications.
- ii. All the hoses in hot area shall be with stainless steel braided cover and silica cloth cover.
- iii. Each and every hose in a hydraulic system must be able to handle the highest pressure produced by the system. Pressure surges or peaks exceeding the hose

rated working pressure are destructive and must be considered when selecting a hose. Please ensure compatibility of hose with design pressure of system.

- iv. Improper Length/ Routing - Forcing a hose into an improper geometry causes high stresses in the hose components that may also reduce pressure capacity (avoid multi-plane bending, small bend radii, tension in hose, etc.). Hose life can be reduced by 90% when subject to these type of stresses (Refer Figure 6).
- v. Locking arrangement may be provided to avoid swinging of hoses in case of failure from crimping portion (Refer Figure 5).
- vi. Abrasion and Cuts - Wear against other hoses or objects will wear off the outer cover and lead to corrosion of the reinforcing mesh.
- vii. Extreme Pressure Fluctuations - Pressure surges above the hose working pressure will damage hose components.
- viii. Vibration - Cyclic loading of hoses can damage hose components even when motion seems relatively small.
- ix. Hoses having bulges or getting wet surface to be immediately replaced.
- x. Hose rupture valve may be provided near the actuator for enhanced safety in case of hose failure.



Figure - 5

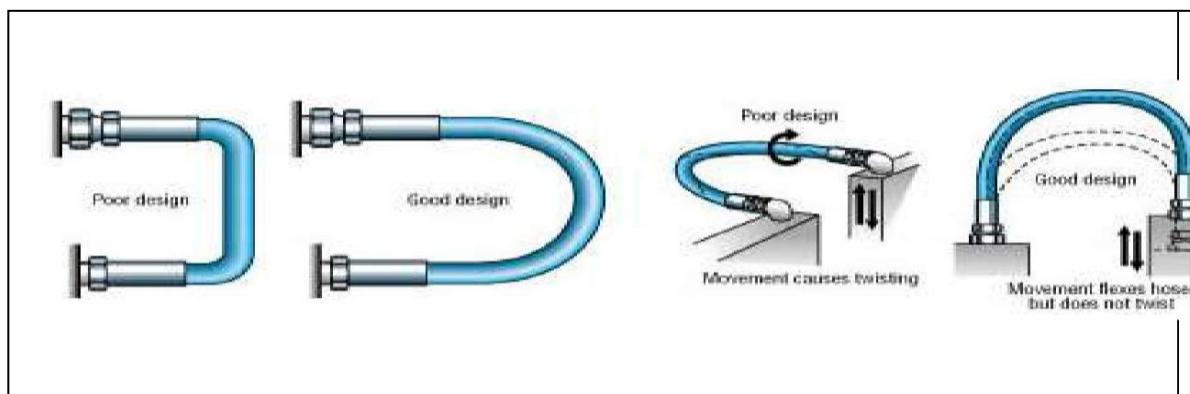


FIGURE - 6

3.8 Pipes & fittings

- i. Seamless and pre-treated (pickled, washed and oiled) precision steel tubes are to be used for all piping. All pipes & fittings should be rated for at least 1.5 times working pressure.
- ii. Pipe bends should be supported by clamps as near to the bends as possible. Pipe bend radius should be minimum 5 times of pipe diameter. Clamping of the pipelines should be proper. The distance between two clamps should not be greater than 1.5 m.
- iii. For pipe joints up to 38 mm OD pipe, weld-nipple type fittings(24 deg)/walform fittings with 'O'-ring shall be used and above 38 mm OD pipe, SAE flanges of suitable pressure class with 'O'-ring shall be used for each hydraulic system.

Ferrule Fittings should not be used in hydraulic systems. "O" rings should be of reputed make and of 90 shore hardness.

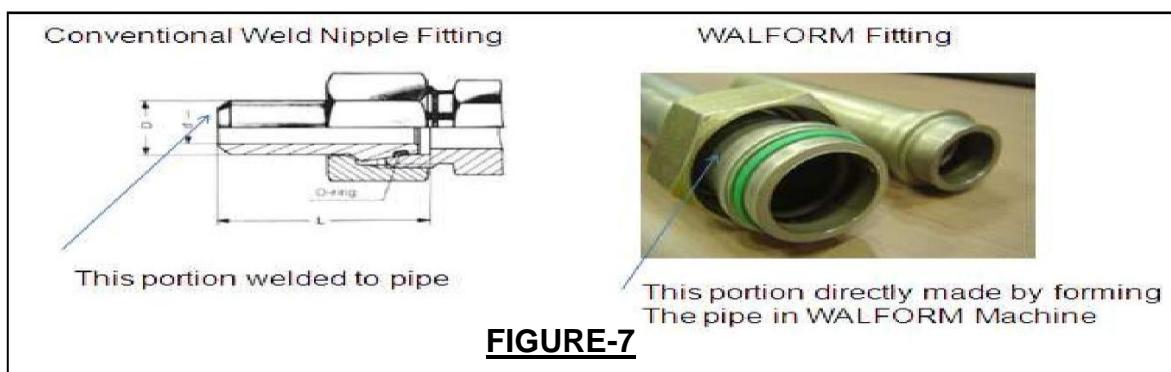


FIGURE-7

- iv. Up to 38 mm OD pipe, welding of pipes and pipe joints shall be carried out by TIG welding only. For pipe sizes above 38 mm OD, the root shall be TIG welded and the balance portion shall be electric ARC welded.

In addition to the above general guidelines, every hydraulic machine will have specific hydraulic safety procedure, which is to be adhered to.

4.0 Operation of Hydraulic Systems

- i. Audio and visual alarms should be provided for following faults in the hydraulic system.
 - a) Low pressure in the system
 - b) Excessive temperature of oil in reservoir
 - c) High level of oil in reservoir
 - d) Low level of oil on the reservoir
 - e) Low-low level of oil in the reservoir and pump cutoff
 - f) Clogging of filters
 - g) Motor overload
- ii. Maintain cleanliness around work surroundings. Good house keeping standard to be maintained in the hydraulic room, machine parts/ hoses and floor made to be free from Oil smears.
- iii. All oil leakage and rise in temperature must be attended immediately.
- iv. Allow proper ventilation all-around in the cellar. Proper natural/ mechanical ventilation to be provided in the hydraulic room for extraction of hydraulic fumes
- v. Noise level in the cellars must not exceed 85 dba. Anti vibration pads to be periodically & replaced, if required.
- vi. Install a Fire Extinguisher (Dry Chemical or CO₂) near the hydraulic system.
- vii. Oil Cellar must have provision of Foam Spray, MVWS, FDA system, fire extinguishers and fire hydrant lines as per standard (IS 3844:1989).
- viii. In Oil Cellars, spark proof lighting should be provided. Loose wiring or temporary wire connections should not be permitted. Waste cotton should be disposed in bins filled with water. Smoking should be strictly prohibited and 'No Smoking' signs should be displayed at appropriate locations. The entry & exit should not be the same and they should be provided in opposite directions and free from any obstruction.

- ix. Suitable automatic Fire Detectors and suppression system to be provided in hydraulic room for early detection and suppression of fire.
- x. Suitable personnel protective equipment (PPEs) like Spectacles, Gloves (preferable Nitrile), Oil resistant aprons etc to be used by the person working on hydraulic systems.
- xi. Probably the most common injury associated with hydraulic systems is the result of pinhole leaks in hoses. These leaks are difficult to locate. A person may notice a damp, oily, dirty place near a hydraulic line. Not seeing the leak, the person runs a hand or finger along the line to find it. When the pinhole is reached, the fluid can be injected into the skin as if from a hypodermic syringe. Immediately after the injection, the person experiences only a slight stinging sensation and may not think much about it. Several hours later, however, the wound begins to throb and severe pain begins. By the time a doctor is seen, it is often too late, and the individual loses a finger or entire arm. Unfortunately, this kind of accident is not uncommon. To prevent this type of injury, run a piece of wood or cardboard along the hose (rather than fingers) to detect the leak (refer figure 8).
- xii. Material safety data sheet (MSDS) to be displayed in the hydraulic room.

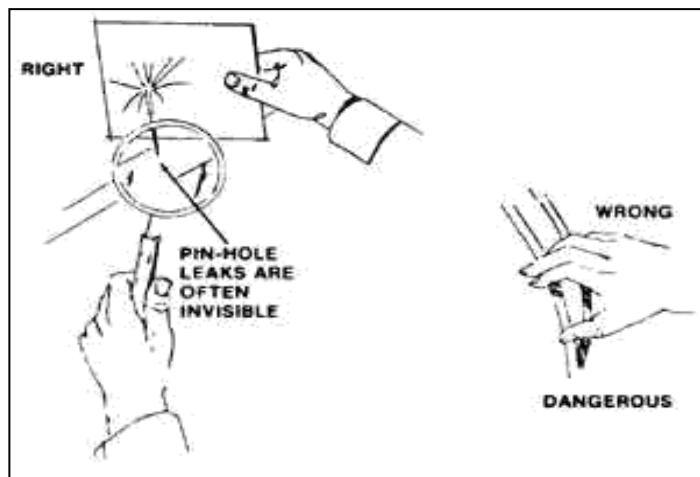


Figure 8: Detecting pinhole leaks in a hydraulic system.

- xiii. System of periodical cleaning of drip tray for preventing spillage to be put in place and the drip tray to be periodically cleaned.
- xiv. Full body showers/ eye wash showers to be provided in the close vicinity of hydraulic system for drenching / flushing of eyes of persons affected by hydraulic oil and location to be displayed with proper signage.

5.0 Inspection

A system of periodic inspection of hydraulic systems is to be developed. An indicative checklist is attached at [Annexure-1](#).

6.0 Records

- I. Records on Inspection and Maintenance of Hydraulic Systems shall be available at User Department.
- II. Records on Hydraulic System Audit shall be maintained by the User Department and auditing agency.

References:

1. IPSS 1-11-032-17 : Safety for Hydraulic System.
2. SAIL's guidelines for 'Fire Mitigation Management'.

ANNEXURE-1**SAFETY PRECAUTIONS & INTERLOCKS TO BE CHECKED DURING PRE-START UP**

S. NO.	DESCRIPTION OF ITEM / FUNCTION	DETAIL OF ITEM INVOLVED / OBSERVATION
1.	Oil level in Tank	Level switch/ Transmitter - To be checked
2.	Oil Temperature in Tank	Temperature Transmitter - To be checked
3.	Breather in Tank	Cleanliness of oil / Physical verification
4.	Main Pump-Motor	Direction of Rotation (Motor rotation to be checked with respect to pump)
5.	Main Pump Overloading	Pump Relief Valve / Motor overload tripping (Electrical)
6.	Main pump / recirculation pump Tripping	Limit switch at the suction valve - Tripping when suction valve is closed
7.	Pressure Line filter - Cleanliness	Setting of differential pressure switch to be checked
8.	Duplex Return type filter- Cleanliness	Setting of differential pressure switch to be checked
9.	Recirculation Duplex filter - Cleanliness	Setting of differential pressure switch to be checked
10.	Recirculation Pump Motor	Direction of Rotation (Motor rotation to be checked with respect to pump)
11.	Recirculation Pump Overloading	Pump Relief Valve / Motor overload tripping (Electrical)
12.	Accumulator Safety	Relief Valve at safely shut-off block - To be checked.
13.	Heat Exchanger - Cooling Water ON/ OFF Valve	Solenoid Valve - To be checked
14.	Heat Exchanger	During normal operation, bypass valve shall be closed

NOTE:

1. Checks as mentioned above shall be done as per the parameter mentioned in schematic drgs.
2. For all process Safety interlocks functional description and PLC logic may be referred and that will prevail upon.

ACTIVITY AND OBSERVATION /CHECK

S. NO.	ACTIVITY	OBSERVATION /CHECK
1.	Changing of filter element	Observation of visual / audio signal at cellar / control pulpit (As applicable)
2.	Changing of oil seal / 'O' Ring at valve stand and in pipeline.	Observation of oil seepage at valve stand and fittings / flanges in pipeline
3.	Proper Functioning of sump pump at cellar	Physically checking of operations of sump pump in manual / auto mode
4.	Proper Functioning of Ventilation system	Physical checking of Ventilation system time to time in Hydraulic Cellar.
5.	Proper Functioning of Fire fighting system	Physical checking of Fire fighting system time to time in Hydraulic Cellar.

RISK ASSESSMENT RELATED TO EQUIPMENT/ OPERATING PERSONNEL & MITIGATION PLAN

SL. NO.	ACTIVITY	RISK ASSESSMENT	MITIGATION PLAN
1.	Checking of Hydraulic Oil seepage at fittings / flanges in pipeline in walking area	Falling of plant person in walking area due to skidding	Changing of 'O' Ring / gasket as applicable during observation
2.	Checking of Fire fighting system in Hydraulic, oil & water cellar	Loss to equipment / harm to operational manpower in case of fire	Ensure healthiness of Firefighting equipment in Hydraulic cellar

Form No. : MED/M/ PCL-HYD/REP/01/00

MAINTENANCE ENGINEERING DEPARTMENT (MECHANICAL)
INSPECTION REPORT OF HYDRAULIC SYSTEM

INSP.REPORT NO : Inspected By :
DEPARTMENT : Date & Time :
EQUIPMENT :

Temp Taken by Non Contact Gauge

SL. NO.	ITEMS TO BE CHECKED	OBSERVATION
A.	HOUSE KEEPING OF HYDRAULIC ROOM (FLOOR CLEANLINESS/ILLUMINATION ETC.)	
B.	CLEANLINESS OF HYDRAULIC POWER PACK & PIPING	
C.	RESERVIOR :	
	1. HYDRAULIC FLUID LEVEL IN TANK	
	2. CONDITION OF LEVEL INDICATOR	
	3. HYDRAULIC FLUID TEMPERATURE	
	4. VISUAL APPEARANCE OF HYDRAULIC FLUID	
	5. CONDITION OF FILLER/BREATHER	
	6. CONDITION OF SUCTION STRAINER	
	7. RETURN LINE FILTER	
D.	HEAT EXCHANGER :	
	1. INLET FLUID TEMPERATURE	
	2. OUTLET FLUID TEMPERATURE	
	3. INLET COOLANT TEMPERATURE	
	4. OUTLET COOLANT TEMPERATURE	
E.	RECONDITIONING UNIT :	
	1. NO. OF PUMPS INSTALLED	
	2. PUMP NO. IN SERVICE	
	3. NOISE - HEAT ETC. OF PUMPS IN SERVICE	
F.	PILOT PRESSURE UNIT :	
	1. PUMP NO. IN SERVICE	
	2. CONDITION OF STANDBY PUMP	
	3. LINE PRESSURE	
	4. CONDITION OF FILTER	

ANNEXURE-1 (contd.)

SL. NO.	ITEMS TO BE CHECKED	OBSERVATION
G.	MAIN SYSTEM :	
1.	1. NO. OF PUMP INSTALLED	
2.	2. PUMP NOS. IN SERVICE	
3.	3. PUMP MOUNTING (OK / NOT OK)	
4.	4. NOISE - HEAT ETC. OF PUMPS IN SERVICE	
5.	5. LEAKS	
6.	6. PUMP OPERATION (SMOOTH / NOISY)	
7.	7. CONDITION OF STAND BY PUMP	
8.	8. DELIVERY PRESSURE	
H.	VALVE STANDS :	
1.	1. MOUNTING OF VALVES	
2.	2. CONDITION OF VALVE STANDS	
3.	3. LEAKAGES	
4.	4. FUNCTIONING OF THE VALVES	
I.	ACCUMULATOR STANDS :	
1.	1. PRE-CHARGE PRESSURE	
2.	2. ACCUMULATOR WORKING / NOT WORKING	
J.	ACTUATORS :	
1.	1. CLEANLINESS	
2.	2. OPERATION (SMOOTH / JERKY)	
3.	3. MOUNTING (TIGHT / LOOSE)	
4.	4. CONDITION OF HOSES	
K.	INSTRUMENTS AND PROTECTIVE DEVICES :	
1.	1. PRESSURE GAUGES	
2.	2. TEMPERATURE GAUGES	
L.	ANY OTHER OBSERVATION & REMARKS	

Signature of Inspector:

Date : _____

Signature of Dept. Rep. :

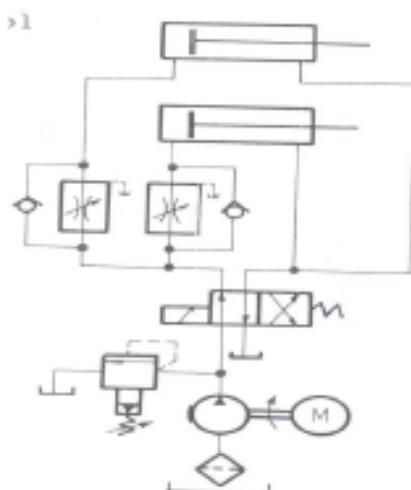
Name : _____

Date : _____

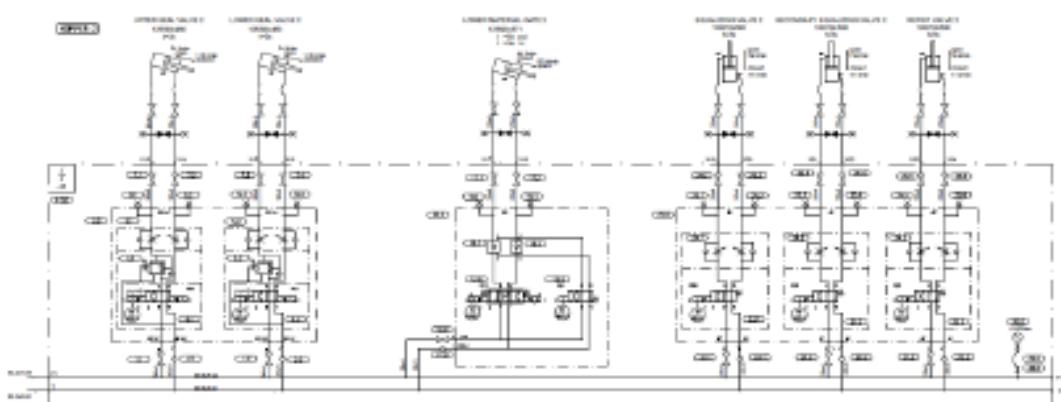
ANNEXURE -2**Annexure2: Positive Isolation of Hydraulic Systems:**

A typical hydraulic system may have single or multiple valve stands. One Valve Stand may supply to one or multiple actuators.

Following is the example of a simple Hydraulic System with Single Valve Stand.



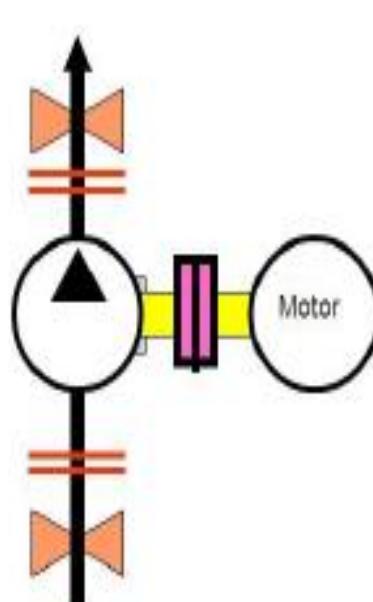
A typical hydraulic circuit with multiple valve stands is shown below. Each valve stand is used to actuate a particular actuator or set of actuators.



ANNEXURE – 2 (contd.)

Following procedure is followed for positive isolation of hydraulic systems.

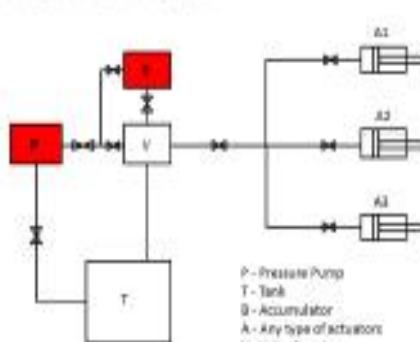
- Cut off power of pump and lock the respective electric panels by pad lock as per positive isolation procedure SS/ENG/26 revision4.
- Close the isolation valve at suction and delivery side of each pump.
- Lock the handle of isolation valve at pump delivery by a pad lock.
- Drain the accumulator (if provided in the system) to ensure zero pressure (read zero pressure in the gauge).



- Bleed off the actuators to release entrapped hydraulic pressure as per safe work procedure.
- Close and lock isolation ball valves as per requirement.
- Always ensure zero pressure (read zero in the pressure gauge) in the line where work is being performed.
- Lower the hanging load if any.
- Mechanical Locking of equipment is done to prevent hydraulic cylinder movement because of load.
- All trials should be taken in the end once positive isolation is deactivated.

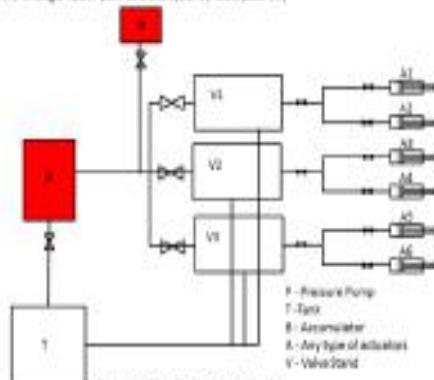
ANNEXURE -2 (contd.)

TYPE A: Single Power pack to Single System



A general Flow Diagram for example.

TYPE B: Single Power pack to Multi System (Power pack off)



A general Flow Diagram for example.

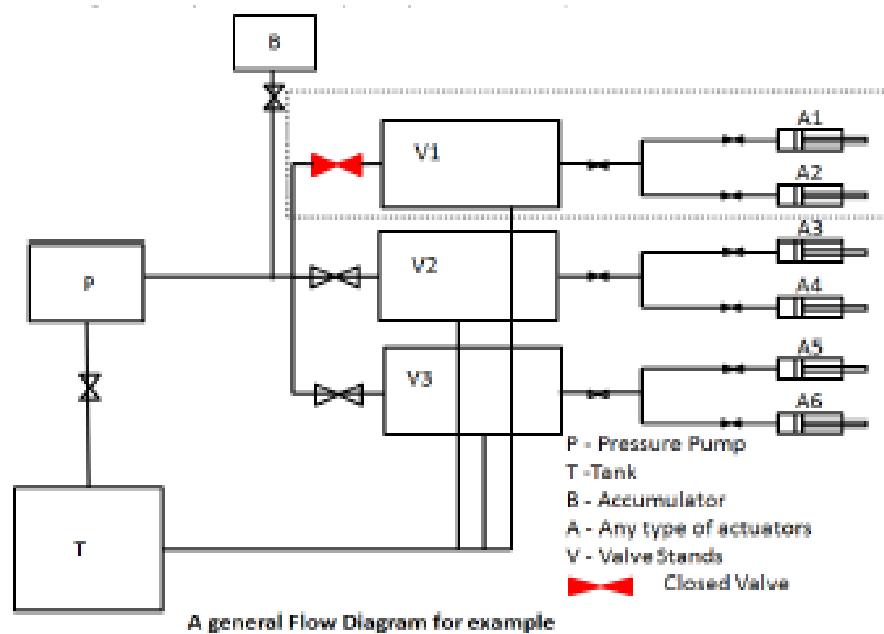
Block Diagram showing Power Pack (P) put-off and Accumulator Block (B) drained

Note: In few exceptional cases, process constraints do not allow power pack to be put-off. In such cases, isolation is done by closing and locking the ball valve and depressurizing the hydraulic line after the ball valve (there is full system pressure before the ball valve). Few such examples are Slide Gate Hydraulic System at LD1 and Mudgun Hydraulics at Blast Furnaces.

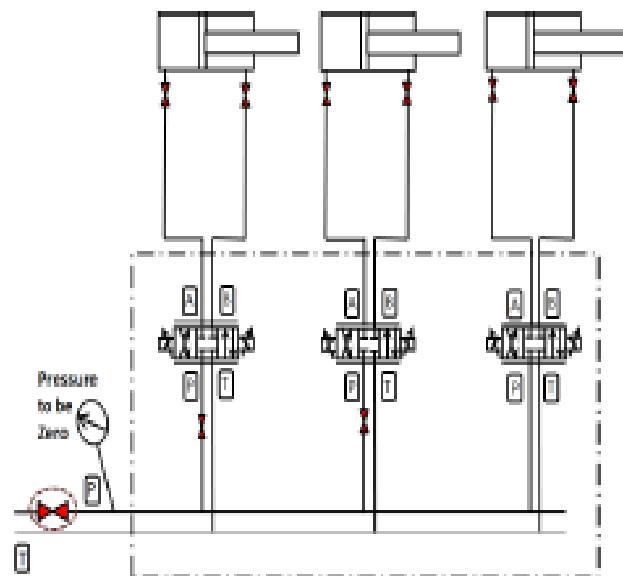
In all such cases, there must be a pressure measuring minimess point after the ball valve being isolated. Pressure must be read zero after connecting the Pressure Gauge to the minimess point. After that, minimess hose should be kept open (remove the pressure gauge) and work should only be done if no oil is dripping from the minimess (which means that there is no leak from the ball valve). During the entire work, this should be kept under observation. Connected hose with minimesh should be rigidly fixed and open point of minimesh should be diverted to drain.



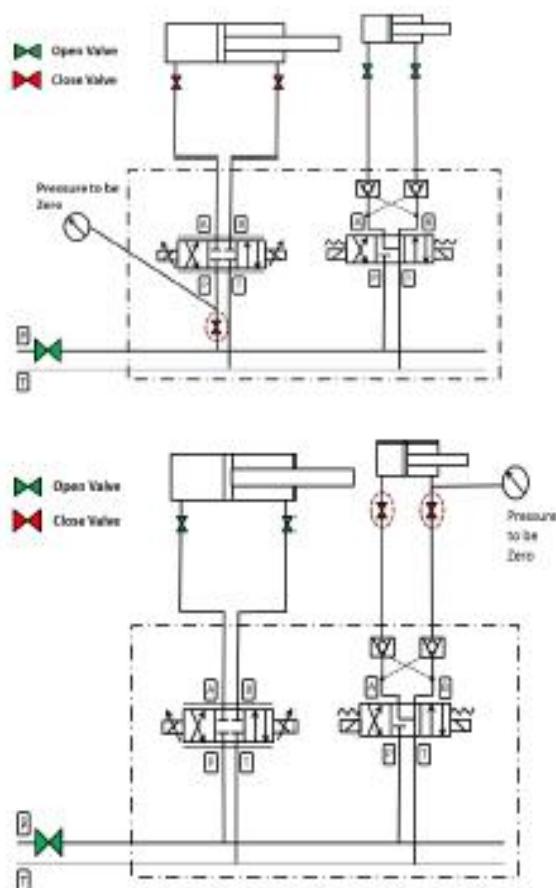
Photograph of minimess point and minimesh hose

ANNEXURE -2 (contd.)

A general Flow Diagram for example

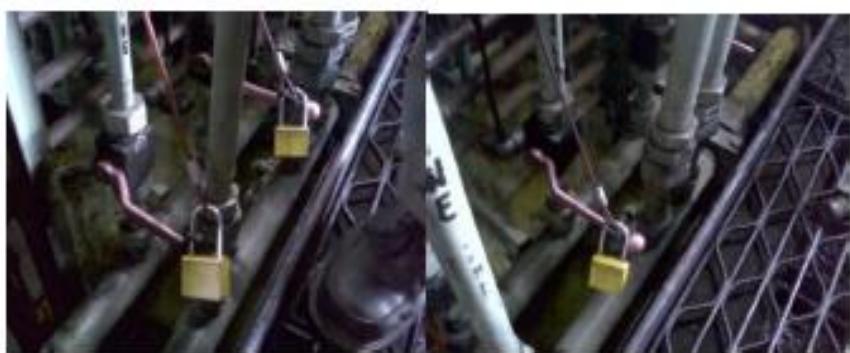


ANNEXURE -2 (contd.)



Isolation could be done by either closing the ball valve before manifold or in P line going to individual cylinder or by closing the ball valve just before the actuator.

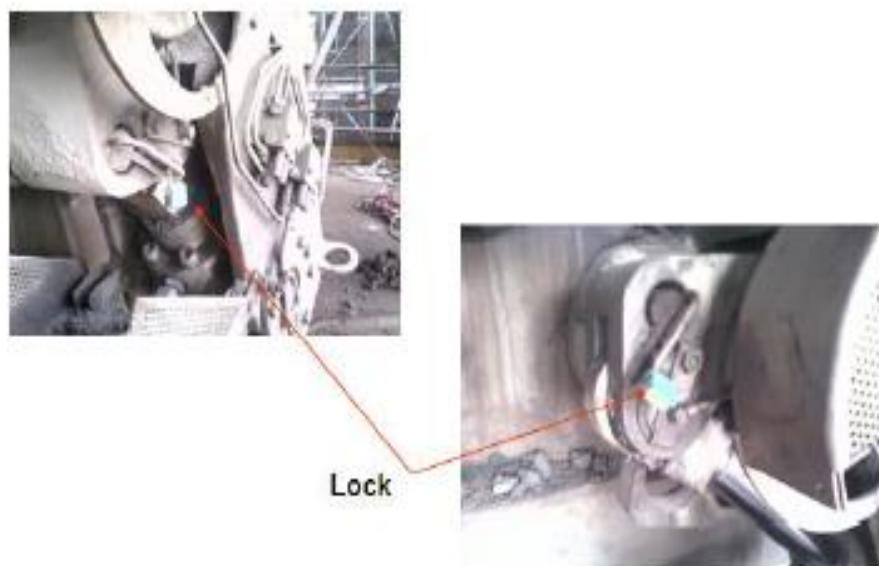
Some of the photographs of ball valve locking and mechanical locking of equipment are shown below.



ANNEXURE -2 (contd.)

Locking of Ball Valves

Mechanical locking arrangement



Mechanical locking of equipment to prevent hydraulic cylinder movement because of Load



Mechanical Jamming of wheel in NBM Foe. Walking Beam to prevent Hydraulic Cylinder Movement

ANNEXURE -2 (contd.)



Arrangement made to lock hydraulic line ball valve at HSM

Ball Valve Locking Devices



Ball valves with provision made for locking

DE-ISOLATION OF HYDRAULIC SYSTEM:

1. Deaeration of hydraulic system by connecting the pressure line with return line/ looping of P&T line.
2. Set the system at low pressure and start.
3. Removal/ disconnection of P&T line.
4. Slowly increase pressure to the rated pressure.
5. If the system is having the provision of loading / unloading valves, then above procedure can be done through these valves following the procedure given by OEM.

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	BARRICADING	Doc. No: SG/11 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

This safety guideline outlines the process of deploying various practices in barricading at shop floor. It provides engineering solutions on restriction of unwanted access to hazardous place at shop floor and construction activities.

2. Scope

The scope of work covers all steel plants in Iron and Steel sector.

3. Procedure

3.1 Deployment Methodology

- i) Gap Identification and assessment of current practices.
- ii) Identifying critical areas to improve and prioritize.
- iii) Preparation of deployment plan.
- iv) Review and monitoring the improvement and compliance of plan

3.2 Process

3.2.1 Barricades

- i) Barricades are used as warning devices for alerting people of the hazards in the workplace. These are also used to control traffic movement on plant roads and to protect hazard prone vital installations like gas holders, electrical sub-stations etc. and activities like excavation, trenching, construction and demolition work etc. are being performed.
- ii) Barricades are used to prevent un-authorized entry into hazardous area inside production departments.
- iii) Where required for protection of workers, public safety, or as required by laws, substantial barricades shall be provided.
- iv) Barricades shall be provided to protect people from associated hazards and to prevent trespassing into vital installations as per the requirement of prevailing laws.
- v) An opening in any floor, platform, pavement or yard through which person may fall; such as hatch way, stair or ladder opening, pit, large manhole, should be barricaded.
- vi) Traffic flow shall be controlled by using appropriate barricades to guide the vehicles into desired lane.
- vii) All barricades shall be visible from a safe distance, to alert people well in advance.

- viii) Caution board, diversion board, shutdown board to be displayed at both ends of barricade.
- ix) Two persons with red / green flag and whistle to be deputed at both ends of the barricades to regulate traffic.
- x) Red light to be provided on the barricades if job is to be done after sunset at the site.
- xi) No material to project / spill beyond barricades.
- xii) Only authorized persons shall remove the barricades once the job is complete.
- xiii) All extended open bars at construction site as well as at plants, other projected bars, valve spindle etc in the plants at man-height must be protected with Bar-cap, to cover the sharp projection of the bar.

3.2.2 Type of barricades

- i) Indicative Barricades:
- ii) Protective Barricades:
- i) **Indicative Barricades**



ii) **Protective Barricading**



Barricading signage for access control



- i) Danger Flags are to be attached with a maximum spacing of 5m.
- ii) The size of the Danger Flag shall be of minimum A4 size (210 X 297 mm).
- iii) In addition to English, message /warning signs in local language also to be provided.

3.2.3 Barricading hazardous areas within a production department

- i) Departmental head will ensure identification of all hazardous areas, within his/her department, which require permanent protective barricades to control and prevent entry of un-authorised persons.
- ii) All such areas shall be given unique identification numbers and ownership shall be assigned to officers/supervisors of the department. The owner of the hazardous area will also be responsible for installation and maintenance of the permanent protective barricades in his/her areas.

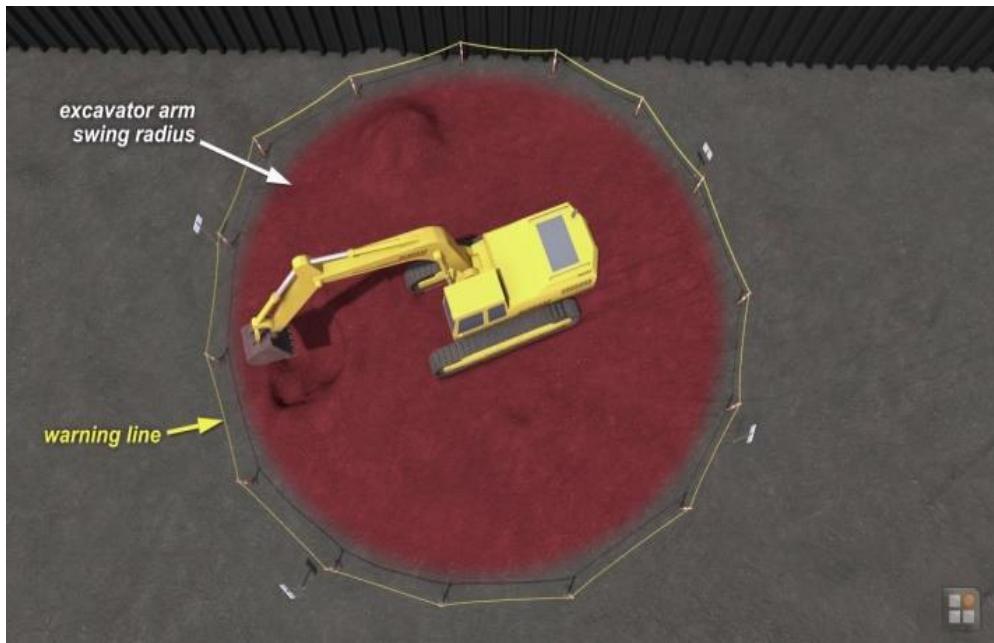
- iii) For any job requiring the removal and/or modification of the permanent barricade, written permission shall be taken from the owner of the barricade.
- iv) All permanent type protective barricades shall be designed, fabricated and erected to ensure safety and operational requirements.
- v) Status and conditions of permanent protective barricades shall be reviewed by the departmental head at regular interval.

3.2.4 Barricading Construction site

3.2.4.1 Construction sites are to be barricaded using the appropriate barricades, as given in the following bullet points:

- i) The construction sites shall be provided with barricade all around its periphery as per standard guideline given in [Annexure- 6](#).
 - ii) Barricade with pre-colour coated profile sheets supported on bars, angle, channel, hollow sections depending upon availability. The height of barricades shall be minimum 1.0 m. Barricade with height more than 1.2 meter shall be approved by designers.
 - iii) Barricades with scaffolding pipes. Vertical pipes shall be placed at about 2.0 m centre to centre and firmly grouted onto ground. All vertical and horizontal pipes shall be painted with black-yellow zebra fashion.
- 3.2.4.2 Wherever construction debris is dropped without the use of an enclosed chute, the area is to be barricaded using either of the barricade standards given at [Annexure-2, 3 or 4](#) depending upon the availability of angle/square hollow section and pipes, with 1 meter clearance from the deposited materials.
- 3.2.4.3 Areas with temporary wiring operating at more than 600 volts shall be barricaded with indicative barricade comprising “Red-White” safety tape, if the job requires at most one day to complete. If job requires longer time, then the site is to be barricaded with protective barricades as per the above-mentioned sketches. Plastic barriers must not be used to barricade the work area.
- 3.2.4.4 The swing radius of the rotating superstructure of cranes, excavator or other equipment is to be protected using minimum 50 mm wide ‘Red-White’ safety tapes. One strand of tape must run continuously from post to post at 1000 mm above ground. Another strand of tape is to run above 300 mm from the ground. Alternately, temporary steel frame barricades may also be used to barricade the swing radius. Danger sign as shown below is to be attached to the barricade.





- 3.2.4.5 All construction materials shall be barricaded with temporary steel barricade, as shown in the following figure. No part of any material shall protrude beyond the barricade.



3.2.5 Barricading at excavations site

For road-side excavations, a protective barricade of at least 1,200mm high must be erected around a trench that is 1.0 meter or more deep using standard drawing given in [Annexure-6](#). In other cases, indicative barricades with red-white tape in two layers may be used suitably, around the excavated pit at minimum 1.5m from the edge of excavation.



**PROTECTIVE
BARRICADING**

3.2.6 Barricading at Demolition site

- i) All the roads and open areas adjacent to demolition site shall be barricaded with caution board. Unauthorized entry to demolition site must be prevented.
- ii) Properly cover or securely barricade all the floors or roof openings / lift shaft entrances / doorways leading to staircases (where staircases are to be removed).
- iii) When floors are being removed, the area underneath shall be properly barricaded to prevent any other workman to work under the floor.
- iv) All floor openings / wall openings shall be adequately guarded / barricaded.
- v) During night, red light and/or luminescent danger signs shall be placed on and around the barricades.

3.2.7 Barricading Roads

- i) Before working on road or along road side, the executing agency shall obtain approval for working on road from respective Department. Barricade to control or to protect traffic is to be provided as per the norms and to be approved by the site-in-charge and the safety officer of the concerned department before starting the job.
- ii) Executing agency shall make safe work procedure for the job.
- iii) Care should be taken to block only one-half of road width at a time. Caution boards and boards indicating diversion are to be placed at both sides of barricade.

- iv) If entire road width is to be blocked, in addition to the caution board, the road diversion sign is to be prominently placed on both ends of the work area.
- v) If access by construction vehicles is required, the contractor or agency doing the work is responsible for properly replacing the barricades immediately after entry & exit of the construction vehicle.
- vi) If access to local office building is to be maintained beyond the point of the closure then an adequate opening shall be provided between the barricades to allow safe ingress and egress through the closure.
- vii) Drum painted white with red stripes at the middle and barricade with red / white safety tape may be used as barricade. However, barricades as shown either in the standard drawings given at [Annexure -2, 3 or 4](#) are preferable to drums.
- viii) Two persons with red / green flag and whistle to be deputed at both sides of the barricade to regulate traffic.
- ix) Red light to be provided if job is to be done after sunset. The cable for red lights shall be tied only with non-conductive material.
- x) No material to be projected / spilled beyond barricades.
- xi) Barricade is to be provided around if equipment is left unattended near a roadway at night.
- xii) Rail guards, as per the standard drawing given at [Annexure-1](#), are to be permanently placed in the ground, when road is passing parallel to railway track within 2 meter. These will be placed at places, where permanent rail track fencing is not provided.
- xiii) For any work on a road near railway track or level crossing, Safety precautions are to be strictly followed, including barricading the work site. Escape route, assembling area are to be notified in barricading area. Work in progress board is to be placed.

3.2.8 Barricading water bodies:

- i) Permanent rail guards as shown in the standard drawing given at [Annexure-1](#) are to be grouted in the ground along the side of roads passing along water bodies like lake, cooling pond etc. Same guards are to be placed on both sides of roads running on the top of dam.
- ii) For roads passing on the top of a dam, rail guards along with hand rails and mid rails are to be fixed permanently on both side of the road.
- iii) All bridges crossing any stream or river must have railings with hand-rail and mid-rails and toe guards

3.2.9 Barricading for positive isolation

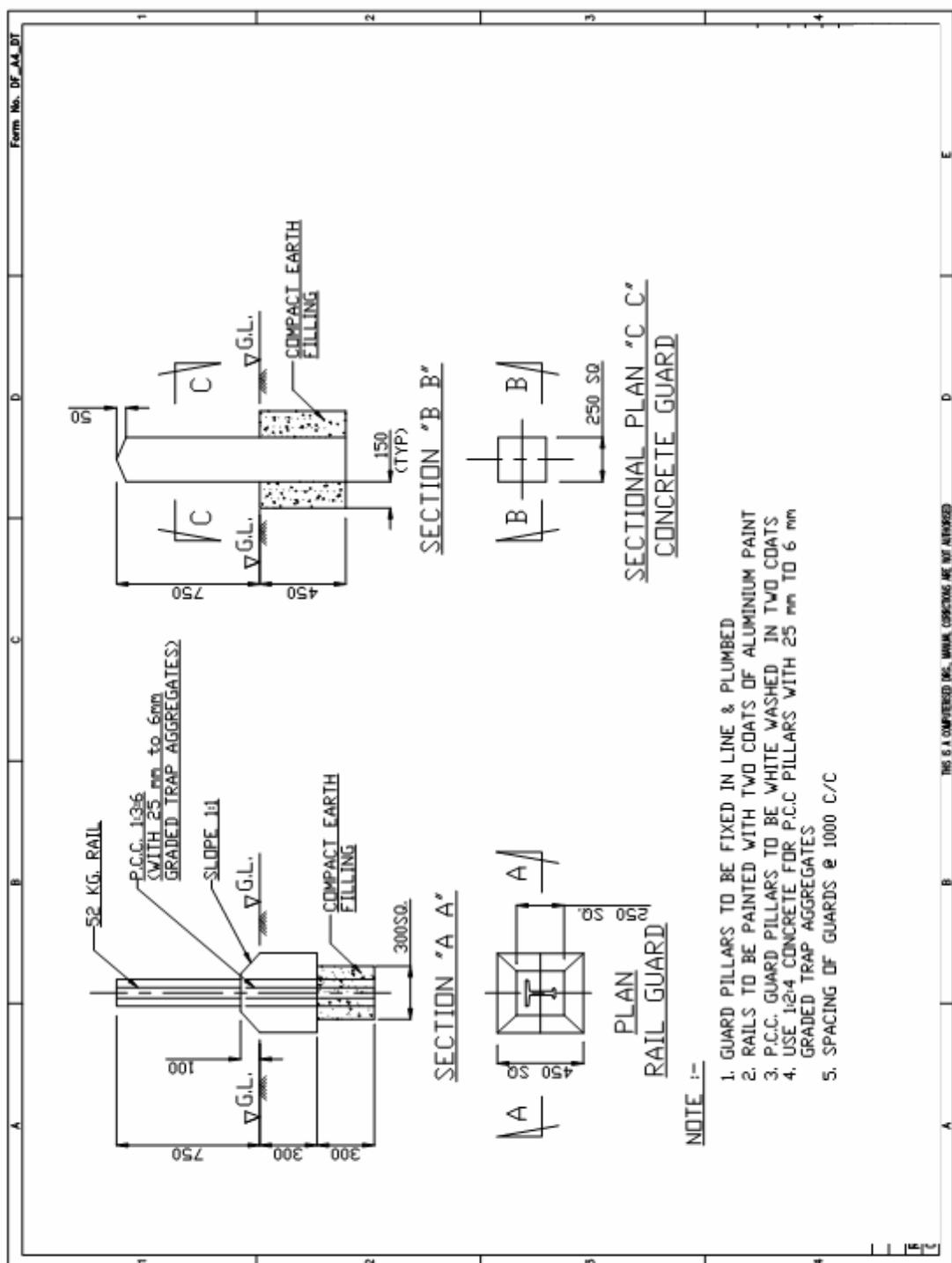
- i) For positive isolation, the entry of the personnel and the trucks and cranes to the working area shall be restricted by using barricades as shown in the standard drawing given at [Annexure-5](#).

- ii) Separate gate shall be provided, for the entry of personnel and trucks.
- iii) The barricades shall have self closing door for entry of persons.

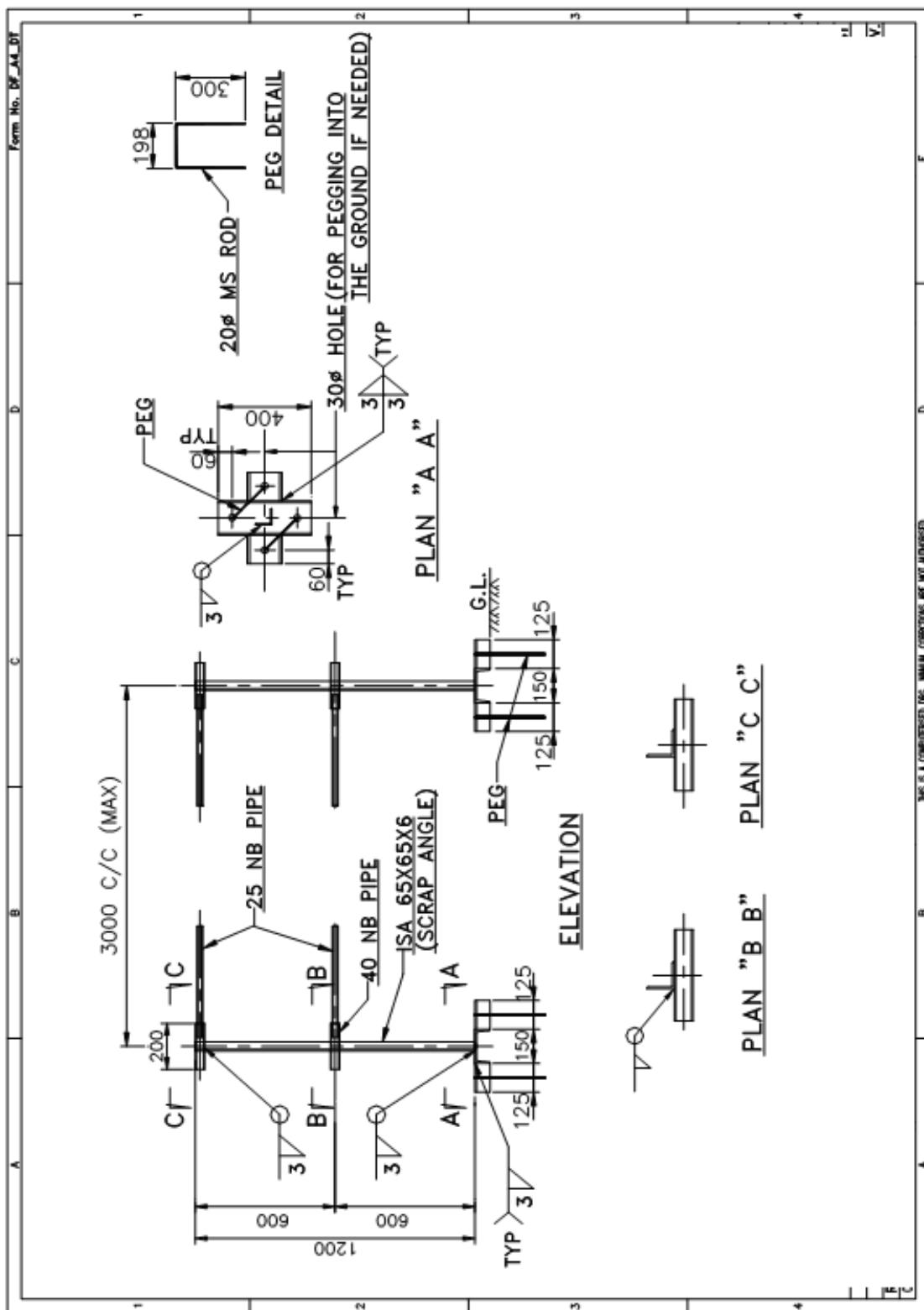
Reference:

1. IPSS:1-11-022-14 “Guidelines for Installation and use of Barricading”
2. TSL Safety Standard: SS/ENGG-13, Version-06

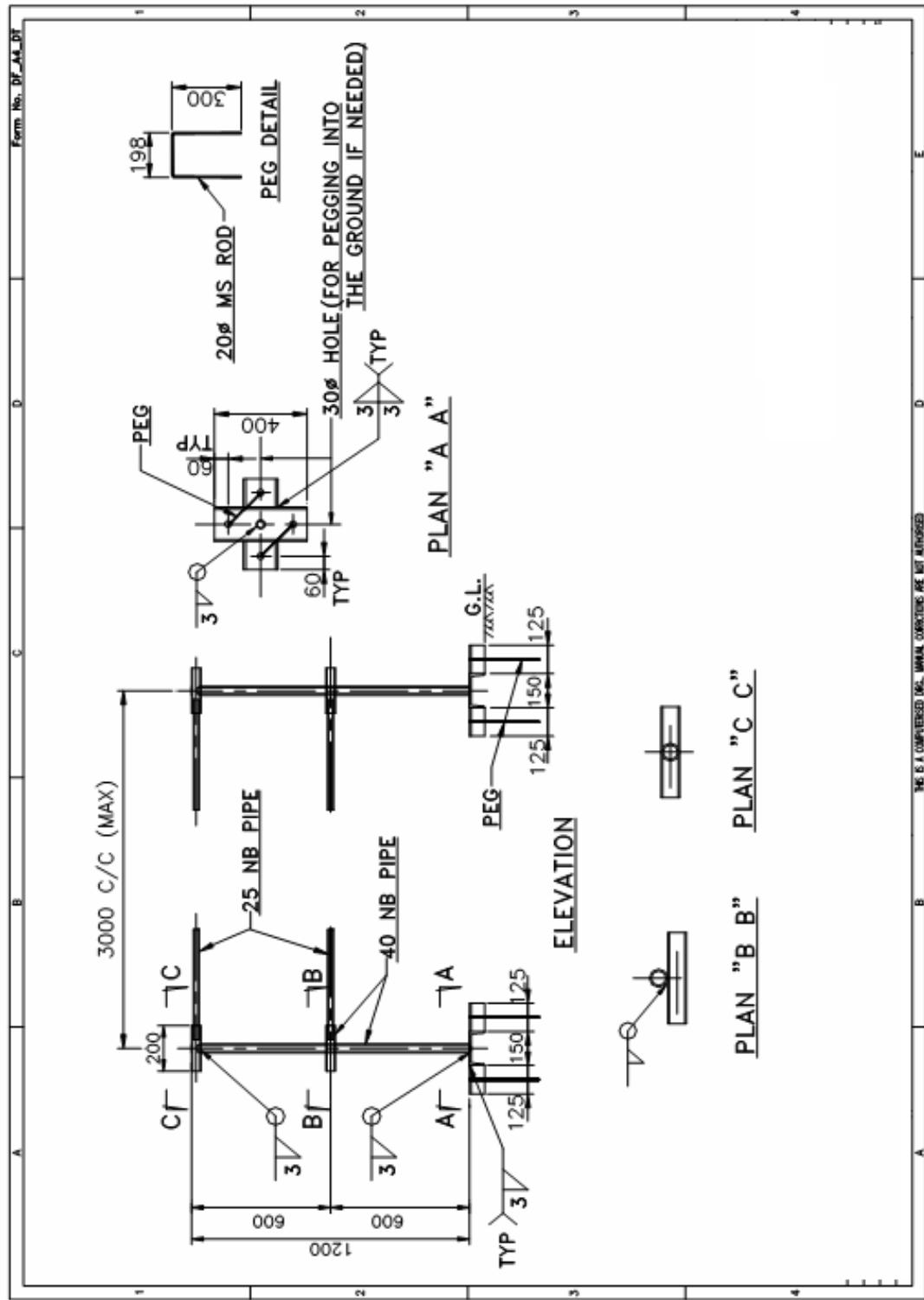
ANNEXURE-1



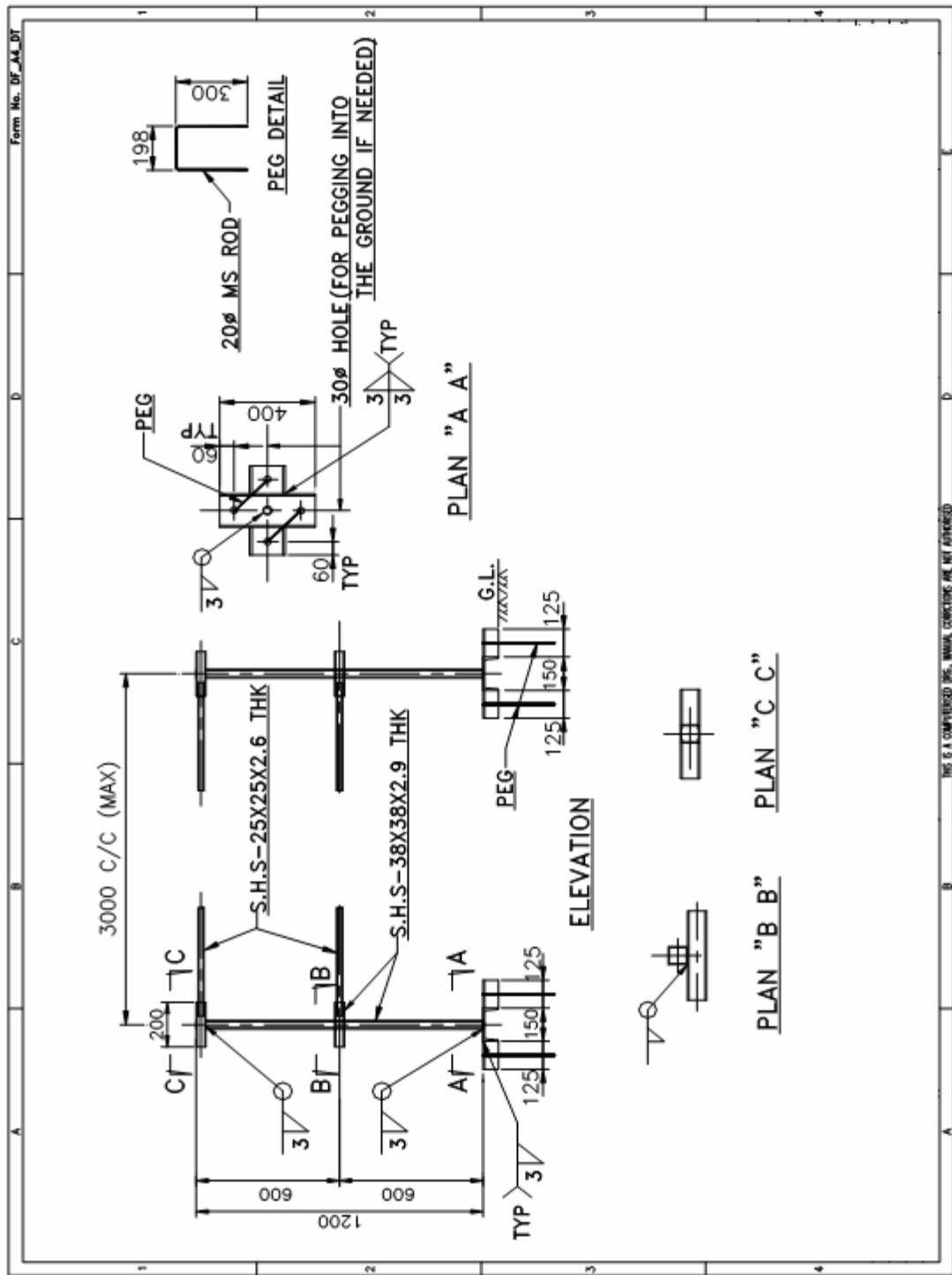
ANNEXURE-2



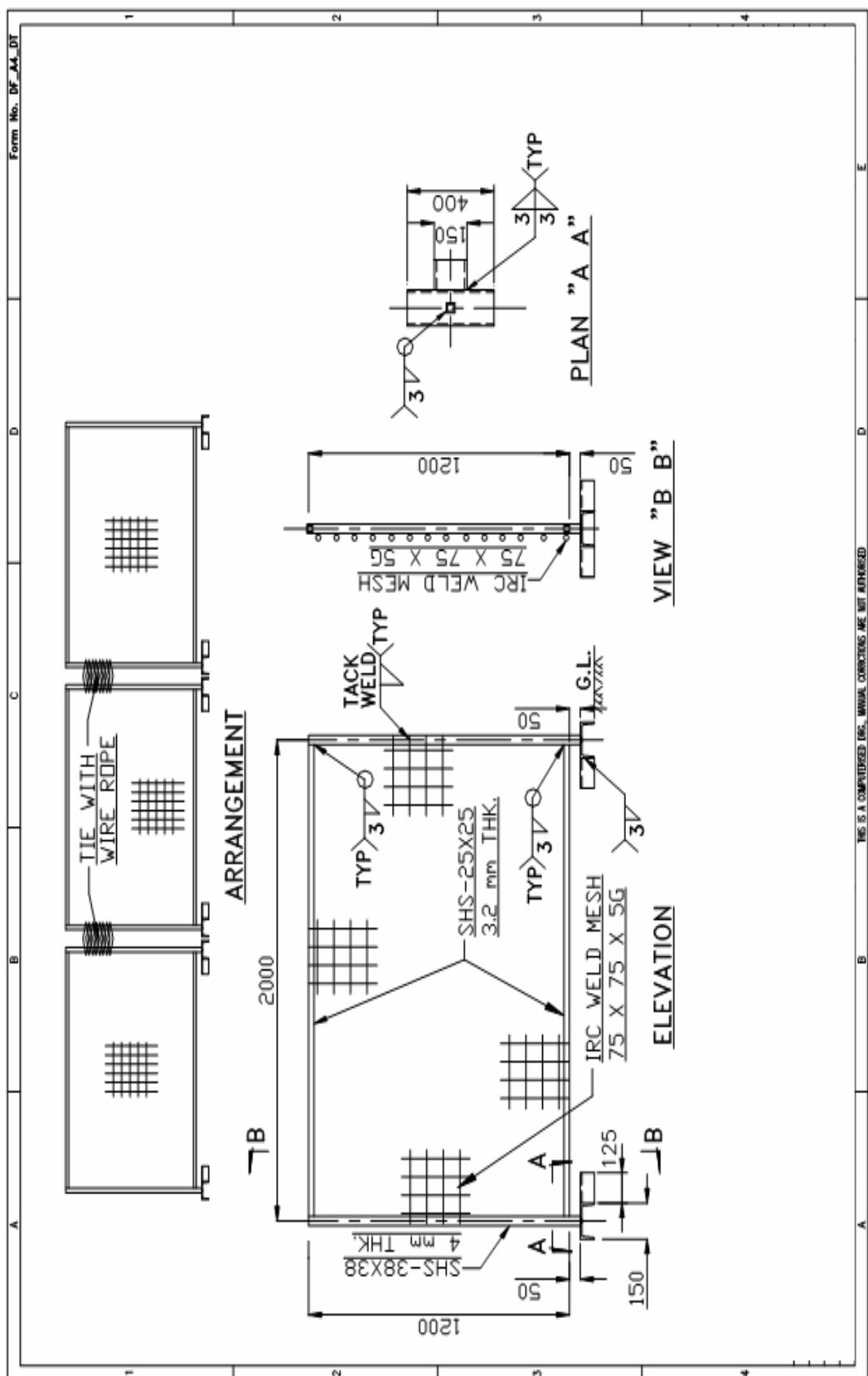
ANNEXURE-3

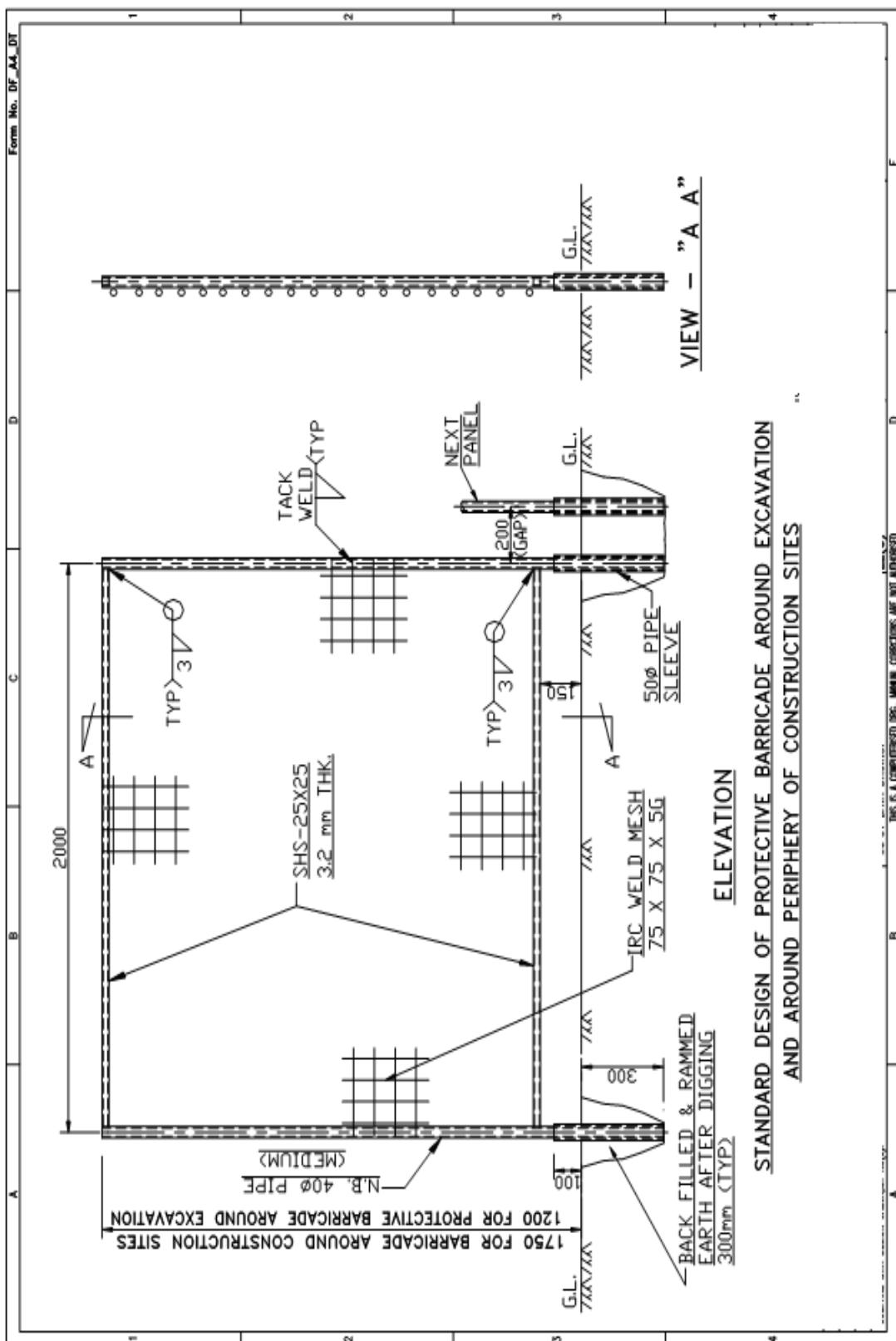


ANNEXURE-4



ANNEXURE-5



ANNEXURE-6

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	DEMOLITION OF BUILDING & STRUCTURE	Doc. No: SG/12 Rev no. : 00 Effective Date : 14.10.2019

1.0 **Objective**

This Safety guideline provides a safe Procedure for demolition of building and structures. Associated hazards are collapse of structure, falling material, flying material, impact/ hit by material, collapse of equipment/ machinery, noise, entrapment, fall from height, electrocution, fire, explosion etc.

2.0 **Scope**

The scope of work covers all steel plants in Iron and Steel sector.

3.0 **Procedure**

3.1 **Preplanning & Precautions before starting Demolition Work**

- i) Prior to permitting employees to start demolition operations, an engineering survey of the structures/ buildings/ equipment shall be made, by a competent person, to determine structural integrity and the possibility of unplanned collapse of any portion of the structure/ building/ equipment. Any adjacent structure where employees may be exposed shall also be similarly checked. The employer shall have in writing, evidence that such a survey has been performed.
- ii) Ensure that proper document/ letter is available for demolition of a building/ structure/ equipment etc. Schematic sketches for the key plan and elevations showing the different buildings/ structures/ equipment etc. to be demolished, are to be prepared. Necessary documents are to be prepared.
- iii) Adequacy & stability of parts to be demolished/ retained, are to be ensured. A definite plan of procedure for the demolition work shall be prepared by contractor/ Consultants and finalized in consultation with the executing department/ supervising department/ supervising agency. A copy of the survey report and of the plans and/ or methods of operations shall be maintained at the job site for the duration of the demolition operation.
- iv) Permanent deployment of ambulance to be done at site.
- v) Complete cleaning of soak pit and septic tank are to be done prior to start of demolition of civil building structure.

Adjacent or adjoining building

- i) No part of the demolition process should adversely affect the structural integrity of any other building. Consideration may be given to the use of shoring and underpinning and to the effects of changes in soil conditions because of the demolition work.
- ii) Adequate lateral support for adjoining structures should be provided. Before the existing lateral support is disturbed, provision should be made

for the erection of temporary supports, which will need to be checked for effectiveness as the demolition proceeds.

- iii) It is also important that other buildings in and around the demolition site are not adversely affected by vibration or concussion during the demolition process.
- iv) No part of the demolition process should cause flooding or water penetration to any adjoining building.

Essential Services

- i) One of the most important elements of pre-demolition planning is the location and disconnection of all essential services.
- ii) Essential services include the supply of gas, water, sewerage, telecommunications, electricity, chemicals, fuel and refrigerant in pipes or lines. The contractor must ensure, so far as is reasonably practicable, that essential services at the workplace are without risks to health and safety. All electric, gas, water, sewer, steam and other service lines not required in the demolition process should be shut-off, capped, or otherwise controlled, at or outside the building line, before demolition work is started.
- iii) In each case, any utility agency involved should be notified in advance and its approval or services, if necessary, obtained. Any service retained for the demolition work should be adequately protected as required by the relevant authority.

Basic technical and other requirements

- i) The stability and structural integrity of the structure at all stages of demolition.
- ii) Wind effect for partially demolished structures/ on temporary scaffolding system.
- iii) The effect of the proposed demolition sequence on stability.
- iv) The stability requirements for all components of the structure as it is sequentially demolished according to the structural engineer's requirements.
- v) The proximity of adjacent or adjoining buildings.
- vi) The competent person's assessment of loadings at all stages of demolition.
- vii) The provision of clear instructions for temporary bracing/ stays/ guys/ propping etc.
- viii) The equipment to be used for the work, including the size, type, position and coverage of proposed demolition crane(s) should be indicated on a site plan, locations such as unloading points and storage areas (if any) should be shown.
- ix) The need to ensure that the ground is compacted to any design specifications to enable plant to be moved and used safely at the workplace.

- x) The proposed methods for handling heavy, bulky or awkward components.
- xi) The need for specific lifting arrangements to be detailed to facilitate safe lifting.
- xii) The handling, lifting, storing, stacking and transportation of components, depending on their size, shape and weight.
- xiii) The provision of safe access and safe working areas.

3.2 Methods of Demolition

Various methods or system for demolition may be adopted based on site requirements and availability. These methods or systems are as specified below:

- i) Use of Scaffolding.
- ii) Use of Portable scaffoldings.
- iii) Use of construction staircases & platforms during demolition as specified in safety standard for working at height.
- iv) Use of existing staircases & platforms of existing buildings after inspection & ascertaining their suitability and their strengthening or replacement as required.
- v) Use of appropriate & adequate man lifters (Genie or other equivalent man lifters).
- vi) Use of appropriate & adequate Mobile Elevating Work Platform (MEWP) like scissors type MEWP etc.
- vii) Use of appropriate and adequate Electrical Winches with dog lock or safe break system.
- viii) Use of hanging scaffolds/ cradles/ cages.
- ix) Use of rope access system with specialized workforce.
- x) Use of appropriate & adequate Rope ladders with fall arrestor.
- xi) Use of mechanized climber system supplied by authentic manufactures & its Installation & operation as per OEM (Original Equipment Manufacturer).
- xii) Other methods based on study, preparation of schemes for the adopted method & their approval from Competent Engineer of the executing department.

3.2.1 Written Job Plan

The written Job Safety Plan/ job safety statement should be prepared before demolition.

It must include the process to be used and persons who should be involved in developing the new plan.

Demolition Safety Plan (Job Method Statement):

- i) Equipment – All Tools and Tackles should have valid Test Certificate as per statutory norms for all the equipment engaged for demolition job.

- ii) Personal Protective Equipment (PPEs) to be used.
- iii) Risk to health and adequate control measures to be taken in case of use of Hazardous substances e.g. Hydraulic Oil, Diesel, Gases (oxygen/ etc.).
- iv) Clear Responsibility to be given: Executing Authority to be designated.
- v) Technical content of the job should be taken care.
- vi) Follow the approved dismantling sequence.
- vii) Disposal of demolished debris and scrap as per instruction of the Executing Authority.
- viii) Safety Risk Assessment of the work to be done.

(The person in charge of the Executing Authority is responsible for ensuring that all controls are in place well in time)

Risk Assessment

Hazards	Risk to People	Control Measures
Slips, Trips & Falls	Company Employee, Contractor's employee, Site Visitors	Employ good housekeeping, remove materials from the workplace progressively. At the end of the shift, remove all tools etc. and inspect all areas to ensure they are left in a safe condition.
Cuts, grazes & Abrasions		Ensure a safe system of work is in place and is explained to all operatives and carry out toolbox talks on any hazardous areas etc.
Falling material		Flagmen and workers of the executing contractor are to be positioned at a safe distance away during demolition.
Services		All known live services are to be identified and protected during the demolition. Access to be maintained to the gas valve at the front of the main building in the event of an emergency.
Manual Handling		Should manual handling be required, minimum of two persons are needed for heavier items, adopt correct handling techniques. Only lift what can easily be managed. Access each item prior to lift and clear transit route to ensure safe passage.
Fire		As soon as is Reasonably practicable, remove waste from site to prevent a build-up of combustible material.
Foot penetration Injuries		Safety boots as specified in safety standard of PPEs, are to be used. Refer SG-18: Safety Guideline for Personal Protective Equipment (PPE) Management.

Hazards	Risk to People	Control Measures
Obstruction of assigned Emergency access/ egress routes movement		The site supervisor should coordinate on site vehicle/ plant including ensuring that the access to site is unblocked.
Clothing		Loose clothing must not be worn.
Traffic Movements		Traffic movements in and out of the barricaded area to be coordinated by the safety supervisor. Flagmen to be in place during traffic movements to ensure that traffic is not affected.
Hazardous Materials		There shall be no known hazardous materials within the site boundary, however should any material/ substance be on site, the Site Supervisors must immediately be informed.
Flying particles, Dust, Noise	Company Employee, Contractor's employee, Site Visitors	<ul style="list-style-type: none"> i) Standard safety goggles to be worn. ii) Dust will be minimized as far as possible by wetting down during the demolition. iii) Workers working with the noisy equipment must wear ear plug.
Uncontrolled Collapse		<ul style="list-style-type: none"> i) Workers are to be briefed about the sequence of demolition prior to commencement, by the job landsite supervisors. ii) The machine operator shall be fully conversant with the sequence of removal of any support members. iii) No structure/s to be left partially collapsed or in an unsafe condition.
Unsafe structure		<ul style="list-style-type: none"> i). The plant operator is to be briefed on the method of demolition by the supervisor prior to commencement. ii) Progressive demolition by controlled methods. No structure is to be left in an unsafe condition overnight.
Loading/ Unloading		<ul style="list-style-type: none"> i) All unloading activities should be carried out in a safe area within the barricaded demolition site or adjacent to the demolition site at a safe place per space availability, in the presence of a flag man.

- ix) Any device or equipment such as scaffolds, ladders, derricks, hoists, etc., used about demolition work shall be constructed, installed, inspected, maintained and operated in accordance with the regulations governing the construction, installation, inspection, maintenance and operation of such device or equipment. The cage, hoists, tackles shall not be overloaded. Safety

appliances (Helmet, Shoes, Goggles, Gloves, Safety Belts and others as may be required) shall be used. Refer SG-18: Safety Guideline for Personal Protective Equipment (PPE) Management.

- x) Demolition of all buildings and structures shall be conducted under competent supervision, and safe working conditions shall be afforded to the employees. Before the commencement of each stage of demolition, the supervisor shall brief the workmen in detail regarding the safety aspects to be kept in view.
- xi) When employees are required to work within a structure to be demolished which has been damaged by fire, flood, explosion, or other cause, the walls or floor shall be shored or braced.
- xii) Ensure Positive Isolation of the building/ structure from electrical or any other energy source. All electric, gas, water, steam, sewer, and other service lines shall be shut off, capped, or otherwise controlled, outside the building line before demolition work is started. In each case, any utility service which is involved shall be notified in advance.
- xiii) All the mains and meters of the building shall be removed or protected from danger. If it is necessary to maintain any power, water or other utilities during demolition, such lines shall be temporarily relocated, as necessary, and protected.
- xiv) All the roads and open areas adjacent to the work site shall be protected and Caution Boards/ Danger Sign in local language, Hindi and English shall be displayed at prominent places. Unauthorized entry to the building under demolition shall be efficiently controlled.
- xv) Provisions shall be made for at least two independent exits for escape of workmen during any emergency.
- xvi) During nights, red lights or luminescent danger sign shall be placed on or around all the barricades.
- xvii) Following work permits shall be obtained before commencement of job from the working department. Refer SG-04: Safety guideline for Permit to Work (Operation & Maintenance)
 - a) Power cutting clearance.
 - b) Work permit for Gas cutting and welding and working at height as may be applicable.
 - c) Work permit for working in gaseous areas (If applicable).
 - d) Any other clearance as found appropriate by executing department in consultation with the concerned department of Organisation.
- xiii) Walkways and passageways shall be provided for the use of the workmen and they will be strictly instructed to use these only. All such walkways and passageways shall be kept adequately lighted, free from debris and other materials.
- xiv) Shoring of other buildings/ adjacent structures shall be provided when the demolition operation exposes or breaches an adjoining wall of the adjacent structure.

- xv) Before demolition buildings with over hangs, chhajjas, etc. they should be properly supported and demolished first before demolishing superstructure of the building.
- xvi) While breaking roof slabs, workmen shall not be allowed to sit on the same floor, but on a separate platform, supported independently. In case they have to work from the same floor, independent life line to fasten their lanyard shall be provided. Lifeline should not be connected with the portion to be dismantled.
- xvii) It shall be determined whether asbestos, hazardous materials, hazardous chemicals, gases, explosives, flammable materials, or similarly dangerous substances are present at the work site. When the presence of any such substance is apparent or suspected, testing and removal or purging shall be performed and the hazard should be eliminated before demolition is started.
- xviii) Protruding nails in boards, planks and timber shall be withdrawn, driven in or bent over as soon as the same is removed from the structure being demolished.
- xix) Any material to be removed which will cause safety hazards.

3.3 Type of General Demolition

3.3.1 Manual Demolition

Manual demolition includes any technique where hand tools such as jackhammers, sledgehammers and picks are used. Manual demolition has many of the hazards that are present in other major demolition activities including unexpected collapse, falls, falling objects, manual handling and exposure to noise, dust and hazardous chemicals.

To manage the risk of unplanned collapses, the condition of roofs, walls and floors of the building should be assessed by an experienced person before commencing demolition work. Where concrete members are being demolished manually, the reinforcement shall not be cut while breaking of the concrete is in progress. Where pre-and post-tension demolition work is undertaken, experienced person's advice should be sought as to demolition sequence. Areas where debris will fall should be barricaded off and signs erected to prevent persons from entering before demolition starts.

3.3.2 Mechanical Demolition

Mechanical demolition involves the use of powered mobile plant, such as excavators, cranes, loaders and bulldozers. There may be a mix of hand and mechanical demolition methods applied.

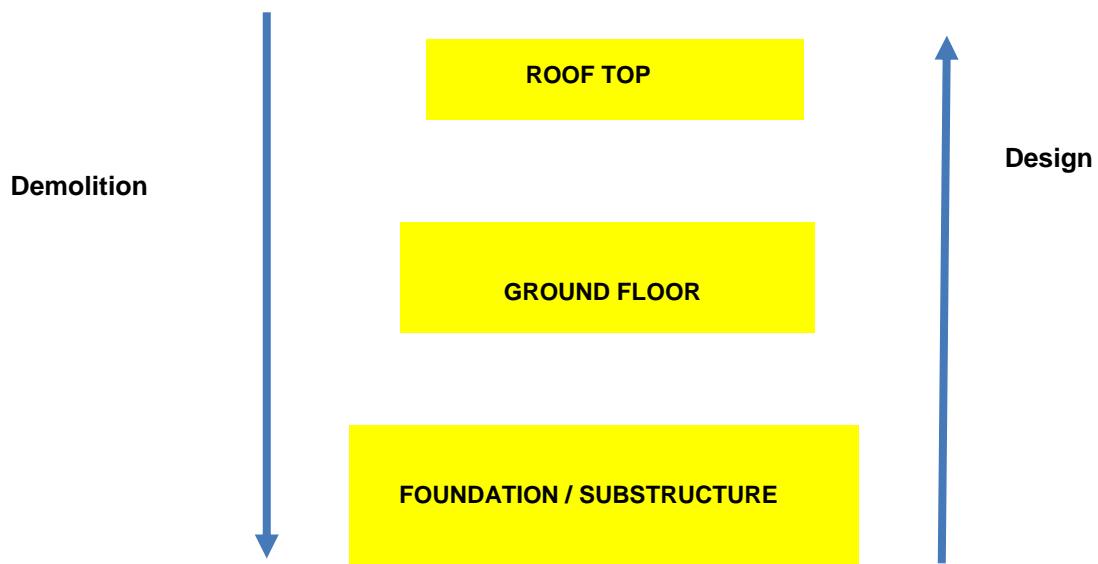
All powered mobile plant used for demolition work must be fitted with a suitable combination of operator protective devices. Operator protective structures should be designed to the appropriate standard that eliminates or minimizes the risk, so far as is reasonably practicable, of operator injury due to:

- i) roll over and consequent cabin impact damage
- ii) objects falling on or over the cabin
- iii) objects penetrating the cabin
- iv) Hazardous noise.

3.4 Sequence of Demolition Operations

3.4.1 Basics of sequence of demolition

Demolition is “Reverse construction”. This concept will help to form a general guideline about sequence of demolition.



Demolition sequence shall be determined according to actual site conditions, restraints, the building layout, the structural layout and its construction. In general, the following sequence shall apply:

- i) All cantilevered structures, canopies, verandas and features attached to the external walls shall first be demolished prior to demolition of main building and its internal structures on each floor.
 - a) be appropriately propped to provide support and prevent unintentional collapse during demolition, or
 - b) Have a supporting scaffolding gantry installed to prevent unintentional collapse during demolition.
 - ii) When demolishing the roof structure, all lift machine rooms and water tanks at high level shall be demolished in “top down” sequence to the main roof level.
 - iii) If site conditions permit, the first-floor slab directly above the ground floor may be demolished by machine sitting on ground level and mounted with demolition accessories.
- 3.4.2 Before demolition work is started, glazed sash, glazed doors and windows, all fragile and loose fixtures shall be removed. All loose plaster shall be stripped off throughout the entire building.
- 3.4.3 All exterior wall openings, which extend down to floor level shall be barricaded to height of not less than one meter above the floor level. This provision shall not apply to a storey after structural demolition has been started for the ground level floor.

- 3.4.4 All floor openings and shafts not used for material chutes shall be closed and be enclosed with guard rails and toe boards.
- 3.4.5 The demolition shall always proceed systematically storey by storey in descending order and the work on the upper floors shall be completely over before any of the supporting members or other important portion on the lower floor is disturbed (These requirements shall not prohibit the demolition of structure in sections., if means are taken to prevent injuries to persons or damage to property). Stability of the remaining part of structure must be checked, before dismantling of any part is taken up.

3.5 Removal of Materials/ Debris

- i) Debris shall not be allowed to be thrown from height. Remove all debris promptly, using chutes or by using bags.
- ii) Metal chutes may be provided for removal of materials. The chutes shall preferably be provided as per site requirement for efficient disposal of debris.
- iii) Chutes, if provided at an angle of more than 45 degree from the horizontal shall be entirely enclosed on all the four sides, except for opening at or above the floor level for receiving the materials.
- iv) Opening for the chutes shall not exceed 1.2 m in height measured along the wall of the chute and in all stories below the top floor such opening shall be kept closed when not in use.
- v) To prevent the descending material attaining a dangerous speed, chute shall not be extended in an unbroken line for more than two stories. A gate or stop shall be provided with suitable means for closing the bottom of each chute to stop the flow of materials.
- vi) Chutes at an angle of less than 45 degree with the horizontal may be left open on the upper side provided that at the point where such a chute discharges into a chute steeper than 45 degrees to the horizontal. The top of the steeper chute shall be boarded over to prevent the escape of materials.
- vii) Any opening into which workmen dump debris at the top of a chute shall be guarded by substantial guard rail extending at least one meter above the level of the floor or other surface on which men stand to dump the material into the chute.
- viii) A wooden toe board or bumper not less than 50 mm thick and 150 mm high shall be provided at each chute opening, if the material is dumped from the wheel barrows. Any space between the chute and the edge of the opening in the floor through which it passes shall be solidly planked over.

3.6 Stairs, Passageways and Ladders

- i) Stairs and stair railings, passageways and ladders shall be left in place as long as possible.
- ii) All stairs, passageways and ladders to be used by workmen during the process of demolition.
- iii) Shall be maintained in a safe condition.
- iv) Ladders or their side rails shall extend not less than 1.0 m above the floor or platform to which such ladder gives access.

- v) All ladders shall be secured / fastened against slipping / turning out at the bottom as well as top end.

3.7 Demolition of Walls

- i) When walls or sections of masonry are being demolished, it shall be ensured that they do not fall as single mass upon the floors of the building that are being demolished, so as to exceed the safe carrying capacity of the floors.
- ii) Overloading of floors shall be prevented by removing the accumulated debris through chutes or by other means immediately.
- iii) Walls shall be removed part by part. Stages shall be provided for the men to work in, if the walls are very thin and dangerous to work by standing over them.
- iv) No section of wall whose height is more than 8 times of thickness shall be permitted to stand without lateral bracing unless such wall is in good condition and was originally designed to stand without such lateral bracing or support.
- v) Structural or load supporting members on any floor shall not be cut or removed until all the storeys above that floor have been demolished and removed.
- vi) In framed structures, the steel frame may be left in place during demolition of masonry work. Where this is done, all steel beams, girders, etc. shall be cleared off loose materials as the demolition of masonry work progresses downward.
- vii) Walkways shall be provided to enable workmen to reach or leave their work on any scaffold or wall. Such walkways shall not be less than 0.75 m in width.
- viii) At the completion of each day's work, all installations shall be left stable to avoid any danger of getting overturned.
- ix) Foundation walls which serve as retaining walls to support earth or adjoining structure, shall not be demolished until such an adjoining structure has been underpinned or braced and the earth removed by sheet piling or sheeting.
- x) Non-load bearing walls shall be removed prior to demolition of load bearing walls.
- xi) Columns and load bearing walls shall be demolished after removal of beams on top.
- xii) Brick in-fill Wall - To avoid any potential hazard of bricks falling out of the building, all the brick in-fill shall be removed by pushing inward, before dismantling the reinforced concrete framing. Working platforms outside the building shall be used for removal of the brick in-fill walls. Brick removal shall begin from the top layer downwards. The works shall be carried out layer by layer with each layer not larger than 300 mm.

3.8 Demolition of Floors

- i) In cutting holes in floor which spans in one direction, a slit of width not exceeding 300 mm shall be cut at the first stage for the entire length of the

slab along which it spans. The opening shall thereafter be increased to the desired width by suitable instalments.

- ii) Planks of sufficient strength, not less than 50 mm thick and 250 mm wide, shall be provided at spacing not greater than 0.4 m for the workmen to work. The length of planks shall not be less than 2 m. These planks shall be so placed as to give workmen firm support to guard against any unexpected floor collapse.
- iii) Stringers of ample strength shall be installed to support the planks where necessary and the ends of such stringers shall be supported by floor beams, girders and not by floor slab alone.
- iv) When floors are being removed, no workman shall be allowed to work in the area, directly underneath and such area shall be barricaded to prevent access to it.
- v) The demolition of floor shall be started only after the floor in question and the surrounding.
- vi) Floor area for 6 m has been entirely cleared of persons, and the debris and other unnecessary materials removed.
- vii) The reinforcement shall remain and be cut off after the concrete is broken away.
- viii) The two-way slab is supported by beams or structural members on all four sides. Demolition of the slab shall begin in the middle of the slab and advance towards the sides in all 4 directions.
- ix) Flat slab shall begin at the centre of the bay between the supporting columns and proceed outwards to the columns and/ or members that provide lateral support of the slab. Care must be exercised not to prematurely weaken the shear capacity of the columns or other supports. In general, when demolishing a column strip or part of it, adequate supports shall be provided to the strip in advance.

3.9 Demolition of Simple Precast Construction

The joints in this type of structure do not normally provide continuity. The stability of this type of structure relies on other elements such as stairs, lift shafts, shear walls or other framed structures.

- i) Dismantling each precast element shall be removed in the reverse order of construction and broken on the ground or an adequately supported floor.
- ii) Elements providing lateral stability shall not be demolished prior to the removal of the precast elements or prior to the installation of the temporary bracing. Temporary supports shall be adequately braced or tied to laterally stable elements.
- iii) Existing lifting points: The re-use of the existing lifting points or accessories to lift the precast elements shall not be allowed unless the record of erection plans showing the function of the existing lifting points are checked and verified to be adequate for current use.

- iv) Lateral support during lifting : Special consideration shall be given to long span precast elements with narrow compression flanges during lifting. Spreader beams shall be used to reduce the spacing of the lifting points.

3.10 Demolition of Fire Damaged Building

Fire reduces a structure's ability to act as a load platform for plant, people and materials. As a result, great uncertainty exists concerning what might happen when various actions are taken.

It is necessary that a thorough inspection is undertaken prior to demolition commencing. The following should be looked for during the inspection:

- i) Evaluate the fire temperature and locate areas where material strengths appear reduced and deflections larger than normal.
- ii) Look for shear failures of connections.
- iii) Evaluate concrete strengths and identify areas of weakness.
- iv) Look for cracked concrete members, even those remote from the fire.
- v) Check if structural steel requiring compression flange restraint has lost that restraint (purlins or floor joists, for example).
- vi) With composite flooring, check for shear failure.
- vii) Where loss of strength has occurred in beams, columns or their connections, additional propping may be required to ensure stability.
- viii) Before any work starts, ensure that internal areas are well ventilated, and be aware that some debris may be toxic. Take particular care if the building has been used to store chemicals.

3.11 Demolition of Structures

- i) When a derrick is used, care shall be taken to see that the floor on which it is supported is amply strong for the loading so imposed, if necessary heavy planking shall be used to distribute the load to floor beams and girders.
- ii) Overloading of equipment shall not be allowed.
- iii) Tag lines shall be used on all materials being lowered or hoisted up and standard signal system shall be used. The workmen shall be instructed on the signals.
- iv) No person shall be permitted to ride the load line.
- v) No beams shall be cut until precautions have been taken to prevent it from swinging freely and possibly striking any worker or equipment or any part of the structure being demolished.
- vi) All structural steel members shall be lowered from the building and shall not be allowed to drop.

3.12 Catch Platforms

- i) In demolition of exterior wall of multi-storey structure, it is advisable to provide catch platform of heavy planking to prevent injuries to the worker working below and to the public, when the external walls are more than 20 m in height.

- ii) Such catch platform shall be constructed and maintained not more than 3 storeys below the storey from which exterior walls are being demolished. When demolition has progressed to within 3 stories of ground level, catch platform will not be considered necessary.
- iii) Catch platforms shall not be less than 1.5 m in width measured in a horizontal direction from the face of the structure and shall consist of outriggers and planks/ steel decks. These shall be laid tight together without openings between them and the walls. Catch platform shall be provided with a continuous solid parapet along its outer edge of at least 1 m height. The parapet shall be constructed of the same specifications as the platform.
- iv) Catch platforms can be constructed of material other than wood also, provided such material is of equal strength.
- v) Catch platform shall be capable of sustaining a live load of not less than 610 kg per square meter.
- vi) The outriggers shall be of ample strength and shall not be spaced more than 3 m apart.
- vii) Materials shall not be dumped on catch platform nor shall such catch platform be used for the storage of materials.

3.13 Removal of Walls, Floor and Material with Equipment

- i) Mechanical equipment shall not be used on floors or working surfaces unless such floor or surfaces are of sufficient strength to support the imposed load.
- ii) Floor openings shall have strong curbs to prevent equipment from falling over the edge.

3.14 Removing AC Sheet Roofing

- i) Before attempting the actual removal, a careful study should be made to find out the strength of the asbestos sheet. In any case, workmen should not be allowed to walk and stand on AC sheets.
- ii) A firm ladder should be provided for workmen to climb to the roof.
- iii) A cat ladder which can be kept on the sloping roof (supported from the ridge) should be used for the workmen to stand and remove the sheets.
- iv) Only experienced workmen should be engaged. They will never step on the unsupported portion of the sheets.
- v) Caution boards should be fixed at the ladders leading to the roof top, DANGER: DO NOT GO ON THE ROOF TOP WITHOUT PERMISSION.

3.15 Mechanical Demolition

- i) When demolition is to be performed by mechanical devices, such as weight ball and power shovels, the following additional precautions may be observed.
 - a) The building height should not exceed 25 m.
 - b) The area shall be barricaded for a minimum distance of 1.5 times the height of the wall or the maximum available space, whichever is less. In

all cases, precaution is to be taken to prevent entry of people in the barricaded area.

- c) While the mechanical device is in operation, no workman shall be allowed to enter the building being demolished.
- d) The device shall be so located as to avoid falling debris.
- e) The mechanical device when being used shall not cause any damage to adjacent structure, power line, etc.

3.16 Recommendation for Demolition of Certain Special Types and Elements of Structures

3.16.1 Roof Trusses

- i) If a building has a pitched roof, the roof structure should be removed to wall top level by hand methods. Sufficient purlin and bracing should be retained to ensure stability of the remaining roof trusses while each individual truss is removed progressively.
- ii) Temporary bracing should be added, where necessary, to maintain stability. The end frame opposite to the end where dismantling is commenced, or a convenient intermediate frame should be independently and securely guyed in both directions before work starts.
- iii) On no account should the bottom tie of roof trusses be cut until the principal rafters are prevented from making outward movement.

3.16.2 Heavy Floor Beams

- i) Heavy blocks of timber and steel beams should be supported before cutting at the extremities and should then be lowered to a safe working place.

3.16.3 Reinforced Concrete Beams

- i) For beams, a supporting rope should be attached to the beam. Then the concrete should be removed from both ends by pneumatic drill and the reinforcement exposed. The reinforcement should then be cut in such a way as to allow the beam to be lowered under control to the floor.

3.16.4 Reinforced Concrete Columns

- i) For columns, the reinforcement should be exposed at the base after restraining wire guy ropes have been placed round the member at the top. The reinforcement should then be cut in such a way as to allow the column to be pulled down to the floor under control.

3.16.5 Reinforced Concrete Walls

- i) Reinforced concrete walls should be cut into strips and demolished in the same way as columns.

3.16.6 Suspended Floors and Roots

Before demolishing suspended floors and roofs, the type of construction should be ascertained. In solid slabs, the direction of the main reinforcement should be determined; the slab should then be cut into strips parallel to the

main reinforcement and demolished strip by strip. Where ribbed construction has been used, the principle of design and method of construction should be determined before demolition is commenced. Care should be taken not to cut the ribs inadvertently.

3.16.7 Precast Reinforced Concrete

- i) Precast reinforced concrete units used in a structure are normally held in position by the strength of the joints made in-situ or on supporting walls, etc. As such, before starting demolition, the joint structures and/ or the supporting mechanisms shall be studied and understood.
- ii) In devising and following the demolition sequences, due precaution shall be taken to avoid toppling over of prefabricated units or any other part of the structure and wherever necessary temporary supports shall be provided.
- iii) Before commencing of the demolition work involving such structures advice of an expert in such demolition shall be obtained and followed.

3.16.8 Storage Tank & Pipelines

- i) Before an above ground or underground storage tank and/ or associated pipelines are removed or demolished, any previous use should be determined and appropriate action taken to identify and remove any hazardous chemicals. Delivery lines and vent pipes should be purged. The tank should be emptied and certified by a competent person as being free of gas, flammable vapours or other hazardous chemicals.
- ii) If work is to be undertaken on storage tanks then it is necessary to determine whether they are a confined space for the purpose of the work.

3.16.9.1 General Precautions

During the demolition of tanks and pipelines, the following precautions should be taken:

- i) Make sure that no flammable or toxic substances or combustible liquid is allowed to enter any drainage system or watercourse.
- ii) If excavating underground tanks and/ or pipelines, check the soil surrounding the tank/ pipe to establish that it is not contaminated, either by leakage from the tank/ pipe or by spillage.
- iii) Hot work (for example, welding; oxy-acetylene cutting) should not be undertaken where there is a chance that flammable material may be present as a result of leakage/ spillage or after cleaning out the tank/ pipe.

3.16.9.2 Hazardous Facilities

- i) Special precautions should be taken during the demolition of Major Hazard Facilities (MHF), chemical works, gas works and similar establishments. These types of facilities should be examined in conjunction with a competent person (for example, a chemical engineer), in order to determine the nature of any of the plant, chemical deposits and their influence on the method of demolition or dismantling.

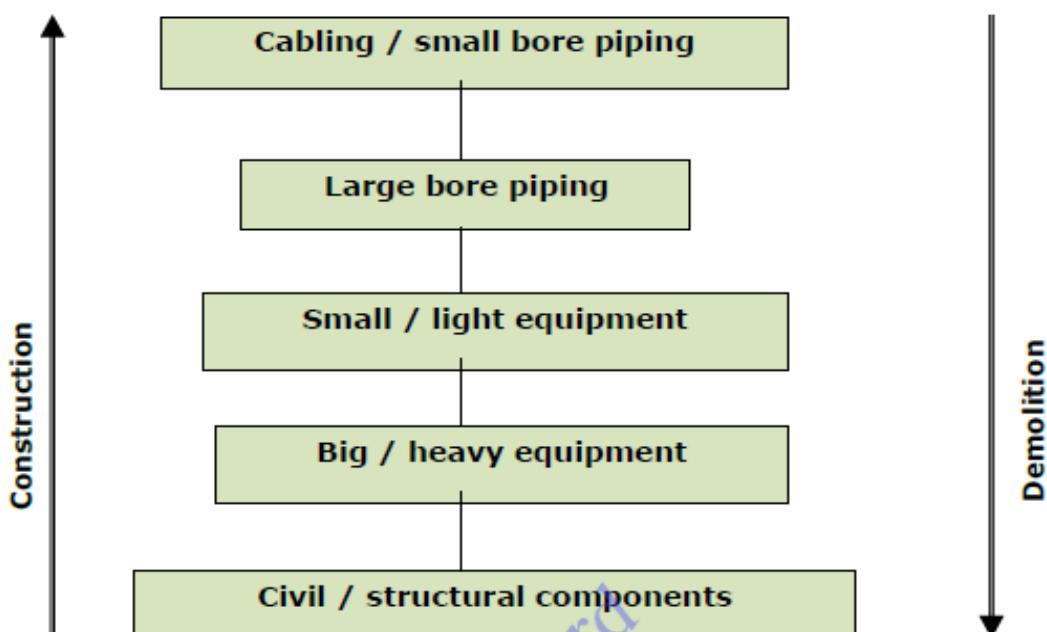
- ii) The removal of flammable materials and their new locations should be ascertained before any demolition work starts.

3.16.9.3 Containers that have held flammable or combustible material

- i) Welding and cutting work on containers that have held flammable or combustible liquids, solids, gases or dusts can result in fire or explosion if the containers are not entirely free of these materials.
- ii) It is therefore important to conduct a rigorous cleaning process and that any instructions for cleaning are followed. Containers which have held any of the following materials are considered unsafe and hot work should not be started before they are properly cleaned:
 - a) Petrol, kerosene, solvents, or light oil, acids and alkaline, which can react with metal to produce explosive or toxic gases heavy oils, tars or solids which can release combustible gases when exposed to heat flammable solids, whose finely divided particles may form an explosive dust cloud.
- iii) Any container which has held flammable or combustible substances should be considered unsafe until confirmed otherwise by a competent person.

3.17 Dismantling of Steel Structures

(A) Generic sequence diagram:



3.17.1 Attachment-1

Practice for Sequential Dismantling of Steel Structure:

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Section – 1: Precautions to be taken before Dismantling of Steel Structures.

Section – 2: General Sequence of Dismantling Structural Building.

Section – 3: General Sequence of Dismantling Open Gantry

Section – 4: General Sequence of Dismantling Conveyor Gallery.

Section – 5: General Sequence of Dismantling Crane

Section - 6: General Sequence of Dismantling of Trestles & Towers.

Sketch – 1: Detail of Shed Type Building (Sheet 1 of 2)

Sketch – 2: Detail of Shed Type Building (Sheet 2 of 2)

Sketch – 3: Detail of Open Gantry.

Sketch – 4: Detail of Conveyor Gallery (Sheet 1 of 2)

Sketch – 5: Detail of Conveyor Gallery (Sheet 2 of 2)

Sketch – 6: Details of Trestles /Towers (Sheet 1 of 2)

Sketch - 7: Details of Trestles / Towers (Sheet 2 of 2)

3.17.2 Section – 1

Precautions to be taken before Dismantling of Steel Structural

Before any dismantling job is taken up, the Contractor shall officially identify a “Dismantling Leader” by a letter to Organisation authorities. The Dismantling Leader must have adequate knowledge and experience of structural dismantling and shall be responsible for safe dismantling work. Apart from other safety precautions, he will take care of the points, mentioned below:

- i) Ensure that the structural to be dismantled are not supporting any other structures. In case, it is supporting, the other structures should be suitably supported before dismantling work is taken up.
- ii) All service lines like Oxygen, Nitrogen, Compressed air, CO gas, BF gas, LD gas carrying lines supported on the structural intended to be dismantled, should be re-routed. In case, it is decided that structural will be partially dismantled to retain support of the service lines, adequate safety precautions should be taken while dismantling, to avoid fire hazards and puncturing of service lines.
- iii) All electrical lines supported on structural intended to be dismantled, should be disconnected from source of power, and dismantling should start only after necessary clearance to that effect is obtained, in writing from concerned Electrical Power/ Operation Department. Ensure **Positive Isolation** for the entire building.
- iv) The condition of structural intended to be dismantled shall be inspected for corrosion, to ensure that it does not collapse while dismantling.

- v) All tools and tackles used for dismantling should be in sound condition and adequately strong. Lifting tools and tackles used should have test certificate, issued by competent authority.
- vi) Cranes, used for dismantling, should have necessary fitness certificate. The driver shall also have necessary health and eye test certificate.
- vii) If derrick is used in place of crane, it should be properly guyed for stability and should have specified lifting capacity. In no case, the specified lifting capacity should be exceeded.
- viii) All persons engaged in dismantling work should be given safety training and they should ensure use of safety appliances. If the dismantling is near any gas line, then the workmen engaged should be given gas safety training.
- ix) While working at height, full body harness should be used. While climbing up or down, snatch ropes or fall arrestor should be used. A wire rope may be tied at two rigid points to fasten the lifeline of full body harness, where other tying members are not available.
- x) All dismantled material should be lowered down on ground in controlled way.
- xi) Job safety analysis should be done before dismantling.
- xii) Dismantling sequence should be prepared before dismantling.

3.17.3 Section – 2

General Sequence of Dismantling Structural Building

The sequence of dismantling should be such that the structure does not lose its stability at any time.

- i) Ensure that all precautions, as indicated in Section – 1, are taken.
- ii) Remove all roof and side sheeting's. Purlins should not be dismantled at this stage, but side girts can be dismantled.
- iii) If necessary, all purlins between monitor trusses can be removed and monitor truss dismantled without damaging the roof truss.
- iv) Start dismantling from gable end, and work towards any intermediate braced bay. This braced bay is to be dismantled last.
- v) Remove gable steel work except roof truss.
- vi) Remove alternate purlins between end roof truss and adjacent truss.
- vii) Hold the roof truss to be dismantled with crane or derrick and remove balance purlins, rafter bracings, bottom chord bracings and struts, if any, between this truss and adjacent truss.
- viii) Gas cut the truss members along the face of column on both sides, and lower the roof truss.
- ix) Sequence vii to viii to be repeated for dismantling subsequent roof trusses.
- x) While removing the last two trusses, both the trusses should be held with crane before repeating sequence vii and viii.
- xi) Dismantle gantry girder, surge platform, surge girder and outrigger girder between end column intended to be dismantled and adjacent column.

- xii) Remove longitudinal bracings and struts, if any, between end column and adjacent column. Also remove any other structural or platform. Dismantle end column.
- xiii) Repeat sequence xi and xii for subsequent columns on both lines.
- xiv) For multi storeyed building, dismantle all floor beams and floor plates except the beams connecting the building column. These framing beams and parts of columns shall be dismantled floor wise, starting from top, maintaining the stability of structures at all time.
- xv) For bin house, dismantle all bin plates except the girder or bin plates connecting the building columns.
- xvi) Dismantle longitudinal bracings, struts, floor beams, bin plates etc., between end columns and adjacent columns on both rows. Also dismantle beam, bin plates etc. across the building for end column.
- xvii) Dismantle end columns. For long columns, columns can be dismantled in pieces starting from top.
- xviii) Repeat sequence xvi and xvii for subsequent columns on both sides.
- xix) Refer to [sketch sheet no. 1](#) for identification of shed type building components.
- xx) If during dismantling, a situation is faced, where the remaining component to be removed is likely to lose its stability due to removal of other connecting members, the component must be stabilized with guy ropes.
Based on the above sequence of dismantling, for hazardous jobs, the components like columns, bracings, girders etc. may be given identifying marking at site to avoid wrong member cutting.

3.17.4 Section – 3

General Sequence of Dismantling Open Gantry

- i) Ensure that all precautions, as indicated in Section – 1 are taken.
- ii) Start dismantling from the end, where column bracing is not provided.
- iii) Hold the top of end column/ A-frame using a crane/ derrick.
- iv) Remove gantry girder, surge girder/ platform, outrigger girder and any other structural between end column/ frame and adjoining column/ frame.
- v) Dismantle end frame/ column.
- vi) Repeat sequence iii to v for all other frames/ columns except for last two braced columns/ frames.
- vii) For last two braced columns/ frames, cut and remove all structurals except bracing between the columns/ frames.
- viii) Cut and remove top portion of bracing strut and diagonals along with top portion of columns/ frames.
- ix) Repeat sequence viii for next lower portion of bracings and columns/ frames, till complete column/ frame is removed.

- x) Refer to [Sketch Sheet No. 3](#) for identification of structural parts of open gantry.

3.17.5 Section – 4:

General Sequence of Dismantling Conveyor Gallery

- i) Ensure that all precautions as indicated in Section – 1 are taken.
- ii) Remove all mechanical parts like conveyor belt, idlers, deck plates, stringers etc. before removing the gallery structural. Remove all cables, pipes and cable trays.
- iii) Remove all roof and side sheeting including purlins and side runners.
- iv) Provide guy steel ropes on both sides of the trestles in the longitudinal direction tied with firm structure/ foundation at base.
- v) Hold the portion of conveyor gallery between two supports with crane/ derrick. Depending on situation, slinging positions, crane position etc. must be planned and documented. Slings should be tied only at node points.
- vi) Gas cut the end connections without damaging the supports and conveyor gallery. Top end connections to be gas cut.
- vii) Lower the conveyor gallery to ground.
- viii) After lowering on ground, the structures can be removed in small pieces by gas cutting.
- ix) Refer [Sketch Sheet No. 4 and 5](#) for identification of structural components of conveyor gallery.

3.17.6 Section – 5

General Sequence of Dismantling EOT Crane

- i) Ensure that all precautions as given in Section – 1 are taken.
- ii) Dismantle all gear boxes, motors, electrical panels etc. and bring them down to ground.
- iii) Dismantle Trolley structural and hook block using crane/ derrick/ Repair trolley. Trolley assembly may be dismantled as a unit if crane or repair trolley capacity is available.
- iv) Dismantle driver's cabin using crane/ derrick.
- v) Tie end carriage with existing gantry girder and building structural.
- vi) Dismantle bridge girders one by one using crane/derrick.

3.17.7 Section -6

General Sequence of Dismantling of Trestles/ Towers

- i) Ensure that all precautions as given in section -1 are taken.
- ii) Provide the steel guy ropes / steel structural stays on both sides longitudinally & across the trestle/tower based on height, ground condition and type of trestles & tower.
- iii) The steel structural inclined stays shall start from minimum one third heights of the trestle / tower from the ground. The adequate sized steel stays to be fixed at a slope

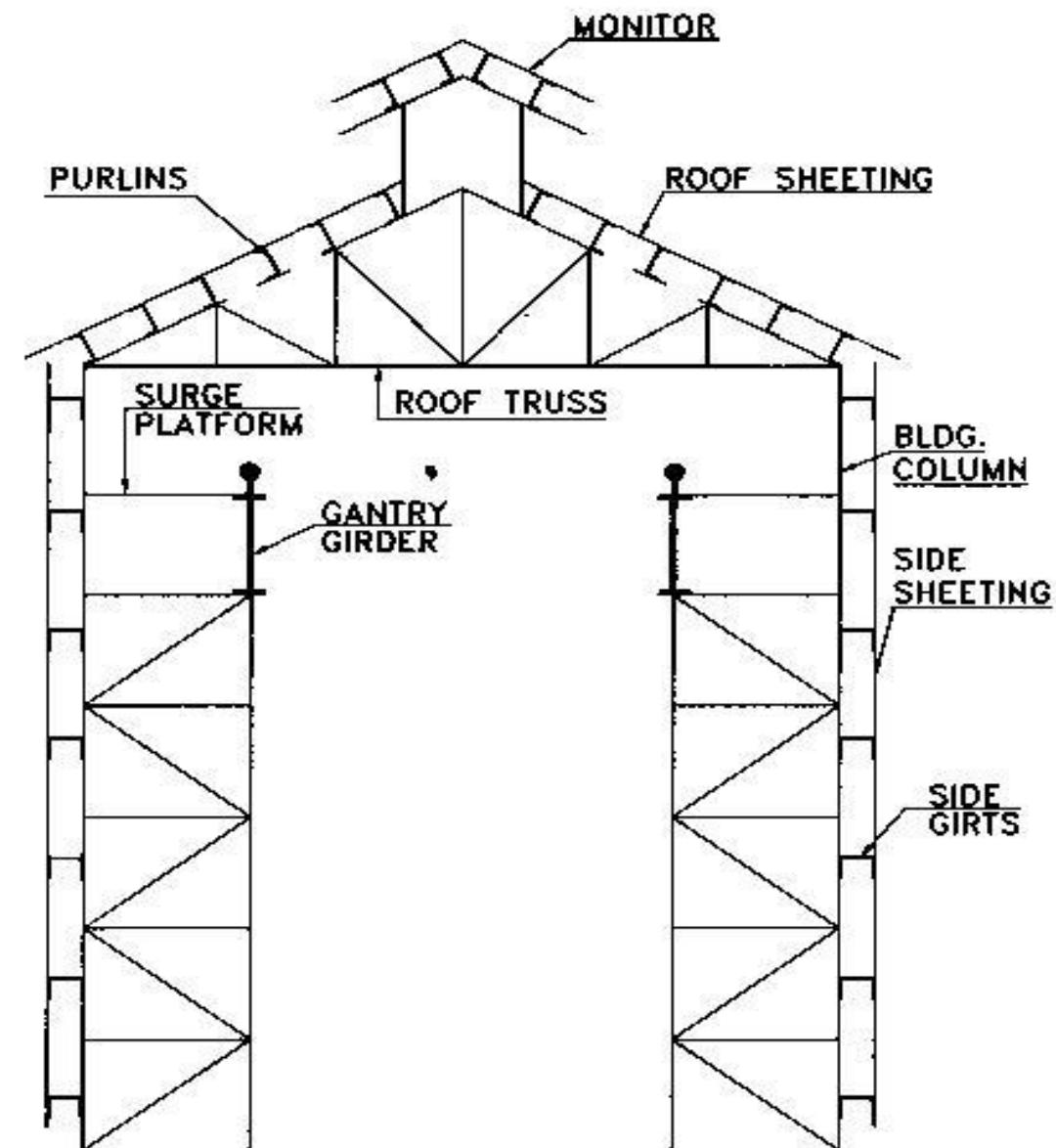
between Min 1:4 and Max. 45 degree. the base of the stay to be anchored on a levelled firm ground with adequate size base plate and H D Bolts. The stays shall be on both sides of the tower/ trestle. Size of the stay to be ascertained based on size of the trestle & tower. Guy rope on both sides in across direction to be provided as per site requirements and trestle/ tower condition.

- iv) Adequate sized steel rope can also be used both side longitudinally as well as across as per requirements and site layout and conditions. The base of the steel rope to be anchored to firm structure / object.
- v) The trestle/ tower to be preferably hold with adequate capacity crane and can be dismantled in single length or multiple short lengths depending upon the height & size of the trestle & towers. If dismantling by crane is not feasible, then manual dismantling in pieces starting from top is to be taken up.
- vi) Before lifting with crane, it is to be ensured that the cut portion is detached completely.
- vii) The stays at the top must be at minimum height of H/3 of the tower at each stage of dismantling.

NOTE: All above sections are the recommended practice. Site & structure specific dismantling sequences of steel structures are to be prepared at site based on above.

SKETCH SHEET NO.1
SHEET '1' OF '2'

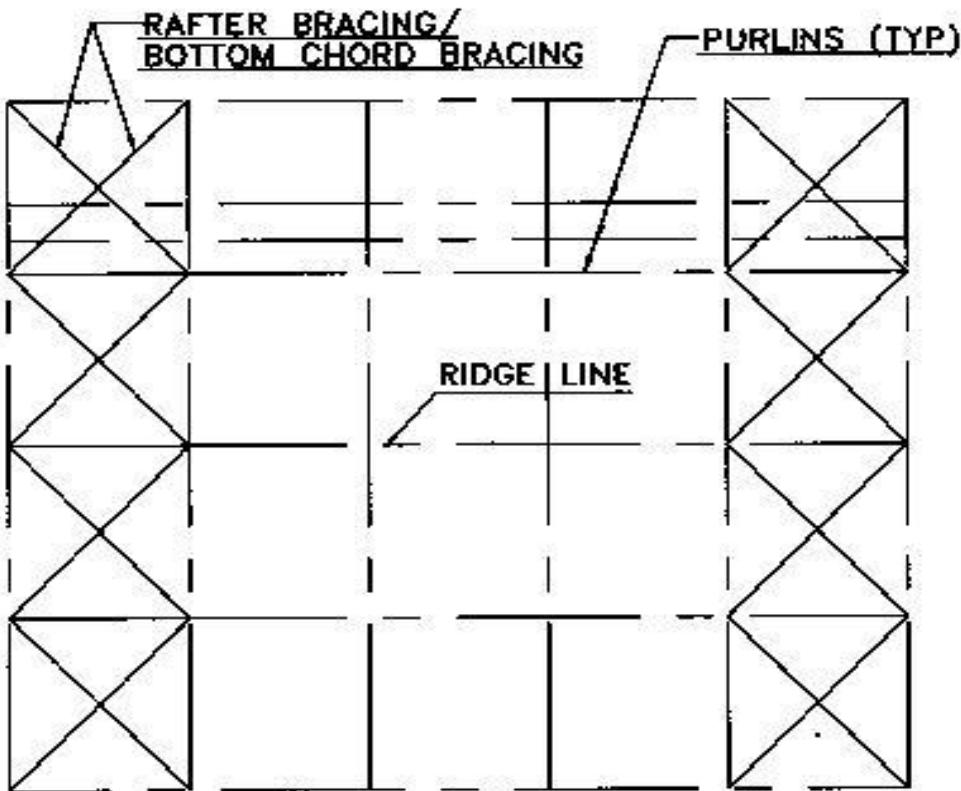
DETAIL OF SHED TYPE BUILDING
SHEET '1' OF '2'



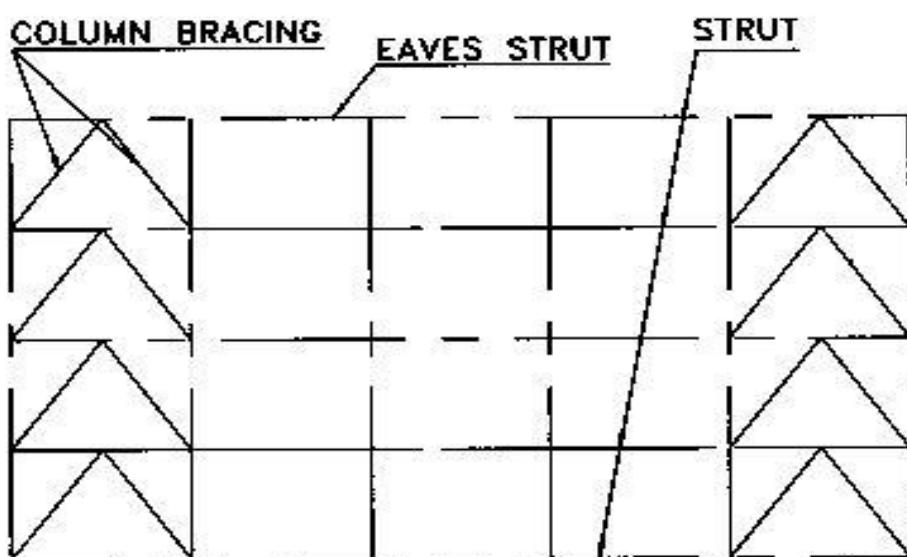
CROSS SECTION OF BUILDING

SKETCH SHEET NO.2
SHEET '2' OF '2'

DETAIL OF SHED TYPE BUILDING
SHEET '2' OF '2'



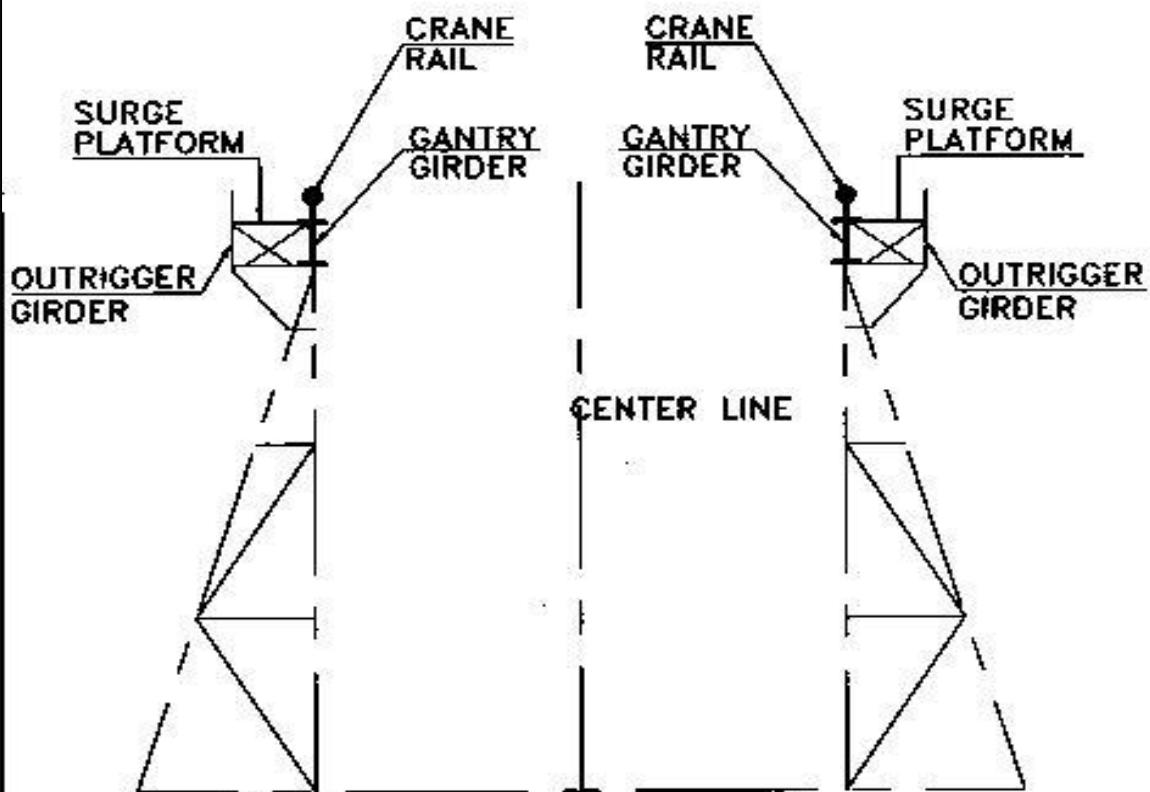
ROOF PLAN



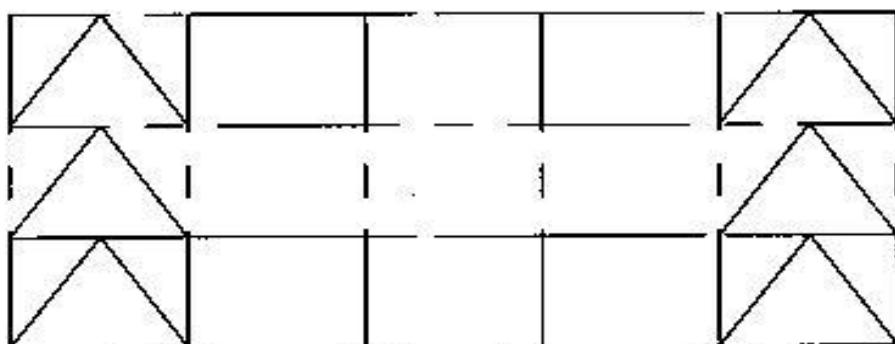
ELEVATION

SKETCH SHEET NO.3

DETAIL OF OPEN GANTRY



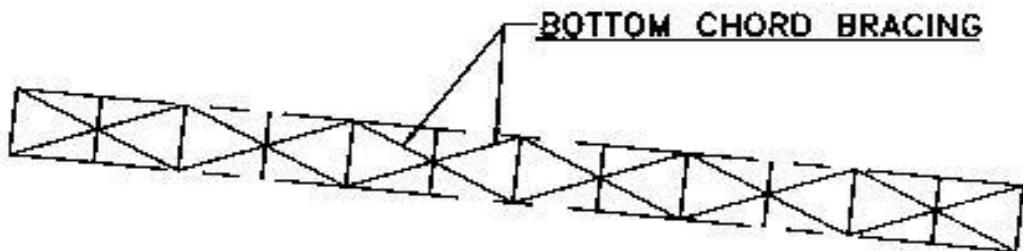
SECTION OF OPEN GANTRY



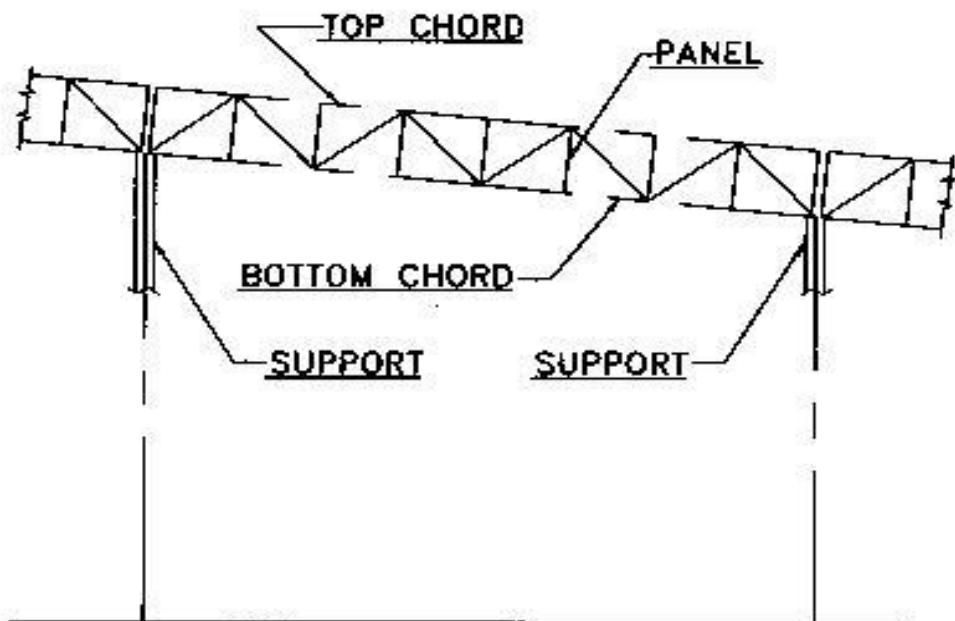
ELEVATION

SKETCH SHEET NO.4
SHEET '1' OF '2'

DETAIL OF CONVEYOR GALLERY
SHEET '1' OF '2'

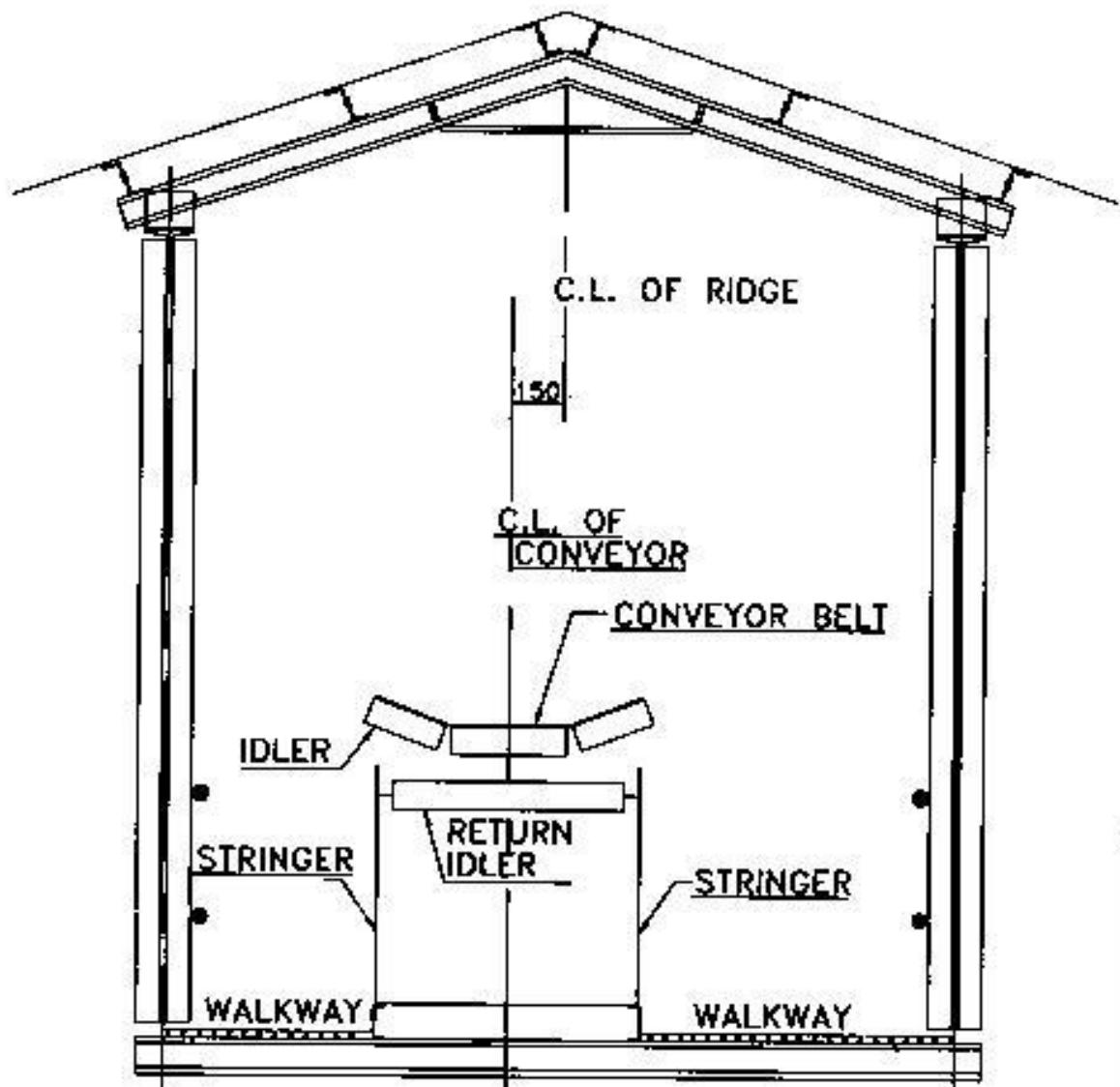


PLAN OF BOTTOM CHORD AND
TOP CHORD BRACING



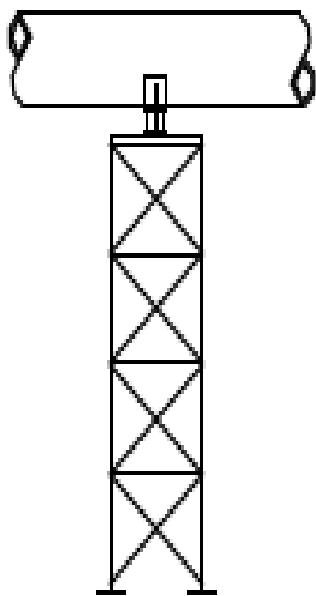
ELEVATION

SKETCH SHEET NO.5
SHEET '2' OF '2'

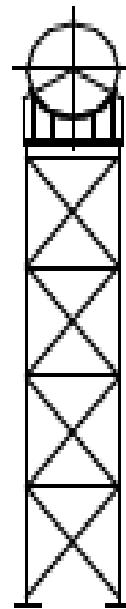


TYPICAL CROSS SECTION OF CONVEYOR GALLERY

SKETCH SHEET NO.-06
SHEET 1 OF 2

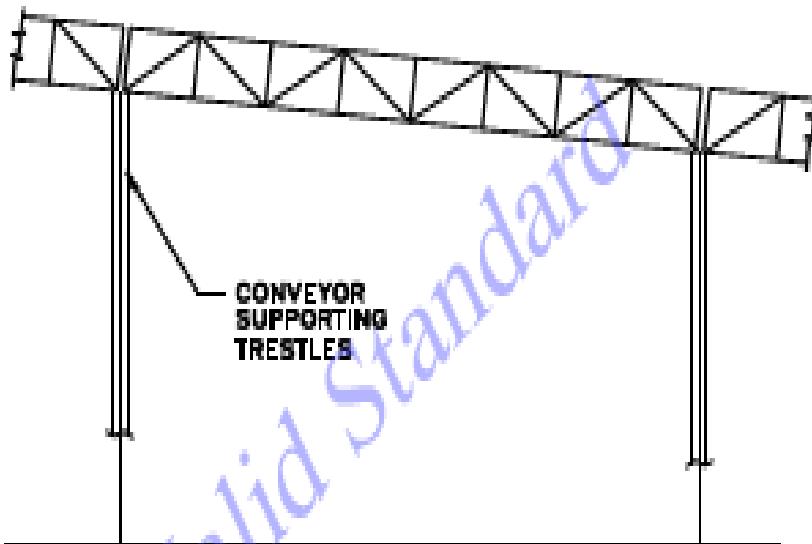


ELEVATION

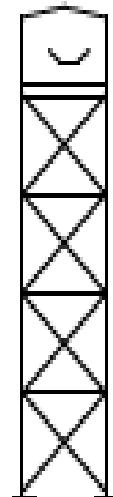


SIDE VIEW

PIPE SUPPORTING TRESTLES



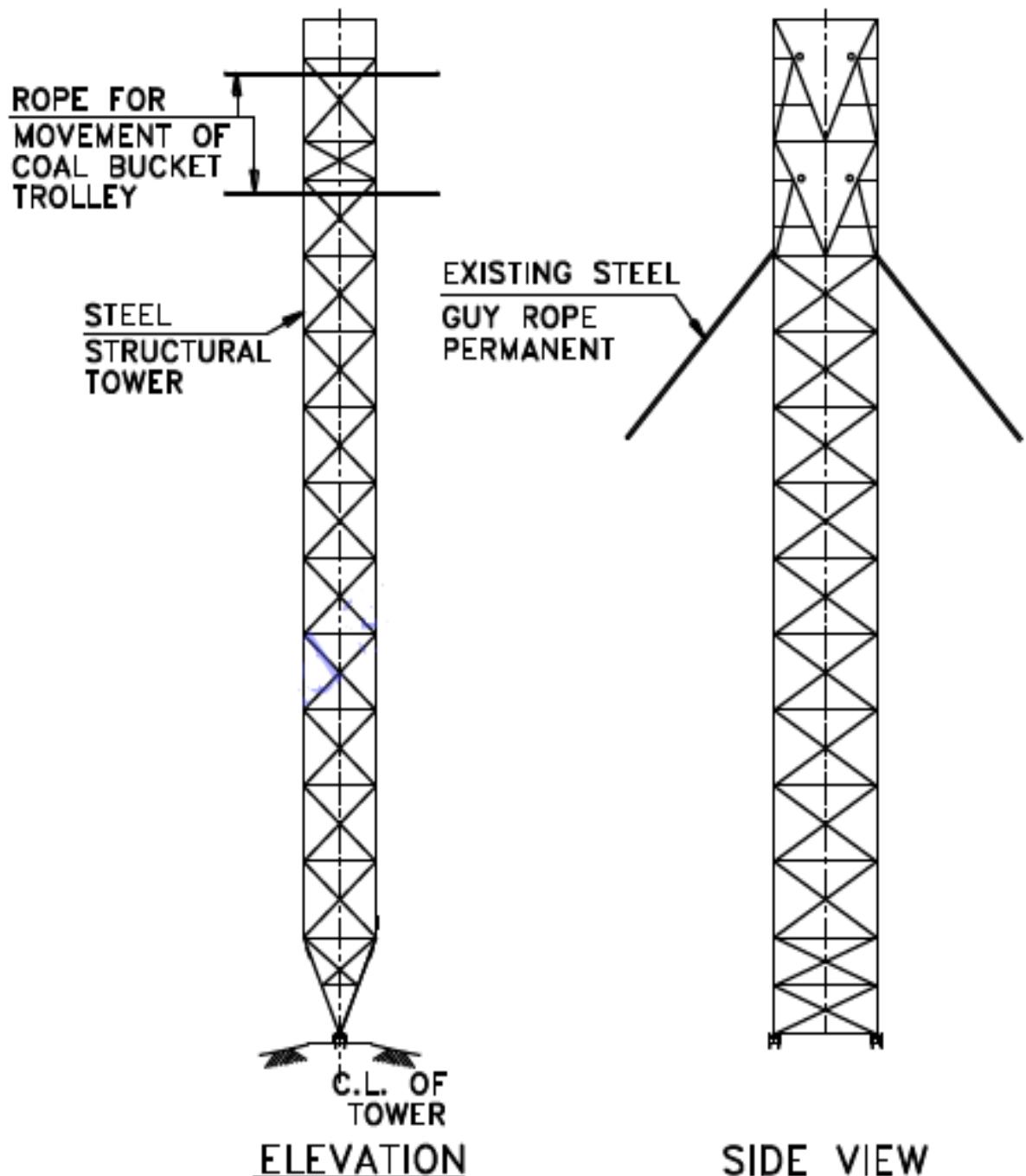
ELEVATION



SIDE VIEW

CONVEYOR SUPPORTING TRESTLE

**SKETCH SHEET NO.-06
SHEET 2 OF 2**



OVERHEAD COAL BUCKET TOWER

NOTE :-

ADEQUATE STAYS AND GUY ROPE AND BASE
LOCKING TO BE ENSURED BEFORE DISMANTLING

3.19 Attachment -2

Recommended Practice for Dismantling and Rearranging (D&R) facilities

The following practices are strongly recommended for all “large” D&R projects. Sites electing not to adopt any of these practices must have an alternative better practice that is at least equal to those not adopted.

1. Equipment Identification

- i) Use different colour paints or stickers on equipment, piping, or electrical to be removed to distinguish it from equipment, piping, or electrical to remain.
- ii) Identify both what is to be removed and what is to remain.
- iii) Use different colours to identify the presence of asbestos, lead, etc. and non-hazardous coatings.
- iv) Use unique colour paint, stickers, or tags to identify the exact location of subsequent breaks being performed by the contractor personnel.
- v) Signs or posters describing the identification method including examples of the actual colours or tags must be posted in strategic locations throughout the work area
- vi) The integrity of the markings should be reviewed throughout the life of the project.

2. Utilities diversion/ isolation

- i) Executing Authority should perform isolation and all utility diversion activities. As a best practice, the facilities should be completely isolated (de-energized, drained, blanked out, etc.) before the work to begin.
- ii) For diversion/ isolation of electrical utilities, prior approval/ permit shall be taken from concerned Electrical Department or Electrical Maintenance Deptt.
- iii) For diversion/ isolation of various gas/ steam pipe lines, prior approval/ permit & clearance for dismantling of pipes shall be taken from concerned department or from Fuel / Energy Management Department as applicable.
- iv) For diversion/ isolation of underground sewer line, storm line and other service water lines, prior approval/ permit shall be taken from Civil Department/ Concerned Department.

3. Auditing

- i) Conduct D&R focused audits separate from the site’s normal audit process.
- ii) Participants on the audit must be trained to recognize unique D&R hazards and be knowledgeable of the D&R job plan.
- iii) Daily focused D&R audits to be conducted.
- iv) Audit team shall comprise of at least a Safety Department, operating area representative, and D&R contractor supervisor.

4. Electrical

- i) All persons performing demolition & rearranging of electrical conduit, cables or conductors must be trained.

- ii) Provide general “electrical safety awareness training” to D&R contractor personnel not engaged in electrical demolition & rearranging.
- iii) Identification and marking of circuits must be performed by personnel with long-term site experience.
- iv) Remove all fuses from motor control centres.
- v) If lighting panels must remain active, determine how energized electrical panels and circuits will be clearly identified and the location communicated to the D&R contractor.

5. Building and Process Decontamination

- i) De-inventory and flush all process vessels, storage tanks, receivers, pumps, and piping systems of all residual chemicals.
- ii) Written authorization from the consultants/ engineers is required before torch cutting any vessels, tanks, or piping carrying flammable liquid or gas.
- iii) Positive verification of removal of flammable liquid, gas, or residual materials by purging before authorizing torch cutting.
- iv) Remove gas from large fixed refrigeration units.
- v) Open process equipment inspection ports/ nozzles for internal inspection.
- vi) Open all low point equipment and piping systems drains and leave all valves in open position.
- vii) Open all jackets and coils and utility side of heat exchangers.
- viii) Decontaminate any process equipment/ piping systems that are not “visually clean”.
- ix) Open, inspect and clean, if necessary, ventilation ductwork.
- x) Clean building ditches, trenches and pumps.

6. Building Isolation

- i) Define and identify any process and/ or service piping systems that must be relocated to isolate the building.
- ii) Define and identify any electrical services that must be relocated to isolate the building.
- iii) Use a service of person with long-term site-specific experience to physically break all electrical, utility, and process piping. Ensure Positive Isolation of the equipment/ system from electrical source or any other energy source.

7. Rigging, Mechanical and Manual Lifting

- i) Treat all rigging and mechanical lifting jobs as “critical” lifts.
- ii) Rigging plan review includes the following:
 - a. Contractor rigging training.
 - b. Crane operator certification.
 - c. Crane certification and inspections.
 - d. Chain fall, hoist, sling inspections.

- e. Routes of “travel”.
- iii) Job supervisor of contractor will plan all mechanical lifts, including the use of ropes. Equipment drawings need to be obtained to determine equipment weights. Allowances may have to be added to the weights due to residual product, catalyst, and/ or caking if the equipment could not be adequately cleaned.
- iv) Weights of platforms, piping, etc., that will remain on the equipment when it is being dismantled must also be determined.
- v) Verify contractor employees involved in any form of rigging have been adequately trained or perform on-site rigging training.
- vi) Designate specific operators of freight elevators and provide training.
- vii) All load-conveying equipment must be labelled with its capacity. Skilled and qualified operators on all demolition equipment.
- viii) Equipment operator training to be verified through review of training documentation.
- ix) Overhead hoisting equipment and supports left in the area must be inspected by the job supervisor of the contractor.
- x) Only steel chains and slings shall be used for securing/ supporting heavy loads and use of Manila ropes, Fibres ropes in rigging activities shall be strictly prohibited for heavy loads greater than 70 Kg.
- xi) Limit manual material handling and lifting to a maximum of two persons; no manual material handling or lifting with more than two individuals is allowed.

8. Staffing:

- i) Contractor with safety knowledge, safety resources dedicated to the D&R project to be utilized.
- ii) Contractor is to utilize experienced operators, mechanics, and resident contractor employees for decommissioning and decontamination.
- iii) Contractor is to utilize experienced operators and mechanics.
- iv) Contractor is to engage qualified electrical resource dedicated to follow electrical D&R fieldwork.
- v) Contractor-provided safety supervisor to be assigned to continuously monitor contractors with inexperienced workers regardless of size of workforce.
- vi) Require contractor to submit proposed workforce makeup, i.e., experienced workers vs. inexperienced workers, and worker to supervisor ratio.

9. Communications

Communicate safety expectations and requirements clearly and early in the bidding process. Hold weekly/ daily safety/ schedule meeting between concerned department and operating area personnel and D&R contractor project management and field supervisors and safety supervisors.

10. Identification of Area with similar Hazards

Develop a plan that requires sampling of all homogenous areas for the presence of hazardous materials such as asbestos, lead, etc.

11. Contract Bid Preparation

As a minimum, involve the following in the bid package preparation:

- i) Contractor safety representative.
- ii) Plant safety resource.
- iii) Operating area owner representative.
- iv) Plant environmental resource
- v) Contract administration
- vi) Electrical resource
- vii) Mechanical and rigging resource.
- viii) D&R project team resources

As a minimum, include in the bid package the following:

- i) Well written, clear, and detailed scope of work.
- ii) All relevant safety procedures.
- iii) List of required submittals.
- iv) Waste disposal guidelines.
- v) Lead, asbestos, and other hazardous coatings assessments.
- vi) Examples of relevant work, flame, etc. permits.
- vii) Barricading requirements.
- viii) Clear and concise worker training requirements

12. Contractor Selection

Following points to be considered:

- i) Competent contractors having records of self-initiative approach for safety measures.
- ii) Contractor having attitude & behavioural dedication towards safety.
- iii) Competent contractors having adequate mechanized resources.
- iv) Competent Engineers, Job supervisors, safety supervisors and other competent staffs for various works related with demolition.
- v) Capability to mobilize adequate resources for completing the work speedily with adequate safety measures.
- vi) No default case found for compromising safety measures for any previous orders.
- vii) Contact other sites for performance history, if possible.
- viii) Select electrical contractor to perform electrical cable and conduit D&R.
- ix) Select authorized contractors to perform lead and asbestos removal.

13. Miscellaneous

- i) The written Job Plan must detail that the work must be stopped, re-evaluated, and a new plan developed if any condition changes. It must include the process to be used and persons who must be involved in developing the new plan.
- ii) Develop a project-specific disciplinary process that is focused on the contractor supervision's accountability for the actions of their workers rather than one that focuses solely on the workers.
- iii) Use task-specific work and hot work permits.
- iv) D&R is truly "reverse construction." The planning of the work must take this into account. As an example, small piping, lighting, instruments, steam and trap manifolds, etc. should be removed first around major pieces of equipment prior to their dismantling.

3.20 Attachment -3

Recommended Planning Checklist for Dismantling and Rearranging (D&R) Facilities

1. **Intent:** This checklist is to be used during the planning of D&R. It lists items that should be evaluated before D&R on facilities, buildings, or equipment takes place.

2. Regulations

All regulations which govern D&R activity must be complied with.

3. Pre-Assessment

Prior to conducting a field assessment of the area, equipment, or facilities to be D & R'd, a knowledgeable/ competent person should conduct a pre-assessment to establish background information and scope of D&R.

- i) Identify the products produced at the facility or in the equipment being D & R'd and their respective health and physical hazards.
- ii) What chemicals were used in the process?
- iii) How and when the facility or equipment was idled, mothballed, or decontaminated?
- iv) Is the area or equipment considered "clean," i.e., are there any concerns with re-use of scrapped material?
- v) Where will scrap be processed?
- vi) What methods/ tests will be needed to determine the state of decontamination?
- vii) What materials can be recycled?
- viii) Where and on what equipment will torch cutting be allowed or will cold cutting be required throughout?
- ix) Will the entire facility or area be D&R'd or are only certain pieces of equipment within the area being removed?

- x) Is equipment (vessels, etc.) to be removed whole or cut up in pieces?
- xi) Know weights of equipment, vessels, etc.
- xii) What method will be used to distinguish between equipment to be removed and equipment to remain?
- xiii) Will any safety or control feature be temporarily or permanently disabled? How will this affect operating equipment?
- xiv) What is the current operating/ energized state of the area?
- xv) How will the equipment be, or is it, isolated from pressurized or energized sources (electrical, service, process, etc.)?
- xvi) Have equipment changes or modifications occurred that are not reflected in the system documentation?
- xvii) What is the proximity of area, equipment, or facilities being D&R'd to occupied area/ operational areas?
- xviii) Will access into the area by those not involved in the D&R be required? If so, what routes will they use and what protections will be required for them?
- xix) Will confined space entry be necessary?
- xx) Is there a possibility of ground or soil contamination?
- xxi) What is the degree of unknown underground services? Will extensive hand excavation be required?
- xxii) Do pits that have been opened by removal of equipment contain residual lubricants, finish paints or other flammable liquids?
- xxiii) Do pits need to be cleaned prior to burning and welding around or above them?
- xxiv) Are there any biological hazards associated with residual materials contained in pits? (Consult the site industrial hygienist.)

4. Assessment

Conduct a field assessment of the area, equipment, or facility to be D&R'd. (photograph areas adjacent to the area, equipment, or facilities (if any) being D&R'd to be used to identify damage done to them in the event it occurs during D&R.)

5. Environmental and Health Related

- i) Identify location of ditches, trenches, sewers and other routes of possible contaminated runoff. Will monitoring for contaminants in runoff be required?
- ii) Identify coatings containing lead.
- iii) Identify asbestos-containing materials in insulation, roofing, flashing, and other coatings and materials.
- iv) Will large enclosures be needed to remove asbestos-containing material?
- v) Check for refractory ceramic fibre (RCF) materials such as firebrick in boiler linings, etc.
- vi) Analyze process/ chemical residue.

- vii) Test for cadmium in high-temperature coatings etc.
- viii) Check for the presence of biological hazards such as bird droppings, vermin, etc.
- ix) Identify mercury-containing equipment such as lighting ballast and tubes.
- x) Will the currently used landfill accept asbestos, lead, etc. contamination?
- xi) Will contaminated soil be encountered?
- xii) Consider dust, smoke, noise, and vibration created by D&R activity and the effect it may have on adjacent areas and equipment.

6. Structural Related

- i) Condition of the structure; has it been idled for an extended period of time and deteriorated?
- ii) What temporary or permanent bracing will be required for equipment or structures being removed or remaining?
- iii) Overhead electrical conductors in close proximity?
- iv) Proximity to other structures not being dismantled or rearranged.
- v) Type of structure (steel, masonry, combination)?
- vi) Composition and condition of roof (built-up, precast concrete, transit, brittle)?
- vii) Allowable roof and floor loads?
- viii) Existing elevator capacities?
- ix) Location and conditions of any confined spaces?
- x) Basement and sumps involved?
- xi) Presence and location of under piping and electrical feeders?
- xii) Coatings, insulation, mastics (flammability, lead, asbestos)?
- xiii) Do combustible metals such as titanium with an oxide coating glass / glass – wools exist?
- xiv) Vessels empty or do they contain material which adds weight?

7. Planning

Once the pre-assessment and field assessment have been conducted, a preliminary plan must be developed. The plan should be laid out step-by-step and encompass every activity of the project with attention to the safety of D&R crew and other employees.

8. Employee Safety

- i) PPE requirements.
- ii) Fall prevention and fall protection.
- iii) Hygiene and decontamination needs.
- iv) Special training needs
- v) Special medical surveillance required.

- vi) Special clothing.
- vii) First-aid plan and clinic location and injury treatment/management process.

9. Miscellaneous Planning

- i) What governmental permits (federal, state, and local) will be required and who will obtain them?
- ii) Spill-handling procedure, emergency response, and clean up.
- iii) Does the area have adequate ventilation should a spill occur?
- iv) Will temporary containment enclosures create a negative impact on natural ventilation and cause a build-up of flammable vapours?
- v) Fire and explosion response.
- vi) How will fire watch personnel be identified (orange vest, red hardhat, etc.)?
- vii) Traffic control and routing of equipment and personnel.
- viii) Perimeter barricading.
- ix) What analytical test will be required and who will perform them (lead, cadmium, asbestos, organic residue)?
- x) Heavy equipment inspection and operating requirements. Auditing of work (method, by whom, frequency).
- xi) Incident (safety, health, and environmental) reporting needs, by whom to whom).
- xii) Lay down area location.

10. Information Provided to the Contractor

In addition to the standard bid documents, the following should be provided to the contractor performing the work.

- i) Structural engineer reports.
- ii) Results of any and all tests performed (lead, asbestos, chemical, etc.) including location, coding on map, and regulatory consequences.
- iii) History of structure and general conditions.
- iv) Training and certification requirements of supervisors and employees performing the work for asbestos, lead, cadmium, equipment operations, etc.
- v) Weights of equipment and basis of assessment.
- vi) Permit system on site.
- vii) Project manager contact.

11. Information Required from the Contractor

- i) Methods used to D&R including major equipment to be used.
- ii) Fall prevention and protection plan.
- iii) Relevant supervisory and employee training records.

- iv) Lifting and rigging plans.
- v) Lay down area requirements including trailers for supervision, lunch, change rooms, showers, etc.
- vi) Decontamination trailer requirements (if needed).
- vii) Detailed plan for controlling dust (foot and airborne) and other identified contaminants.

12.0 Training:

Employees involved in the dismantling shall receive training from a competent & qualified person. The purpose of the training is to recognize any hazards associated with the work in question. Training shall consist of:

- i) the nature of height work hazards
- ii) the correct procedures for dismantling
- iii) the design criteria, maximum intended load carrying capacity, and intended use of the work platform, lifting tackles, access system, climbing system, winch system, lifting system, man lifter system, various anchorages, lifelines, procedures for height work etc.

Employees who perform work while at height shall be trained by a qualified person so they can recognize hazards associated with the type of scaffolding, access, lift system etc. being used and understand the procedures to control those hazards. Training will cover the following topics as necessary:

- i) The nature of any electrical hazards, fall hazards, and falling object hazards in the work area.
- ii) The correct procedures for dealing with electrical hazards and for erecting, maintaining, and disassembling the fall protection systems and falling object protection systems used.
- iii) The proper use of the height facilities and the proper handling of materials on the system being used.

The maximum intended load and the load carrying capacities of the supports system, work platform, cages, cradles, access system, ropes, man-lifters, winches, life lines , anchorages etc.

13.0 Records:

- i) Record of work permit for demolition work shall be kept for at least one year.
- ii) Records for incident/ accident are to be maintained at the department at least for five years.
- iii) Records of tests for the equipment, slings, cage, rope ladders etc being used for demolition shall be kept for the period of work.

Reference:

1. IPSS: 1-11-031-17 "Safety Guidelines for demolition of Building and Structure"
2. TSL Safety Standard, SS/ENGG-04

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	MATERIAL HANDLING (Manual and Mechanized) & STORAGE	Doc. No: SG/13
		Rev no. : 00 Effective Date : 14.10.2019

1. Objective

This guideline is meant for safe Storage and handling of materials manually or by using moving machinery like Fork Lifts Trucks, Conveyors, Cranes and Hoists, Derricks.

Associated Hazards:

Manual Material Handling

- i) Improper lifting of objects is a major cause of back injuries in the work place.
- ii) Improper manual lifting or carrying loads that is too large or heavy.
- iii) Crushed by falling materials or improperly stored materials.

Material Handling Via Machine

- i) Capsizing/Toppling of Crane
- ii) Collapse/Failure of Boom
- iii) Failure of sling, rope, chain etc
- iv) Struck by the moving machine
- v) Object falling from height
- vi) Swinging & hitting of load to adjacent structure
- vii) Finger entanglement with rope, chain, sling etc while lifting
- viii) Electrocutions
- ix) Storm/ heavy wind

2. Scope

The scope of work covers all steel plants in Iron and Steel sector.

3. Procedure

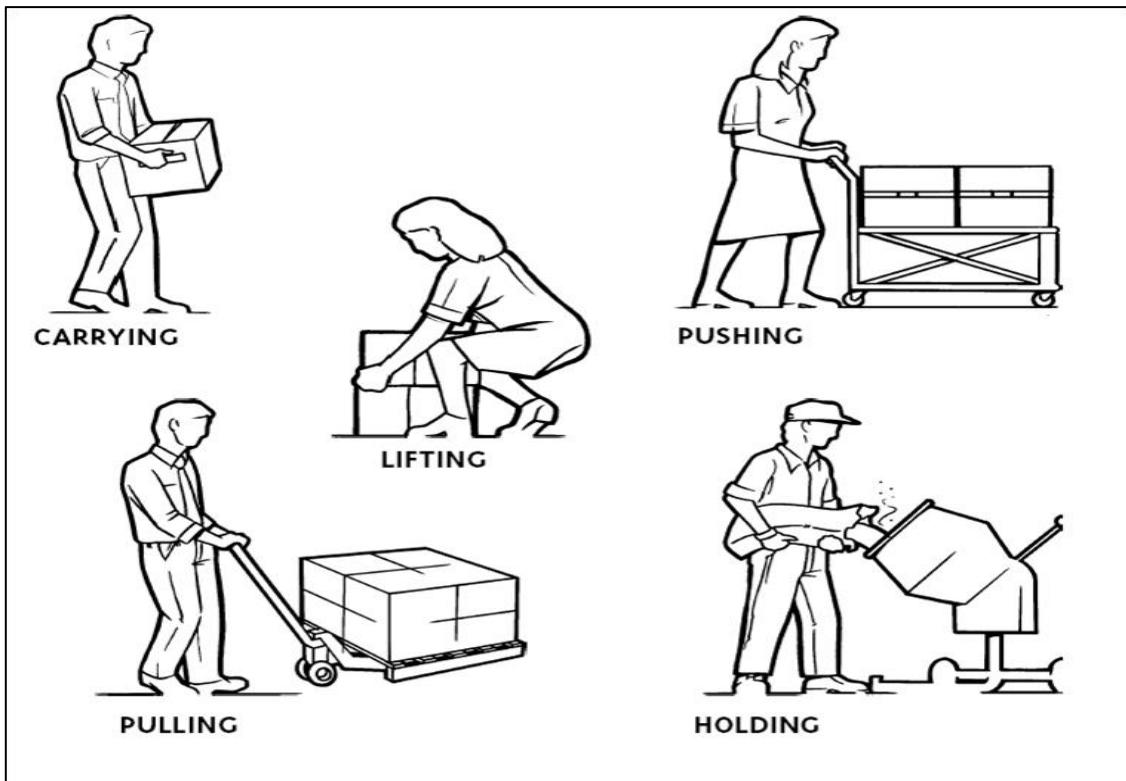
3.1 Definitions

Competent person - One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to people, and who has authorization to take prompt, corrective measures to eliminate them.

Qualified person - One who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his or her ability to solve or resolve problems related to the subject matter, the work, or the project.

3.2 Manual lifting

Manual material handling includes any tasks which require a person to lift, lower, push, pull, hold or carry any object or material.



- i) No employee shall be asked to carry loads above his capacity.
- ii) ISO Standard -11228 guidelines as given in Clause 7.1.3 to be followed.
- iii) Where possible, mechanical lifting equipment shall be used.
- iv) For lifting of materials manually, the safe lifting postures, principles of lifting and lifting techniques as described the following clauses, must be followed.

3.3 Ergonomics in manual handling

Manual material handling tasks may expose workers to physical risk factors if these tasks are performed repeatedly or over a long period of time, it can lead to fatigue and injury. The main risk factors, or conditions associated with the development of injuries in manual handling tasks include:

- i) Awkward posture (e.g. bending, twisting)
- ii) Repetitive motions (e.g. bending, twisting)
- iii) Forceful exertions (e.g. carrying or lifting heavy loads)
- iv) Pressure points (.g grasping (contact form) loads, leaning against parts or
- v) surfaces that are hard or have sharp edges)
- vi) Static posture (e.g. maintaining fixed position for a long time)

3.3.1 Harmful effect of un-ergonomic manual handling

Repeated or continual exposure to one or more of these factors initially may lead to Fatigue and discomfort. Over time, injury to the back, shoulders, hands, wrists or Other parts of the body may occur. Injuries may include damage to muscles, tendons, Ligaments, nerves and blood vessels. Injuries of this type are known as Musculo skeletal disorder or MSDs.

3.3.2 Lifting under non-ideal conditions decreases the safe lifting limit

For manual handling of cement bags, till mechanized arrangement of handling cement is fully implemented, 50kg load per person shall be allowed.

As per ISO Standard 11228, Part-2, following guideline is applicable for pushing and pulling.

Activity	Male	Female
PUSHING: Two-handed initial	34 Kg	22 Kg
PUSHING: Two-handed initial	23 Kg	13 Kg
PULLING: Two-handed initial	32 Kg	23 Kg
PULLING: Two-handed sustained	24 Kg	14Kg

3.3.3 Material lifting techniques

- i) **Correct grip:** The correct grip makes use of the palm of the hand and roots of the fingers and thumb. Gripping with the fingertips shall be avoided as they will lead to strained fingers and muscles in the forearm.
- ii) **Straight back:** In order to pick up a load with a straight back one must approach the task by flexing the hips, knees and ankles and the load must be held close to the body. The lift is to be brought about by the powerful muscles of the leg and not the back, which is to be kept straight throughout the movement. A bent back is a weak back and can lead to a strained back.
- iii) **Head up:** One should practice raising the top of head and this will help to maintain a straight back an essential movement that has to be carried out prior to every lift. This will also enable to see where you are going. Correct foot position: One should always have the feet apart but not wider than the hips, and one foot should be in advance of the other. This leading foot shall be in the direction one intends to move.
- iv) **Arm close to the body:** Lifting carrying or pushing with the arms away from the body results in needless strain being put on the chest, upper back and shoulder muscles. Keep arms as close to the body as possible.
- v) **Use your body weight:** Properly employed body weight can be used in moving a load by acting a counterbalance and thus reducing the amount of muscular effort.

3.3.4 Good ergonomic Practice

- i) Provide mechanical aids such as conveyors, floor cranes, carts, balancing mechanisms, vacuum hoists, turntables, tilt tables, hooks, automatic pushers, wheels etc. to reduce manual handling.
- ii) No head or shoulder load shall be permitted
- iii) Minimize the total cumulative weight handled each day
- iv) Change from lifting to pushing or from pushing to rolling
- v) Introduce team lifting
- vi) Modify the object (change the shape, change the size, use lighter containers, divide into smaller units, move the centre of gravity closer to the employee, create handles, improve casters, etc.).
- vii) Provide education in proper body mechanics, in proper selection of clothing and footwear, in use of personal protective equipment, etc.
- viii) Develop a work procedure and provide training.

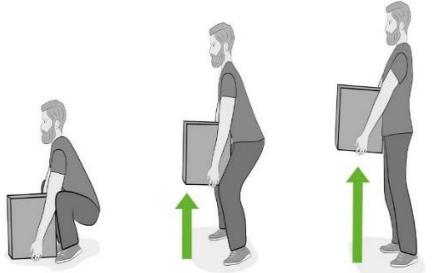
3.3.5 Material includes

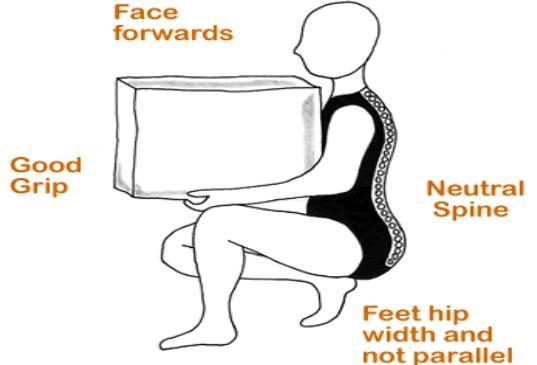
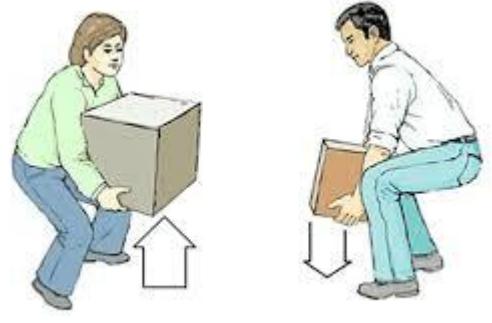
- i) Small weights
- ii) Cement bags
- iii) Reinforcement rods
- iv) Liquid containers
- v) Light angles, channels, linear rolled structures, pipes, cables etc.
- vi) Bricks mortars etc.
- vii) Equipment parts
- viii) Cartons

3.3.6 Basic lifts

Proper lifting and handling will help protect against injury and make the job easier. It takes training and practice to do it right. The following are basic steps in safe lifting and handling.

Principles of lifting:

- | | |
|--|--|
| <ul style="list-style-type: none"> ✓ Size up the load and make sure that the path is clear. ✓ Do not attempt to lift the load alone if it is too heavy or awkward. Get help. ✓ Keep the load close to the body. ✓ Use your thigh and leg muscles, not the back, as the load is lift in one smooth movement. ✓ Have feet shoulder width apart, with the load between them. |  |
|--|--|

<p>Safe Carrying-</p> <ul style="list-style-type: none"> ✓ Keep a good grip on the load. ✓ Keep the load close to body. ✓ Keep loads at a reasonable height so where is he going one can see. ✓ Don't twist back when carrying Load. 	
<p>Lower Material Slowly and Smoothly-</p> <ul style="list-style-type: none"> ✓ Use the lifting principles but in reverse. ✓ When lowering a load onto a deep shelf, put it on the edge of the shelf and push it into place. 	

3.3.7 Modified Lifts

The following lifting techniques may be required in circumstances that make lifting awkward.

<p>Two-person Lift:</p> <ul style="list-style-type: none"> ✓ Both persons should be about the same height. ✓ One person takes charge of the lift, so that you are working together not against each other. ✓ Lift together, walk in step and lower the load together. 	
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3.3.8 Additional tips to ensure safe lifting and carrying

- i) Wear appropriate clothing and safe, comfortable shoes.
- ii) Wear clothes that are comfortable around your hips, knees and shoulders
- iii) Avoid wearing clothes with exposed buttons or loose flaps
- iv) Shoes should be sensible, non-slip with broad based low.

3.4 Material handling via machine

Various type of machine used for material handling	
Fork Lift	
Conveyor	
Crawler Crane	
Derricks	
Tower Crane	
Mobile Crane	
Overhead and Gantry crane	

3.4.1 General

- i) Every driver / Operator of material moving machinery shall possess adequate skill and documented training in the operation of the lifting appliance. Suitable sticker is to be pasted on the helmet of successful employees, as an easy way for supervisors to know if the person operating the equipment has been formally trained.
- ii) No person under 18 years of age shall be employed for operations of these machines or for giving signals to operator.
- iii) Driver must fasten the seat belt while driving Forklifts and similar type of industrial/commercial Vehicles e.g. Listers, Bobcats, 3-wheeler tempos etc.
- iv) All lifting machines and lifting tackles shall conform:
 - a) Identification Mark Number (as mentioned in the Test Certificate)
 - b) Safe Working Load
 - c) Date of Last Test -No chain, rope or lifting gear shall be used unless –
 - it is of good construction, adequate strength, suitable quality and free from any defects.
 - it has been tested and **examined once in a year** for general use and once in six months for hot metal lifting use by a competent person and issued a certificate.
 - d) Rigging equipment for material handling shall be **visually inspected prior to use** on each shift. Defective rigging equipment shall be removed from service.
 - Only steel chains and slings shall be used for securing / supporting heavy loads (≥ 70 kg) and **use of Manila ropes, Fibre ropes in rigging activities shall be strictly prohibited for heavy loads.**
 - Slings shall not be shortened with knots or bolts or other makeshift devices.
 - Shock loading is prohibited.
 - Suitable packing is to be provided to prevent contact with the sling to the sharp edge of the load.
- v) Operator shall leave no machinery unattended, while power is on or load is suspended to above machinery.
- vi) No person shall ride on suspended load or any lifting machine.
- vii) All lifting machinery shall be tested by competent person yearly and the test record shall be maintained by the owner department.
- viii) While material handling, following precautions to be taken:
 - a) The load is safe and secured while lifting.
 - b) Slinging method is proper for the load.
 - c) Lifted load shall not exceed the safe working load of the slinging gear.
 - d) The load is so slung that it will not collapse and does not damage the sling in gear.
- ix) All persons at the site shall strictly use helmet with chin belt and shoes.

- x) Two-crane lift is always considered to be critical and hence care should be taken to ensure-
 - a) proper planning for the lift,
 - b) no lateral load on the boom and
 - c) to use lifting tackles as far as possible.

3.4.2 Hazard during Material handling via machine

- i) Capsizing/Toppling of Crane
- ii) Collapse/Failure of Boom
- iii) Failure of sling, rope, chain etc
- iv) Struck by the moving machine
- v) Object falling from height
- vi) Swinging & hitting of load to adjacent structure
- vii) Finger entanglement with rope, chain, sling etc while lifting
- viii) Electrocutions
- ix) Storm/ heavy wind

3.4.3 Fork Lift Trucks

A forklift is a workplace vehicle, designed to lift, carry and stack heavy loads using two forks situated at the front of the vehicle. Loads are usually secured on wooden pallets that fit over the forks. The formal name for a forklift is an "industrial truck".

Qualified Operator –

- i) is a properly trained person by authorised trainer.
- ii) must have valid Heavy driving license.

Proof of annual inspection - is a documentation indicating compliance of schedule inspection and maintenance of Forklifts.



3.4.3.1 General Procedures

- i) Only authorized and trained personnel will operate Forklifts.
- ii) All Forklifts will be equipped with FOPS (Falling Object Protective Structure), fire extinguisher, back-up alarm and seat belts. Seat belts will be worn at all times by the Operator.
- iii) The operator will perform daily pre- and post-trip inspections.
- iv) Any safety defects (such as hydraulic fluid leaks; defective brakes, steering, lights, or horn; and/or missing fire extinguisher, lights, seat belt, or back-up alarm) will be reported for immediate repair or have the Forklifts taken "Out of Service".
- v) Operators will follow safety procedures while recharging battery for electric forklifts or refuelling for diesel forklifts.
- vi) Loads will be tilted back and carried no more than 6 inches from the ground. Loads that restrict the operator's vision will be transported backwards.
- vii) Forklifts will travel no faster than 5 mph or faster than a normal walk.
- viii) Safety helmet will be worn by Forklifts Operators.
- ix) Operator will sound horn and use extreme caution when meeting pedestrians, making turns and cornering.
- x) Passengers may not ride on any portion of a Forklift. Only the operator will ride Forklifts. "NO PASSENGERS" signage to be affixed on all Forklifts.
- xi) Aisle will be maintained free from obstructions, marked and wide enough(six foot minimum) for vehicle operation.
- xii) Lift capacity will be marked on all Forklifts. Operator will assure load does not exceed rated weight limits.
- xiii) When un-attended, Forklifts will be turned off, forks lowered to the ground and wheels scotch blocked.
- xiv) All Forklifts (with exception of pallet jacks) will be equipped with a multipurpose dry chemical fire extinguisher.

3.4.3.2 Operations

- i) If at any time a Forklift is found to be in need of repair, defective, or in any way unsafe, the Forklift shall be taken out of service until it has been restored to safe operating condition.
- ii) Forklifts shall not be driven up to anyone standing in front of a bench or other fixed object.
- iii) No person shall be allowed to stand or pass under the elevated portion of any Forklift, whether loaded or empty.
- iv) Unauthorized personnel shall not be permitted to ride on Forklift.
- v) Arms or Legs shall not be placed between the uprights of the mast or outside the running lines of the Forklifts.

- vi) When a Forklift is left unattended, load engaging means shall be fully lowered, controls shall be neutralized, power shall be shut off, and brakes set. Wheels shall be scotch blocked if the forklift is parked.
- vii) A safe distance shall be maintained from the edge of ramps or platforms while on any elevated dock, or platform or freight car. Forklifts shall not be used for opening or closing any doors.
- viii) There shall be sufficient headroom under overhead installations, lights, pipes, sprinkler system, etc.
- ix) An overhead guard shall be used as protection against falling objects. It should be noted that an overhead guard is intended to offer protection from the impact of small packages, boxes, bagged material, etc., representative of the job application, but not to withstand the impact of a falling capacity load.
- x) A load backrest extension shall be used whenever necessary to minimize the possibility of the load or part of it from falling rearward.
- xi) Forklifts shall not be parked so as to block fire aisles, access to stairways, or fire equipments.

3.4.3.3 Travelling

- i) All traffic regulations shall be observed, including authorized speed limits. A safe distance shall be maintained approximately three Forklifts lengths from the vehicle ahead, and the Forklift shall be kept under control always.
- ii) Other Forklifts travelling in the same direction at intersections, blind spots, or other dangerous locations shall not be passed.
- iii) The driver shall be required to slow down and sound the horn at cross aisles and other locations where vision is obstructed. If the load being carried obstructs forward view, the driver shall be required to travel with the load trailing.
- iv) The driver shall be required to look in the direction of, and keep a clear view of the path of travel.
- v) Grades shall be ascended or descended slowly. When ascending or descending grades more than 10 percent, loaded Forklift shall be driven with the load upgrade. On all grades, the load and load engaging means shall be tilted back if applicable, and raised only as far as necessary to clear the road surface.
- vi) Under all travel conditions the Forklift shall be operated at a speed that will permit it to be brought to a stop in a safe manner.
- vii) Stunt driving and horseplay shall not be permitted.
- viii) The driver shall be required to slow down for wet and slippery floors.
- ix) Running over loose objects on the roadway surface shall be avoided.

- x) While negotiating turns, speed shall be reduced to a safe level by means of turning the hand steering wheel in a smooth, sweeping motion. Except when manoeuvring at a very low speed, the hand steering wheel shall be turned at a moderate, even rate.

3.4.3.4 Loading

- i) Only stable or safely arranged loads shall be handled. Caution shall be exercised when handling off-centre loads which cannot be centred.
- ii) Only loads within the rated capacity of the Forklifts shall be handled.
- iii) The long or high (including multiple-tiered) loads which may affect capacity shall be adjusted.
- iv) Forklifts equipped with attachments shall be operated as partially loaded Forklifts when not handling a load.
- v) A load engaging means shall be placed under the load as far as possible; the mast shall be carefully tilted backward to stabilize the load.
- vi) Extreme care shall be used when tilting the load forward or backward, particularly when high tiring. Tilting forward with load engaging means elevated shall be prohibited except to pick up a load. An elevated load shall not be tilted forward except when the load is in a deposit position over a rack or stack. When stacking or tiring, only enough backward tilt to stabilize the load shall be used.

3.4.3.5 Fuelling Safety

- i) Fuel tanks shall not be filled while the engine is running. Spillage shall be avoided.
- ii) Spillage of oil or fuel shall be carefully washed away or completely evaporated and the fuel tank cap replaced before restarting engine.
- iii) No Forklifts shall be operated with a leak in the fuel system until the leak has been corrected.
- iv) Open flames shall not be used for checking electrolyte level in storage batteries or gasoline level in fuel tanks.

3.4.3.6 Inspection Records

- i) Inspection records of the inspected Forklift shall be maintained on critical items in use, such as brakes, Mast condition, Hoist chain condition etc. These inspection records should include, the date of inspection, the signature of the person who performed the inspection, and the serial number, or other identifier. This inspection record should be kept readily available for review. The manufacturer's maintenance and inspection records, forms/checklist, or equivalent should be used.

3.4.4 Conveyors

- i) The design of conveyor system must address the proper starting and stopping sequence, to prevent any material spillage and damage to the system.
- ii) Means for stopping the motor or engine shall be provided at the operator's station. Conveyor systems shall be equipped with an audible warning signal to be sounded immediately before starting up the conveyor.
- iii) If the operator station is at a remote point, similar provisions for stopping the motor or engine shall be provided at the motor location.
- iv) Belt conveyors shall be fitted with emergency trip wires (pull-chords) or stop buttons, which must be fully operative at all times.
- v) Emergency stop switches shall be properly interlocked so that the conveyor cannot be started again until the actuating STOP switch has been reset to running or "ON" position.
- vi) Screw conveyors shall be guarded to prevent employee contact with turning screws.
- vii) Where a conveyor passes over work areas, aisles or thoroughfares, suitable guards shall be provided to protect employees required to work below the conveyors.
- viii) All crossovers, aisles, passageways shall be conspicuously marked by suitable signs.
- ix) Conveyors shall be locked out or otherwise rendered inoperable and tagged out with a "do-not-operate" tag during repair and when operation is hazardous to employees performing maintenance work.
- x) No person shall be allowed to ride on or cross over a conveyor.
- xi) Guards shall be provided at all pulleys and belt nips and at all idlers and other places where the risk of trapping exists.
- xii) The provisions of SG-19: Safety guideline on 'Operation and Maintenance of Conveyor Belts' shall be applicable.

3.4.5 Cranes &Derricks

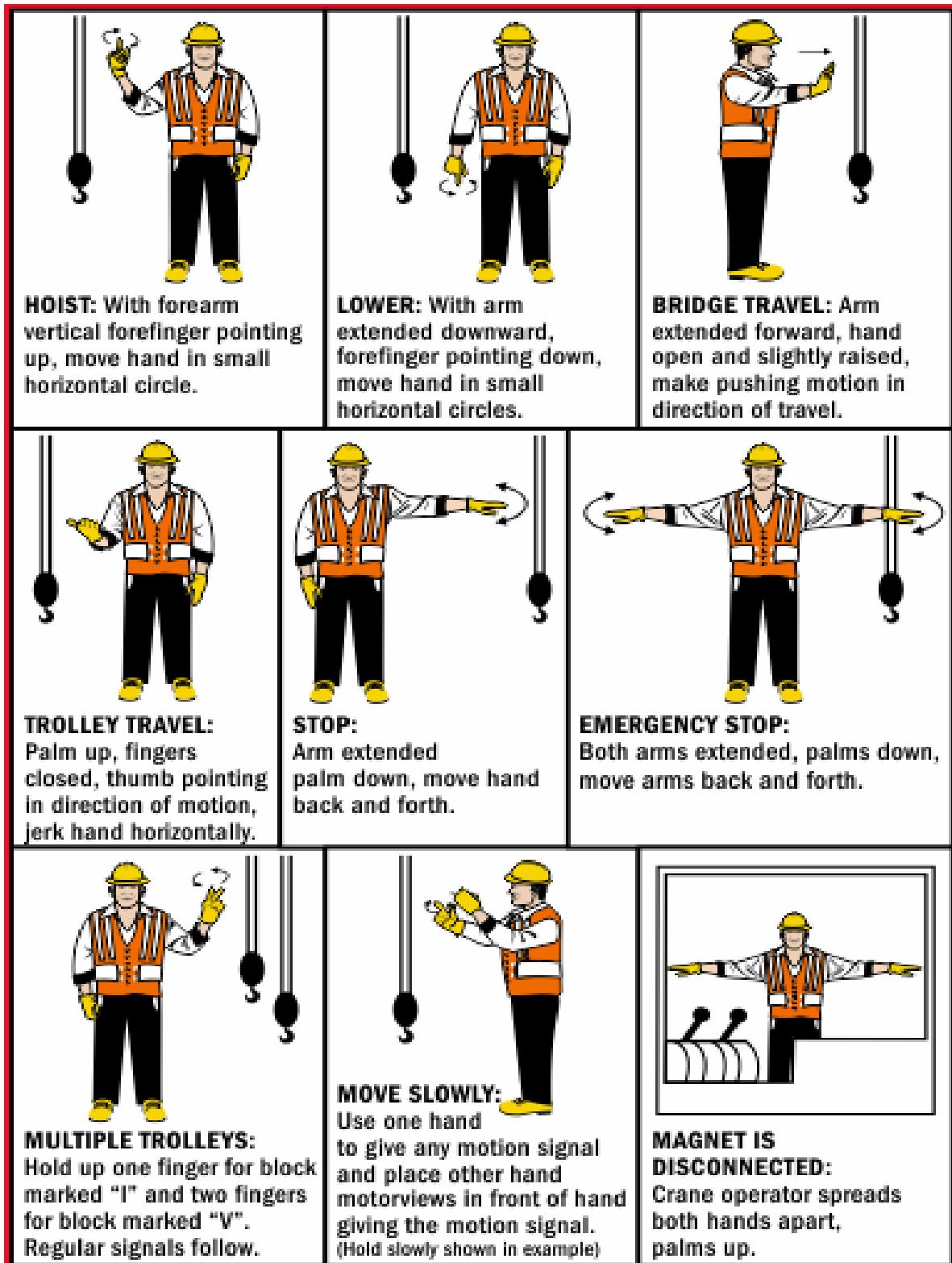
3.4.5.1 General requirements

- i) The employer shall comply with the manufacturer's specifications and limitations applicable to the operation of any and all cranes and derricks. Where manufacturer's specifications are not available the limitations assigned to the equipment shall be based on the determinations of a qualified engineer, competent in this field and such determinations will be appropriately documented and recorded. Attachments used with cranes shall not exceed the capacity, rating, or scope recommended by the manufacturer.

- ii) Rated load capacities, and recommended operating speeds, and special hazard warnings, or instruction shall be conspicuously posted on all equipment. Instructions or warnings shall be visible to the operator while at the control station. A chart indicating safe working load (SWL) at various inclinations or radii of jib shall be displayed in the driver's cabin. This is needed only in cases where automatic SWL indicator is not provided on the crane.
- iii) Standard Hand signals, as shown in **Fig.-1,2 and 3** shall be used to crane and derrick operators.
- iv) Every lifting appliance or machine and every part thereof including all working gear and all other plant or equipment used for anchoring or fixing such appliances or machines shall be of good mechanical construction, sound material, adequate strength and free from defect. The employer shall designate a competent person who shall inspect all machinery and equipment prior to each use, and periodically during use to make sure it is in safe operating condition. Any deficiencies shall be repaired, or defective parts replaced, before further use.
- v) A thorough, annual inspection of the hoisting machinery shall be made by competent person or competent private agency recognized by the department. The employer shall maintain a permanent record of the dates and results of all inspections for each hoisting machine and piece of equipment.
- vi) A tag line or guide rope shall be used on all loads that swing freely. Guide ropes or tag lines shall be held by experienced persons.
- vii) Care shall be taken to guard against injury to workers, or damage to scaffolds or buildings, from swinging loads.
- viii) The operator shall avoid carrying loads over people. No one must walk below suspended load or the boom.
- ix) When work is stopped or when the derrick is not in operation, the boom shall be lowered to a horizontal position or tied in place to prevent it whipping with the wind or other external force.
- x) Only authorized personnel shall make sling hitches on loads.
- xi) Workers shall not be allowed to ride on loads handled by derricks.
- xii) Operators shall observe signals only from duly authorized persons. Under no circumstances shall a load be moved until the signal is received from authorized personnel. The Crane operator shall respond to signals only from appointed signaller but shall obey stop signal given by anyone at any time.
- xiii) Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains, or other reciprocating, rotating, or other moving parts or equipment shall be guarded if such parts are exposed to contact by employees, or otherwise create a hazard. Any anchoring or fixing arrangement provided in connection with the lifting appliances or machines shall be adequate and

secured. Do not operate a crane, which does not have the facility of automatic braking (in case of power failure).

- xiv) A minimum distance of one meter clearance shall be maintained between the swing radius of the greatest extension of the crane superstructure or counterweights and a stationary object, including the crane itself, while the crane is in operation. When this clearance cannot be maintained, suitable barricades or safeguards shall be used to isolate the pinch point hazard area. No person should approach nearer than six meters of the crane truck, when crane is in motion or loaded.
- xv) All exhaust pipes shall be guarded or insulated where contact by employees, in the performance of normal duties, is possible.
- xvi) Crane shall be stationed: on a firm ground when operating.
- xvii) When leaving crane, operator must :
 - a) Lower any suspended load to the ground.
 - b) Disengage the clutch.
 - c) Engage all safety locks.
 - d) Secure boom against high winds.
- xviii) When parking overnight, in addition to the above:
 - a) Release the load
 - b) Lower the boom to ground
 - c) Provide wheel locks and wheel blocks
- xix) Cranes must not be operated between sunset and sunrise without adequate lighting provision.
- xx) When travelling up a gradient, the load shall be derricked out and when travelling down a gradient, the load shall be derricked into the minimum radius, and this position shall be corrected on reaching level ground. Otherwise, constant watch on the radius should be maintained while travelling on uneven surfaces.
- xi) The mobile crane shall be fitted with suitable horn, head lights, side lamps, rear and stop lights and flashing direction indicator.
- xxii) Cranes with cantilever type jib, when travelling without load, the jib should be lowered to a horizontal position.
- xxiii) The pneumatic tyres shall be maintained at the correct pressure always.
- xxiv) Do not block emergency egresses, electrical panel or fire equipment with a trucker load.
- xxv) Lock out the malfunctioning equipment and schedule for repair by an authorised agency.

Figure 1 : Hand Signal - Overhead Crane**Figure 2 : Hand Signals - Mobile Cranes**

Mobile Cranes

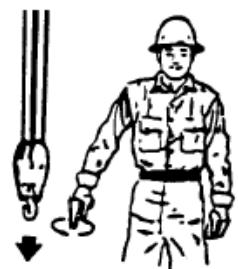
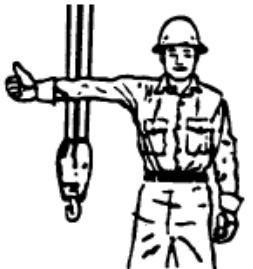
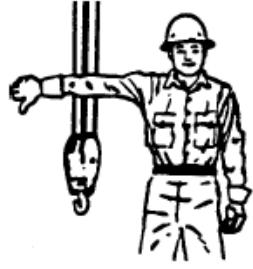
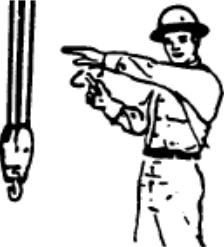
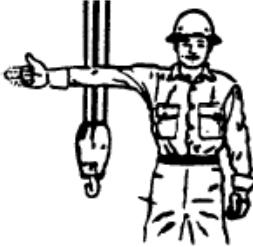
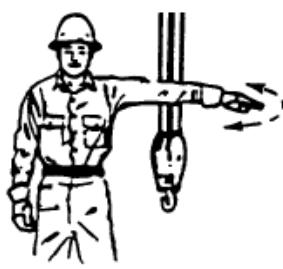
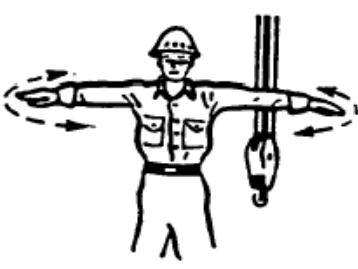
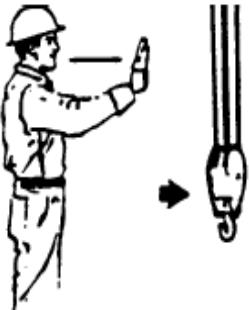
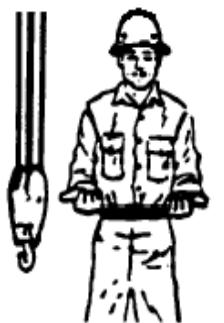
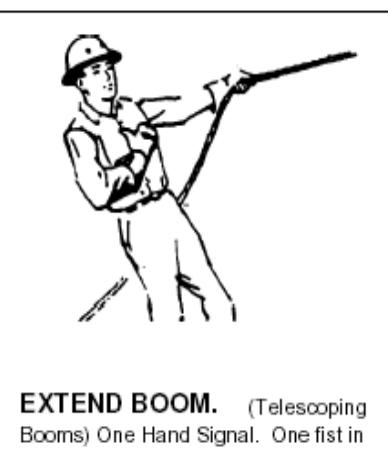
		
HOIST. With forearm vertical, forefinger pointing up, move hand in small horizontal circle.	LOWER. With arm extended downward, forefinger pointing down, move hand in small horizontal circles.	USE MAIN HOIST. Tap fist on head then use regular signals.
		
USE WHIP LINE. (Auxiliary Hoist) Tap elbow with one hand, then use regular signals.	RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.	LOWER BOOM. Arm extended, fingers closed, thumb pointing downward.
		
MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example.)	RAISE THE BOOM AND LOWER THE LOAD. With arm extended, thumb pointing up. Flex fingers in and out as long as load movement is desired.	LOWER THE BOOM AND RAISE THE LOAD. With arm extended, thumb pointing down. Flex fingers in and out as long as load movement is desired.
		
SWING. Arm extended, point with finger in direction of swing of boom.	STOP. Arm extended, palm down, move arm back ad forth horizontally.	EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.

Figure 3 : Hand Signals - Mobile Cranes (Continued)

Mobile Cranes (Continued)

 <p>TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.</p>	 <p>DOG EVERYTHING. Clasp hands in front of body.</p>	 <p>TRAVEL. (Both Tracks) Use both fists in front of body, making a circular motion, about each other, indicating direction of travel; forward or backward. (For land cranes only.)</p>
 <p>TRAVEL. (One Track) Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of either fist, rotated vertically in front of body. (For land cranes only.)</p>	 <p>EXTEND BOOM. (Telescoping Booms) Both fists in front of body with thumbs pointing outward.</p>	 <p>RETRACT BOOM. (Telescoping Booms) Both fists in front of body with thumbs pointing toward each other.</p>
 <p>EXTEND BOOM. (Telescoping Booms) One Hand Signal. One fist in front of chest with thumb tapping chest.</p>		 <p>RETRACT BOOM. (Telescoping Booms) One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.</p>

3.4.5.2 Additional requirements

- i) Whenever internal combustion engine powered equipment exhausts in enclosed spaces, tests shall be made and recorded to see that employees are not exposed to unsafe concentrations of toxic gases or oxygen deficient atmospheres.
- ii) All cab glazing shall be safety glazing material. Windows shall be provided in the frontend on both sides of the cab or operator's compartment with visibility forward and to either side. Visibility forward shall include a vertical range adequate to cover the boom point at all times. The front window may have a section, which can be readily removed or held open, if desired. If the section is of the type held in the open position, it shall be secured to prevent inadvertent closure. A windshield wiper should be provided on the front window.
- iii) Where necessary for rigging or service requirements, a ladder or steps shall be provided to give access to a cab roof.
- iv) On cranes, guardrails, handholds and steps shall be provided for easy access to the car.
- v) Cab Platforms and walkways shall have anti-skid surfaces.
- vi) Fuel tank filler pipe shall be located in such a position, or protected in such manner, as to not allow spill or overflow to run onto the engine, exhaust, or electrical equipment of any machine being fuelled. An accessible fire extinguisher shall be available at all operator stations or cabs of equipment.
- vii) Except where electrical distribution and transmission lines have been de-energized and visibly grounded at point of work or where insulating barriers, not a part of or an attachment to the equipment or machinery, have been erected to prevent physical contact with the lines, equipment or machines shall be operated proximate to power lines only in accordance with the following:
 - a) For lines rated 50 kV or below, minimum clearance between the lines and any part of the crane or load shall be three meters.
 - b) For lines rated over 50 kV, minimum clearance between the lines and any part of the crane or load shall be three meters plus one centimetre for each 1 kV over 50 kV., or twice the length of the line insulator, but never less than three meters.
 - c) In transit with no load and boom lowered, the equipment clearance shall be a minimum of 1.2 m for voltages less than 50 kV., and 3 m for voltages over 50 kV. up to and including 345 kV. and 4.8 m for voltages up to and including 750 kV.
- viii) A person shall be designated to observe clearance of the equipment and give timely warning to ensure that the required separation is maintained for all operations where it is difficult for the operator to maintain the desired clearance by visual means; While working under HT cables. Electrical department Representative and the job Supervisor must be present throughout the entire duration of the jib. A written clearance MUST be signed

by the Electrical Department, the Mechanical Department and Safety Officer, when Cranes operate near or below H.T. electrical cables.

- ix) Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded.
- x) Prior to work near transmitter tower where an electrical charge can be induced in the equipment or materials being handled, the transmitter shall be de-energized or tests shall be made to determine if electrical charge is induced on the crane.
- xi) The following precautions shall be taken when necessary to dissipate induced voltage:
 - a) The equipment shall be provided with an electrical ground directly to the upper rotating structure supporting the boom and
 - b) Ground jumper cables shall be attached to materials being handled by boom of equipment when electrical charge is induced while working near energized transmitters. Crews shall be provided with nonconductive poles having large alligator clips or other similar protection to attach the ground cable to the load.
 - c) Combustible and flammable materials shall be removed from the immediate area prior to operations.
- xii) No modifications or additions which affect the capacity or safe operation of the equipment shall be made by the employer without the manufacturer's or a qualified engineer's written approval. If such modifications or changes are made, the capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly. In no case shall the original safety factor of the equipment be reduced.

3.4.6 Crawler, locomotive, and truck cranes

- i) All jibs shall have positive stops to prevent their movement of more than 5° above the straight line of the jib and boom on conventional type crane booms. The use of cable type belly slings does not constitute compliance with this standard.
- ii) All crawler, truck or locomotive cranes in use shall meet the applicable requirements for design, inspection, construction, testing, maintenance and operation as prescribed in the ANSI B30.5-1989, Safety Code for Crawler, Locomotive and Truck Cranes.

3.4.7 Tower cranes

General Requirements

- i) Tower cranes shall be erected, jumped and dismantled under the immediate supervision of a competent person, designated by the employer.
- ii) Tower cranes shall be erected, maintained and used in accordance with the manufacturer's specifications, recommendations and procedures. All modifications shall be approved by the manufacturer and engineered by

professional engineer. The safety factors shall not be reduced by any modifications. The crane plates and charts shall be changed to reflect any modifications made.

- iii) A professional engineer shall certify that the crane foundations and underlying soil are adequate support for the tower crane with its maximum overturning movement.
- iv) Tower cranes shall be positioned whereby they can swing 360° without either the counterweight or jib striking any building, structure or other object, except:
 - a) If the crane can strike an object or another crane, suitable limit switches shall be installed which will prohibit contact with such objects, or;
 - b) Direct voice communications shall be established between any operator of the tower crane(s) involved and a signal-person so stationed where the boom and/or counterweight movement, and the object with which it may contact can be observed so that the operator(s) can be warned of imminent danger.
 - c) A secondary means of positive communications shall be established as a backup for possible direct voice communication failure.
- v) Prior to installing a climbing tower crane within an existing building or new construction, a structural engineer shall certify that the building is designed to withstand the torque and floor loading created by the crane to be installed.
- vi) Tower cranes erected on a new foundation shall be tested as per following
 - a) The test shall consist of suspending a load of not less than 110% of the rated capacity for 15 minutes. The load shall be suspended from the furthest point of the length of boom (jib) to be used. The results of this test shall be within the manufacturer's recommendations and/or specifications.
 - b) A record of each test shall be made and signed by the person responsible for conducting the test. Such records shall be maintained on the construction site for the duration of the construction work for which it was erected and subsequently made a part of the firm's permanent equipment records. Records shall be made available to authorized representatives of the department, upon request.
- vii) A capacity chart shall be furnished by each crane manufacturer, which shall include a full and complete range of crane load ratings at all stated operating radii for each allowable speed and each recommended counterweight load.
 - a) Such chart shall be posted in the operator's cabin or at the remote control stand in use. In lieu of the chart at the remote-control stand, a minimum of two weight capacity signs shall be affixed to the jib or boom.
 - b) The chart shall be visible and readable to the operator while at the normal operating position.

- viii) Operating controls shall be properly marked to indicate the function of the controls in each position.
- ix) An operating and maintenance manual written in the English language shall be provided with each tower crane.
- x) Limit switches shall be installed and shall be kept properly adjusted. They shall be protected or isolated in a manner which will prevent unauthorized tampering. Limit switches shall provide the following functions:
 - a) Safely limit the travel of the trolley to prevent it from hitting the outer end of the jib.
 - b) Limit the upward travel of the load block to prevent two-blocking.
 - c) Lower over travel limiting device shall be provided for all load hoist where the hook area is not visible to the operator.
 - d) Limit the load being lifted in the manner where by no more than 110 % of the maximum rated load can be lifted or moved.
- xi) The crane shall not be used to pull vehicles of any type, remove piling, loosen formwork, pull away loads attached to the ground or walls, or for any operation other than the proper handling of freely suspended loads.
- xii) When the operator may be exposed to the hazard of falling objects, the tower crane cab and/or remote-control station shall have adequate overhead protection.
- xiii) The operator shall be protected from the weather. If enclosed cabs are provided they shall provide clear visibility in all directions and glass shall be approved safety glass or the equivalent.
- xiv) An approved and safe means shall be provided for access to operator's cab and machinery platform.
- xv) When necessary for inspection or maintenance purposes, ladders, walkways with railing or other fall protection devices must be provided and used.
- xvi) Each tower crane shall be provided with a slewing brake capable of preventing the jib or boom from rotating in either direction and stopping the rotation of the jib or boom while loaded, when desired. Such brake shall have a holding device which, when set, will hold the jib or boom in a fixed location without additional attention of the operator. When the crane is out of operation, the jib or boom shall be pointed downwind and the slewing brake shall be released so as to permit the jib or boom to weathervane, providing the jib or boom has a clear 360 degree rotation. Where a 360 degree rotation is not provided, the jib or boom shall be pointed downwind from the prevailing wind and the slewing brake set.
- xvii) Each tower crane shall be provided with a braking system on the trolley capable of stopping and holding the trolley in any desired position while carrying maximum load. This brake shall be capable of being locked in a fixed location without additional attention of the operator. An automatic brake or device shall be installed which will immediately stop and lock the trolley in position in the event of a breakage of the trolley rope.

- xviii) All electrical equipment shall be properly grounded and protection shall be provided against lightning.
- xix) When the operator is operating the crane, the operator shall remain in stationary position.
- xx) All crane brakes shall automatically set in event of power failure. Swing brakes shall also function in this manner or be capable of being set manually.
- xxi) Climbing jack systems used for raising a tower crane shall be equipped with overpressure relief valves, direct-reading pressure gauges, and pilot-operated hydraulic check valves installed in a manner which will prevent jack from retracting should hydraulic line or fitting rupture or fail.
- xxii) During periods of high winds or weather affecting visibility, i.e., fog, etc., only loads shall be handled that are consistent with good safety practices. Good safety practices shall be mutually agreed upon by the operator and the person in charge of the construction job, with due consideration given to manufacturer's specifications and recommendations.
- xxiii) Counterweights shall be securely fastened in place and shall not exceed the weights recommended by the manufacturer for the length of jib being used. However, an amount of counterweight as recommended by the manufacturer shall be used.
- xxiv) Tower cranes shall be inspected and maintained in accordance with the manufacturer's recommendations or more frequently if there is reason to suspect possible defect or weakening of any portion of the structure or equipment.
- xxv) Guy wires, wedges, braces or other supports shall be inspected at the beginning and at midpoint of each working shift to ascertain that they are functioning as intended.

Additional tower crane requirements

- i) An approved method must be instituted for transmitting signals to the operator. Standard hand signals for crane operations must be used, whenever possible; however, if conditions are such that hand signals are ineffective, radio-controlled or electric-whistle signal or two-way voice communication must be used.
- ii) Tower cranes shall not be erected or raised when the wind velocity at the site exceeds 20 kmph or that specified by the manufacturer.
- iii) Tower crane operators shall be trained and experienced in tower crane operations.
- iv) Adequate clearance shall be maintained between moving and rotating structures of the crane and fixed objects to allow the passage of employees without harm.

- v) Employees required to perform duties on the horizontal boom of hammerhead tower cranes shall be protected against falling by guardrails or by a full body harness and lanyards attached to crane or to lifelines.
- vi) Buffers shall be provided at both ends of travel of the trolley.
- vii) Cranes mounted on rail tracks shall be equipped with limit switches limiting the travel of the crane on the track and stops or buffers at each end of the tracks.
- viii) All hammerhead tower cranes in use shall meet the applicable requirements for design, construction, installation, testing, maintenance, inspection, and operations prescribed by the manufacturer.

3.4.8 Overhead and gantry cranes

- i) The rated load of the crane shall be plainly marked on each side of the crane. If the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its load block, and this marking shall be clearly legible from the ground or floor.
- ii) Bridge trucks shall be equipped with sweeps, which extend below the top of the rail and project in front of the truck wheels.
- iii) Except for floor-operated cranes, a gong or other effective audible warning signal shall be provided for each crane equipped with a power travelling mechanism.
- iv) All overhead and gantry cranes in use, shall meet the applicable requirements for design, construction, installation, testing, maintenance, inspection, and operation as referred in BIS codes, IS 807, 3177 and 4137.

3.4.9 Derricks

- i) All derricks in use shall meet the applicable requirements for design, construction, installation, inspection, testing, maintenance, and operation.
- ii) A competent person shall ascertain the lifting capacity of the derrick and it shallot be overloaded. The test record shall be maintained.
- iii) The mast, guy ropes, wire ropes, swivel hook, rope clamps, etc. of the derrick shall be thoroughly checked before erecting the derrick.
- iv) All precautions shall be taken so that base of the derrick does not shift or sink.
- v) Guys of the derrick shall be anchored tightly with strong structures / hold fasts /Anchorage blocks. The load being hoisted should not run against the derrick.
- vi) All welded parts of Derricks (especially in bracing & stiffeners) should be periodically checked for any crack, or detects in metal itself.
- vii) If bolted joints are used, check for proper bolts and their tightness.

- viii) Derricks when used should be suitably anchored. The length of guy ropes used must not be less than 3 times the stick length. The lifting angle shared be within 5degrees after rigging. The derrick is to be tested to 1.25 times the safe working load. When not in use, the hoisting ropes are to be anchored and the gears properly guarded.

3.5 Rigging Equipments

3.5.1 General Requirements for rigging equipment

- i) All the rigging equipment should carry their unique identification number & safe working load.
- ii) No chain, rope or lifting gear shall be used unless –
 - a) it is of good construction, adequate strength, suitable quality and free from any defects.
 - b) it has been tested and examined once in a year for general use and once in six months for hot metal lifting use by a competent person and issued a certificate.
- iii) Rigging equipment for material handling shall be visually inspected prior to use on each shift. Defective rigging equipment shall be removed from service.
- iv) Only steel chains and slings shall be used for securing / supporting heavy loads (≥ 70 kg) and use of Manila ropes, Fiber ropes in rigging activities shall be strictly prohibited for heavy loads.
- v) Slings shall not be shortened with knots or bolts or other makeshift devices.
- vi) Shock loading is prohibited.
- vii) Suitable packing is to be provided to prevent contact with the sling to the sharp edge of the load.

3.5.2 Rigging safety

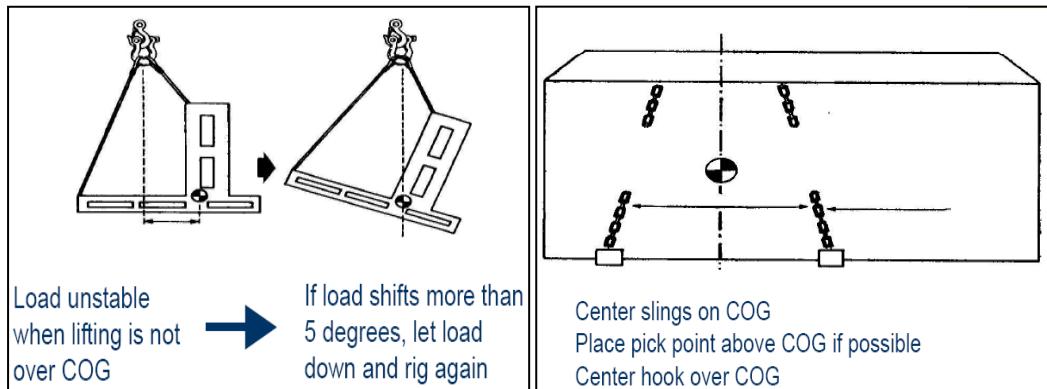
3.5.2.1 Determine

- i) What are you going to lift?
- ii) What does it weigh?
- iii) Where is the center of gravity?
- iv) What type of rigging will you use?
- v) What configuration of rigging will you use (type of hitch)?

3.5.2.2 Center of Gravity

- i) It is always important to rig the load so that it is stable. Load's CG must be directly under the main hook & below the lowest sling attachment point before the load is lifted.
- ii) Determine center of gravity.

- iii) Place the hook directly above the center of gravity.
- iv) Rig load with pick points above center of gravity.
- v) If pick point cannot be placed above center of gravity, keep sling angle as great as possible.



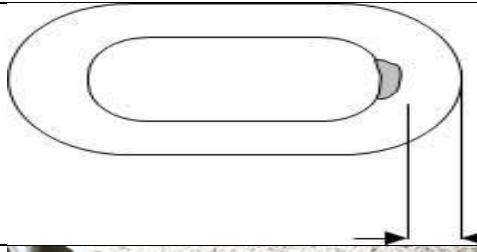
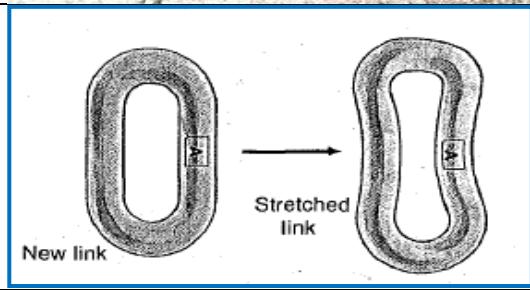
3.5.2.3 Rigging equipment

- i) Alloy steel chain
- ii) Wire rope
- iii) Synthetic web
- iv) Chain blocks / hooks / pull lifts

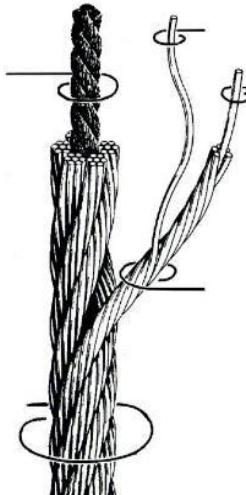
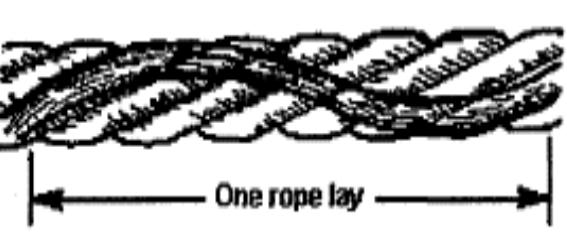
(A) Alloy steel chain- Inspection:

- i) A chain in use shall be thoroughly examined once at least every month by a responsible person.
- ii) Alloy Steel Chains shall never be welded or exposed to excessive temperatures.
- iii) Alloy Steel Chains shall have permanently affixed identification, size, grade and rated capacity
- iv) Hooks, rings, welded or mechanical coupling links and other attachments when used with alloy steel chains shall have a rated capacity at least equal to that of chain.
- v) Shop made hooks and links or make-shift fasteners, formed from bolts, rods. etc. or other such attachments, shall not be used.
- vi) Rings, Hooks, Swivels and end links attached to a chain shall be of the same material as that of the chain.
- vii) Chains should not be hammered (especially with load) either to strengthen the links or to force the link into position.
- viii) The chain shall be free from bent, twisted, damaged or cracked links.
- ix) The safe working load shall be reduced as follows when the diameter of the link is reduced due to wear and tear.

Alloy steel chain- Removal from Service:

Whenever wear at any point of any chain link exceeds 10 per cent reduction in diameter, the chain shall not be used and to be removed from site.	
Non-alloy repair links cannot be used	
The stretch in the chains shall not be more than 5% of its original length.	 <p>New link Stretched link</p>

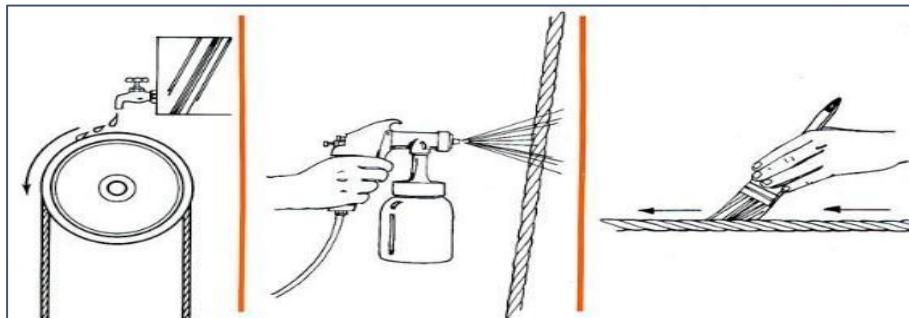
(B) Wire Ropes**Wire Rope construction-**

	Wire Rope Lay -One complete wrap of a strand around the core. Or The lengthwise distance on a wire rope in which a strand makes one complete turnaround the rope's axis.
	One rope lay

Inspection & maintenance of Wire Rope

- i) Every wire rope of lifting appliance and lifting gear shall be inspected by a responsible person for such use once in at least three months.

- ii) The safe working load recommended by the manufacturer for various sizes and classification of wire ropes shall be followed.
- iii) Wire ropes shall not be secured by knots.
- iv) Wire ropes used for construction activities shall have a factor of safety 6 : 1. Only tested wire ropes shall be used.
- v) The wire rope should be properly lubricated.

**Lubrication****Defects in Wire Rope Sling****Wire Ropes -Removal from Service**

- i) Each wire rope used in hoisting or lowering or in pulling loads shall consist of one continuous piece without knot or splice.
- ii) Wire rope shall not be used if in any length of eight diameters, the total number of visible broken wire exceeds 10 per cent of total number of wires or if the rope shows other signs of excessive wear, corrosion or defect.
- iii) In pendants or standing ropes, there should not be more than **3 broken wires in one rope lay /3 broken wire in one strand**. (A rope lay is the length along the rope in which one strand makes a complete revolution around the rope).
- iv) Near attached fittings there should not be any broken wires.
- v) Reduction in diameter of the rope due to core failure, abrasion, etc. should not be more than :
 - a) 1.0 mm for ropes up to - 19 mm dia.
 - b) 1.5 mm for ropes of 22 - 28 mm dia.
 - c) 2.0 mm for ropes of 32 - 38 mm dia.
- vi) Rope stretch should not be more than 150 mm per 30 m length in the six strand wire ropes.
- vii) No defects (bird caging, kinks, crushing, core protrusion etc.) shall exist in the wire rope.

Fixing of Wire Rope Clips:

When using U-bolt wire rope clips to form eyes, ensure the "U" section is in contact with the dead end of the rope.



(C) Synthetic Webbing sling- (Nylon, Polyester and Poly Propylene)

Inspection & maintenance of Synthetic Webbing sling-

- i) Synthetic webbing shall be of uniform thickness width and edges shall not be split from the webbing width.
- ii) Fittings shall be –
 - a) of a minimum breaking strength equal to that of the sling and

- b) free of all sharp edges that could in any way damage the webbing.
- iii) Attachment of end fittings to webbing and formation of eyes-
 - a) Stitching shall be the only method used to attach end fittings to webbing and to form eyes. The thread shall be in an eyes pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling.

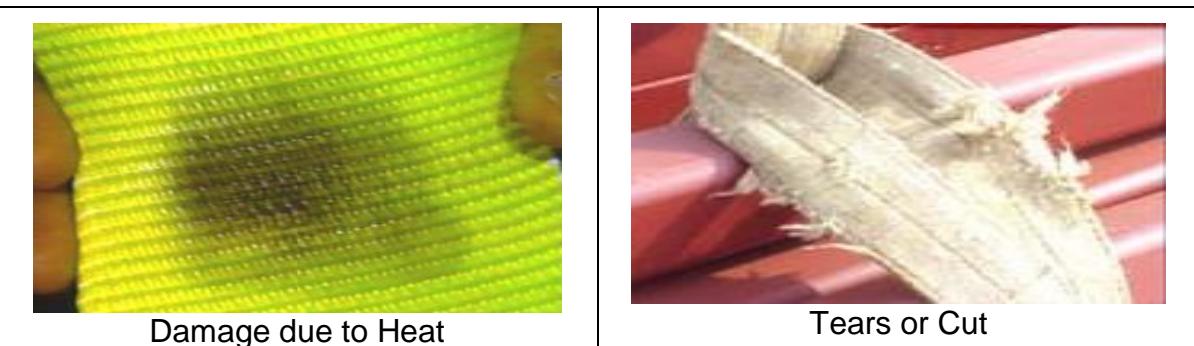
Environmental Conditions

- i) When synthetic web slings are used the following precautions shall be taken.
- a) Nylon web slings shall not be used where fumes, vapors, sprays, mists or liquid of acids or phenol are present.
- b) Polyester and polypropylene web slings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present.

Synthetic Webbing sling - Removal from Service

Synthetic web slings shall be immediately removed from service if any of the following conditions are present.

- a) Acid -or caustic burns.
- b) Melting or charring of any part of the sling surface.
- c) Snags, punctures, tears or cuts.
- d) Broken or worn stitches or Distortion of fittings.



(D) Chain blocks / hooks / pull lifts: Inspection and Maintenance

- i) The Chain Blocks should have safety Latch both in the Top & the Bottom hook.
- ii) Chain blocks of proper lifting capacity supported by Test Certificate should be used for lifting known loads.
- iii) Chain block must be checked, and tested periodically. It should be lubricated before every use.
- iv) Never use undue effort to force the block to operate.
- v) Ensure the slings are secure and load is free to be lifted.

- vi) It should operate freely and the chain should not come out of pulleys.
- vii) Ensure suspension points and anchorages are adequate for the full imposed load.
- viii) Position the hook over the center of gravity of the load.
- ix) No chain block / puller which has been tampered, be used unless it is thoroughly checked and tested by competent person.
- x) Chain block / puller must be checked if stored for longer time, by subjecting to shock load, to observe slipping of load, jamming of links etc.
- xi) Use wire rope / sling for tying in (*do not use Manila or Fibre Rope for tying purposes*)

3.6 Storing materials in safe manner at open yards and other storage places in steel industry

General Requirements

3.6.1 Planning of Storage Layout

For any site, there should be proper planning of the layout for stacking and storage of different materials, components and equipments with proper access and proper manoeuvrability of the vehicles carrying the material. While planning the layout, the requirements of various materials, components and equipments to be stored shall be considered.

3.6.2 Following points should be taken into consideration for storing the material

- i) Materials stored at site shall not obstruct fire& smoke detectors and fire detection panels, fire extinguishers, fire hydrant points, first-aid equipment, lights, electrical switches, gas line drip pots, water seals and other emergency items/ equipments.
- ii) All spares shall be placed in such a manner so that leaving clear access of at least 1 meter from such emergency items/ equipments.
- iii) All spares shall be segregated and stored at designated places.
- iv) Storage areas shall be kept free from accumulation of materials that constitute hazards from tripping, fire or explosion.
- v) The permanent material storage area shall be hard barricaded and material stored temporarily may have indicative abreaction provided the stored material are stable and fully secured. No material shall protrude beyond the barricade.
- vi) No material shall be stored or lie on the pathway, to avoid tripping hazards. Aisles and Passage-ways shall be kept clear to provide for the free and safe movement of Material handling equipment and people.

- vii) Any pipe line (water supply, gas etc.) or electrical installation should not be used for supporting any material or hanging load.
- viii) All material stored in tiers shall be stacked, racked, blocked or otherwise secured to prevent sliding, falling or collapse, toppling.
- ix) Incompatible material shall be stored in segregated manner so as not to cause fire/ other emergency situation.
- x) Combustible materials such as packing boxes, fuel, lubrication and gunny bags are to be kept separately on designated areas for disposal, away from any ignition source to prevent fire.
- xi) All materials shall be stacked tidily, firmly and maximum up to man height to prevent them from falling or causing some other pile to fall. In case of big material (more than man height), extra precaution should be taken like restriction of unauthorized entry, securing of material for preventing it from displacing.
- xii) Power lines & Emergency equipment: Do not store materials under power lines or where materials may block access to emergency equipment.
- xiii) Barricading: Spare yard should be barricaded, named and gates should be provided with locking provision. Only authorized person will allow entry of materials for unloading and loading in the Storage place. The storage place should be under lock & key rest of the times.
- xiv) SOP's for material handling: All Storage places/ yards should have approved SOP for handling and storage of materials.
- xv) Training: Only trained person on material handling SOP's should be allowed to handle the material.
- xvi) Test certificates of tools & tackles: All the material handling equipment e.g. sling, D shackles, hook of the crane etc. should have valid test certificate readily available at the site for verification.
- xvii) Location for Spares: All the spares should be kept only at their designated locations with UI numbers/ name of the spares mentioned on a tag. An inventory register to be maintained for each storage place.

3.6.3 Specific Requirements

3.6.3.1 Pipes and Conveyor pulley

- i) Pipes and Conveyor pulley shall preferably be stored on appropriately designed sills or racks, and must be safely blocked to prevent rolling or spreading.
- ii) Alternately, pipes of diameter higher than 300mm may be stored on ground with maximum two layers high and with proper use of choker block and Dunnage, in order to prevent rolling. When stacked in such fashion, the top most pipes are to be taken out first for use.

- iii) When many small diameter pipes/rods are stored on ground, the pipes/rods are to be bundled into 3-4 units. Proper guards are to be provided to arrest any accidental rolling of the pipes.
- iv) Stopping of rolling or sliding of pipes or Conveyor pulley with hands or feet is strictly prohibited.

3.6.3.2 Fabricated items

- i) Fabricated material shall be checked for stability at ground level. It is to be ensured that there is no chance of tilting, falling or rolling or slipping of material.
- ii) The ground shall have sufficient strength to bear weight of the fabricated items.
- iii) Fabricated items shall not be placed on loose soil.
- iv) The storage area must be properly barricaded.

3.6.3.3 Sheet material

All bundles shall be separated by strips of wood to facilitate handling, to minimize chances of shifting or sliding of the piles of material.

3.6.3.4 Scaffolding Materials

- i) All Material and parts of scaffold, when not in use shall be kept under good condition at designate place.
- ii) Good Scaffold materials should not be mixed with scrap materials and parts.

3.6.3.5 Scrap Materials

- i) Scarp shall be removed from Storage Yard and disposed off promptly. Before Removal, scrap storage area shall be kept under barricading.
- ii) Packaging material should be disposed off quickly and shall not be allowed to remain at storage yard.
- iii) Wooden material with projected nail shall not be stored for future use. If the wooden materials are needed, all nails are to be removed, by appropriate means.

3.6.3.6 Fabrication Debris

- i) Debris shall not be thrown from upper stories, but be removed either by machinery or enclosed tilted passage / enclosed chutes. Accumulated debris shall be appropriately barricaded.
- ii) All waste material and rubbish shall be removed from the immediate work area as the work progresses.

- iii) All solvent waste, oily rags and flammable liquids shall be kept in metal containers with lid. These wastes shall be kept away from other combustible material (such as wood, papers, tyres etc.) & ignition source.
- iv) Waste bins shall be kept at designated places for collection of different categories of wastes (ferrous / non- ferrous / other waste).

3.6.3.7 Slab/ Coils

The maximum safe height of stacking is up-to 2 meters.

3.6.3.8 Impeller Fan with its Shafts

Fan with Shaft should be kept at a rigid frame with saddle to avoid bending & rolling of the impeller fan shaft.

3.6.3.9 Heavy structure / Spares

Stair should be provided for climbing on the spares more than 6 feet height for mounting of sling during lifting & lowering the heavy structures / spares in the yard/storage place.

3.6.3.10 Handling and Storage of Conveyor belts

3.6.3.10.1 Handling

- i) Conveyor belts are generally supplied in cylindrical wooden or steel reels and in cases of overseas transportation, in fully enclosed steel reels, racetrack or similar.
- ii) The reels are always equipped with a square centre to take each company's winder shaft.
- iii) Insert the shaft and make sure that it is protruding at least 200mm from each side to accommodate the slings or the forklifts. To avoid damaging belt edges you should use a spreader bar.
- iv) The best practice for running out the belt is to use a braked stand. Small roll can be pulled from a freewheeling stand however, care should be taken to avoid the belt from running away.
- v) If the belt is to be dragged along the ground, then care should be taken to ensure that no objects are blocking the area and the dragging area should be barricaded with indicative barricading tape.
- vi) In cases, there is a headroom limitation it may be necessary to remove the belt from its reel and store it in a flat position. If that happens make sure that large loops are maintained to prevent carcass fracture.

3.6.3.10.2 Storage

- i) In any case the conveyor belts must be stored upright in the factory package until used, protected from direct sun light and permanent

water. The storage area shall be prepared for stable putting down of the reels and preventing the belts from being damaged by foreign parts.

- ii) A cool dry warehouse, free from direct sunlight, oil, or corrosive fumes is recommended.

3.6.3.10.2 Points of attention

- i) Ensure the soundness of the wrapping.
- ii) Do not lean the belt against walls as this can cause telescoping.
- iii) Before lifting the belt ensure that facilities can handle the weight and the dimensions, which are always marked on the reel side.
- iv) If prolonged intermediate storage is necessary, it is advisable to suspend the coiled belt with one axle in two movable stands. If this is not feasible, the coil should be turned at intervals to change the contact surface.
- v) In case of prolonged storage in the open air (for steel cord belts) the cut edge at the start and end of the belt must be protected from moisture. It may be advisable to coat the cut edge with cold splicing cement.

References:

1. IAPA Manual,
2. IPSS: 1-11-024-16 “Guidelines for storing materials in safe manner at open yards & other places ”
3. IPSS: 1-11-027-16 “Guidelines for selection, usage, inspection & rejection of rigging equipment”
4. ISO Standard -11228 guidelines
5. ANSI B30.5-1989, Safety Code for Crawler, Locomotive and Truck Cranes.
6. SS/Gen-52-Tata Steel
7. SAIL Plants safety manual

Implementation checklist of material storage			
Sr. No.	Description	Status	Remark
1	Planning of the layout for tacking and storage of materials are done.		
2	Proper access of the vehicles carrying the material is provided		
3	Gap between fire detectors & panels, fire extinguishers, first-aid equipment gas lines and other emergency equipments is at least one meter.		
4	Yard has designated place for stacking all kinds of materials/Spares.		
5	All materials/spares are segregated and stored at designated Places		
6	Proper access has been made to reach to every material/spare		
7	Storage areas are free from accumulation of materials that constitute hazards from tripping, fire or explosion.		
8	Material storage area is appropriately barricaded and no materials are protruded beyond the barricade.		
9	No pipe lines (water supply, gas etc.) or electrical installations have been used for supporting any material or hanging any load.		
10	All material stored in tiers are stacked, racked, blocked or otherwise secured to prevent sliding, falling or collapse, toppling.		
11	Designated disposal places and bins for scraps like packing boxes, fuel, lubrication and gunny bags are provided.		
12	All materials are stacked tidily and up to a safe height to prevent them from falling or causing some other pile to fall.		
13	No materials are stored under the power lines.		
14	Spare yards are barricaded with controlled access.		
15	Layout/ drawing of spare/ storage yard is available.		
16	Spare yard has SOPs for loading / unloading process.		
17	Employees engaged in material handling at Spare yards are trained on material handling activities.		
18	All the material handling equipment used at Spare yard is tested and certified.		
19	Appropriately designed sills or racks are provided to stovepipes and Conveyor pulley to prevent rolling or spreading.		
20	Pipes of dia more than 300mm is not stacked in more than two layers high		
21	All fabricated materials are tested for its stability at ground Level.		

Sr. No.	Description	Status	Remark
22	Stacking place of fabricated material is tested for its supporting strength. During stacking the material all care of soil / ground quality has been considered.		
23	There is a schedule of disposal of waste material from spare yards. Sufficient bins are provided for it.		
24	All Impellers, motors, rotors, gear box etc. are stacked on rigid frame with saddle/ support stand.		
25	Proper access provided for safe access to heavy structures having height more than 6 feet.		
26	Sufficient support provided to prevent falling of any unbalanced material stacked in yard.		
27	Schematic diagram of the storage place is displayed at each Entry/ exit point indicating: a. 'You are here' at each entry point. b. Layout for stacking and storage of different materials, components and equipments with proper access and pathway directions. c. Location of Fire extinguishers, Fire hydrant &fire alarms& nearest First Aid Box. d. Display of "Unauthorized entry prohibited". e. Area ownership board is displayed.		
28	Relevant Standard Operating Procedures (SOPs) for handling and storage of materials, training record of the concerned employees on the SOP are available at shop floor. Visual SOP should also be displayed.		
29	MSDS is available and displayed for storage of any hazardous chemical in the stores.		
30	All the electrical panels, DBs, switch board have proper Nomenclature.		
31	Monthly audit system of Storage places/ yards against the standard is in place.		
32	Proper visuals and cautionary signage's are provided in spare yards with Emergency numbers, name of area owner.		

Signage can be used

before_you_act_osh...



carelessness_is_dang...



danger_high_voltage...



danger_highly_flamm...



do_not_enter_authorized...



do_not_smoke_in_this...



don't_take_chances...



ear,_eye_and_head...



eye_protection_must_...



food_or_drink_prohibit...



hard_hat_and_safety...



hard_hat_area_mand...



high_noise_levels_wa...



keep_all_cylinders_ch...



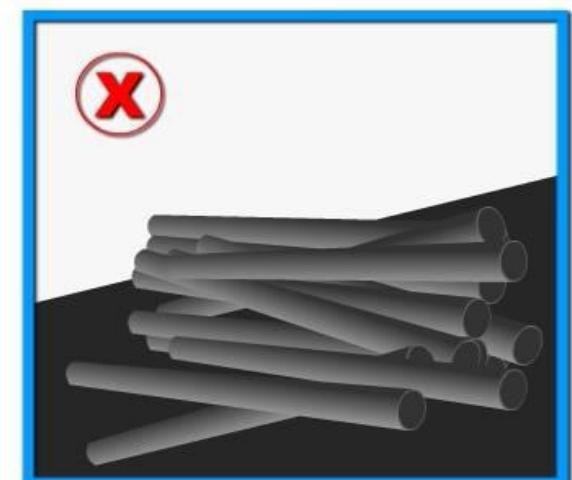
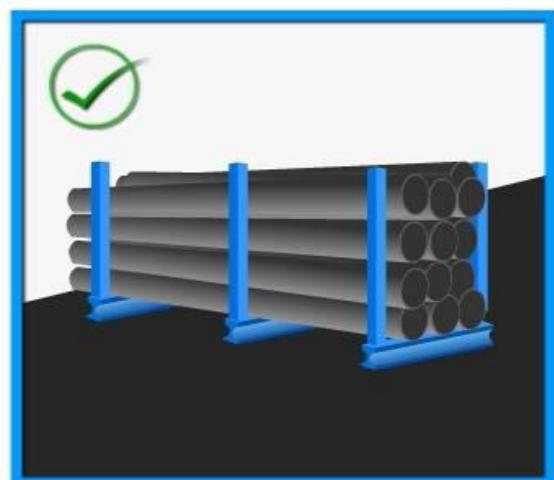
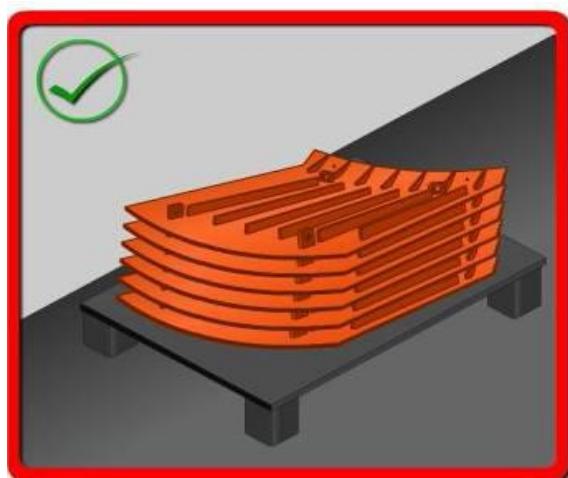
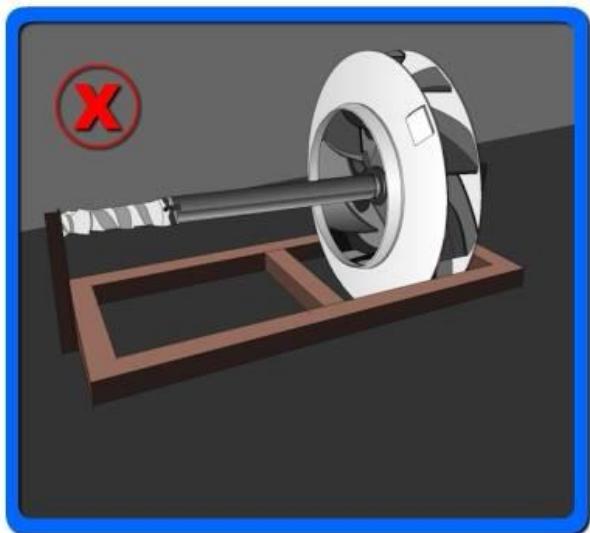
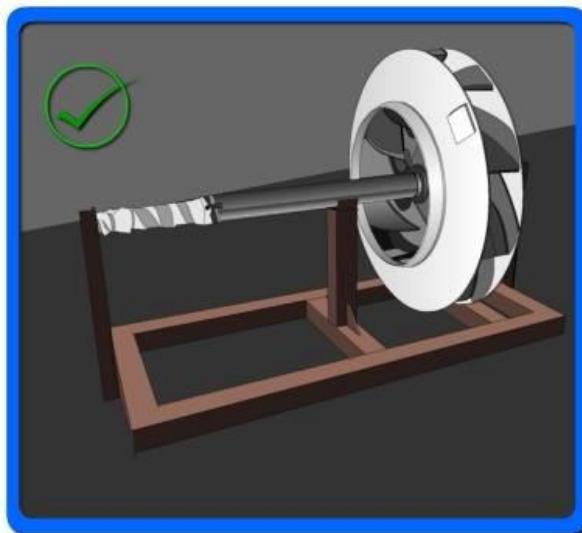
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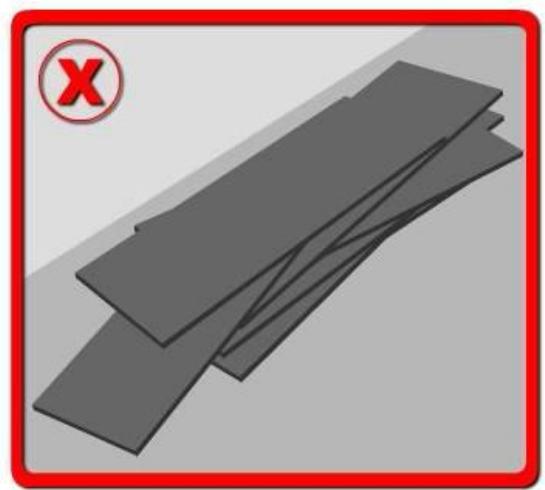
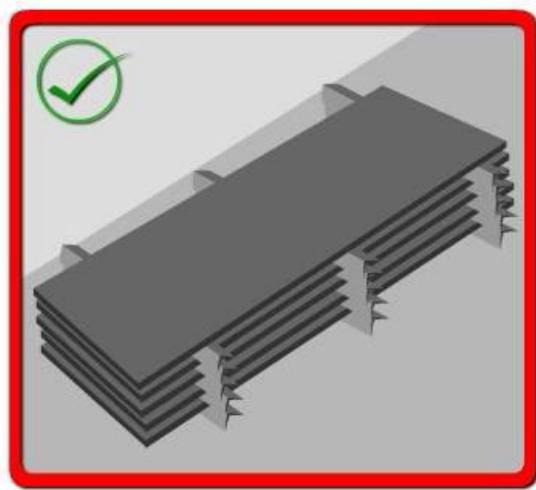
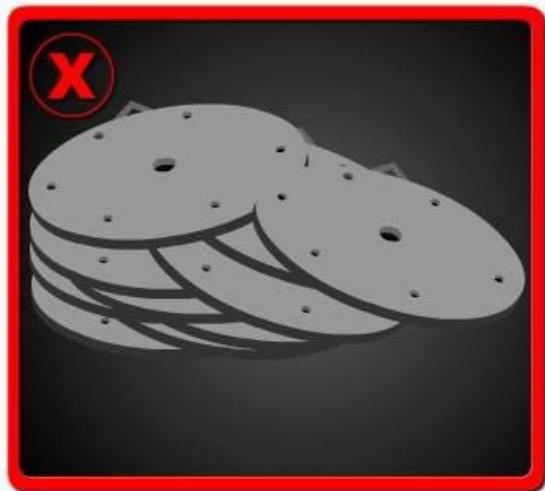
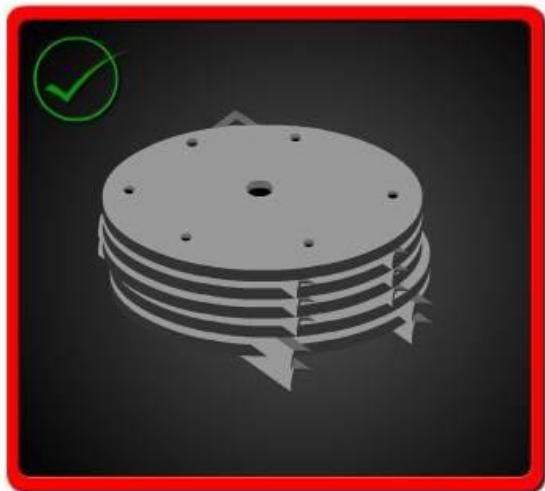


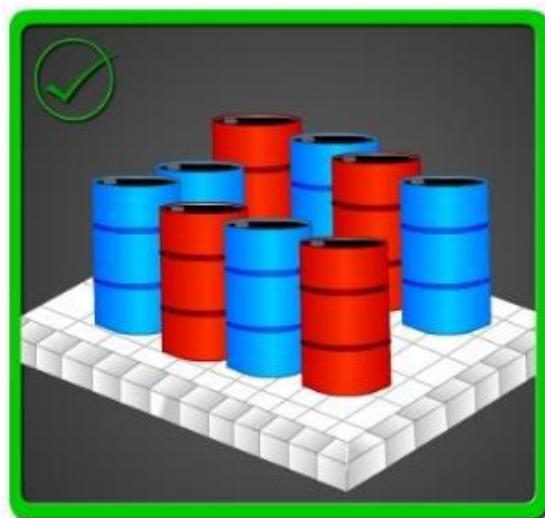
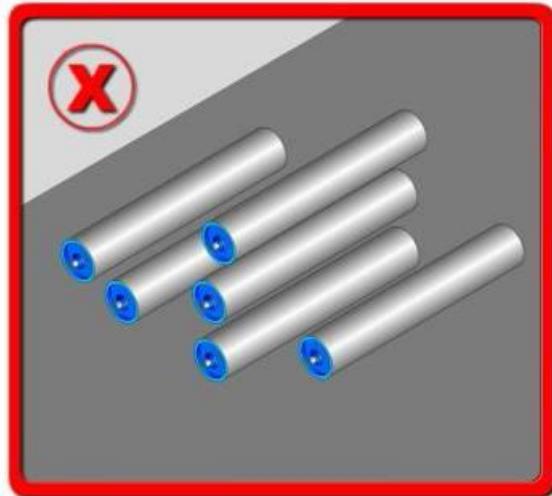
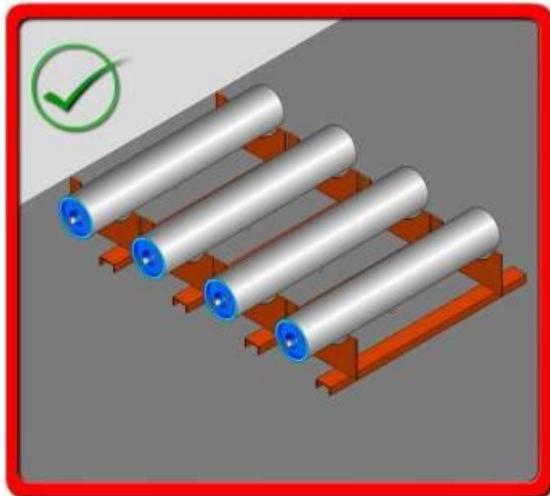
keep_door_closed_at_all_times_osh_notice_sign

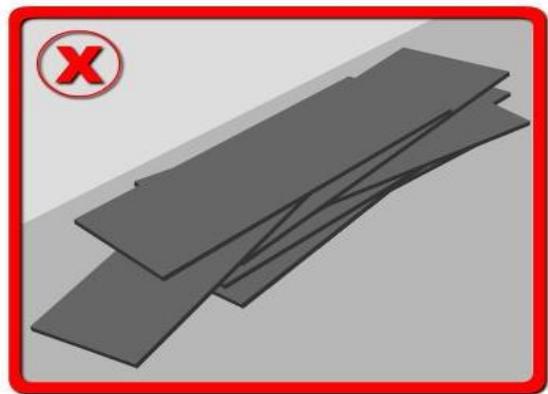
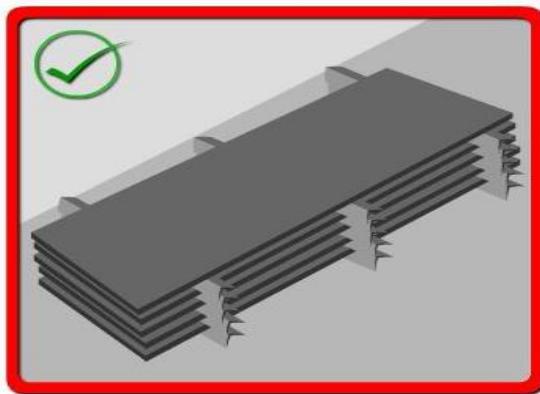
Signage of POISONOUS gas to be displayed wherever material is to be stored near the gas lines.

Signage are from http://www.freesignage.com/osh_caution_signs.php









SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	ELECTRIC OVERHEAD TRAVELLING (EOT) CRANES	Doc. No: SG/14
		Rev no. : 00 Effective Date : 14.10.2019

1. Objective

To provide a generic guideline for Electric Overhead Travelling (EOT) Crane safety practices to be observed in Iron & Steel Industries.

Associated Hazard: Electrical Shock, Electrical Flash, Electrical Burn, Fire, Slip/Trip/ fall, Hit/ Press/ /Cut hazard, Fall of person from height, Fall of materials from height etc.

2. Scope

This guideline is applicable to all location of Iron and Steel Industries where Electric Overhead Travelling (EOT) Crane is being used for material handling.

3. Procedure

3.1 Definitions

- i. **Overhead Travelling Crane:** Overhead travelling crane consists essentially of a girder (or girders) attached at each end to carriages, travelling along elevated tracks fixed in location, and a trolley or crab equipped with a hoisting mechanism, travelling along such girder (or girders).
- ii. **Rated Lifted Load** — The rated lifted load from the mechanism design considerations shall mean the external load lifted and handled by the crane and shall include in addition to the safe working load, weight of rope and lifting tackles such as magnets, grabs, lifting beams, book blocks, but shall exclude wind load.
- iii. **Safe Working Load** — The maximum external load excluding the weight of the lifting tackles under specified conditions for which the crane may be used. This may be a variable quantity for a jib crane. If the grab forms an integral part of the suspended gear, then the weight of the gear shall also be included in the safe working load.

3.2 Design & Engineering Controls to ensure Safety

- i. **Passage ways and clearance for over-head travelling crane (Ref Bihar Factories Rules, 1950, 56-B or similar applicable rules for other states)**
 - a) Passage-way shall be provided along and adjacent to every rail-track of every over-head travelling crane of such width that there is a clear space of not less than 50 cm between crane operating on the track and any column, fixture or fixed

structure, so that no person working or walking over the passage –way may be struck by any part of the crane.

- b) There should be railings at a height of at least 90 c. m. from the floor of the passage –way on the both the side, with at least two rail and with a toe board at a height of at least 10 c .m. from the floor.
- c) Provided that if there is a wall or sheeting on one side of the walk –way the railings may be provided on only the other side.
- d) Safe access ladders with hand rail shall be provided at convenient places and at suitable frequent intervals so that's the crane driver or any other person going up the crane or crane track may not have to walk long distances on the passage-way.
- e) Where there are more than one cranes operating in the same way as on the same run-way, the number of access ladders shall be provided in the considerations of the easy and safe accessibility to the different crane.
- f) For the repair of the track equipment of the cranes and for the greater convenience and safety in changing track wheels if there is no sufficient distance between the end of the crane and the wall of the building, special recesses or the platform with safe access ladders shall be built at different places in the building.
- g) The vertical clearance between the floors of the Crane Bridge or trolley foot-walks or platforms on the travelling cranes and over-head trusses, structural parts or any other permanent fixture shall not be less than two meters.
- h) The provision of sub rule i) shall apply only to factories constructed after the 1st January,1975 and also to crane installed in existing factories after the said date and sub rules ii) and iii) shall apply to the factories constructed after the 4th February,1963and the crane installed in existing factories after the said date.

Provided that chief inspector may, with the approval of the state governments, exempt any such factory in the respect of any particular over-head travelling crane from the operation of any provision of the said –rules subjects to such conditions as he may specify in writing.

- i) In the respect of any over-head travelling crane already in the operation on the date of the coming into force of this rule in any factory, the chief inspector may, by order in writing, direct such measure to be taken within a specified time as he may consider practicable and necessary to prevent accident due to the movement of the crane.
- j) These rules are without any prejudice to, and in addition to and not in derogation to the provision of section 32 of the factories act, 1948; and
- k) The chief inspector may, with the approval of the state governments, exempt any overhead travelling crane in any factory from the operation of the provisions of this rule subject to such conditions as he may specify in writing.

ii. Following display should be provided on the EOT cranes:

SL	TYPE OF BOARD	CONTENTS	WHERE TO PLACE
1	Name Plate	Safe Working Load, Manufacturer Name & Year of Manufacturing	Both outer of the bridge girders
2	'Inspection Date' Board	Last date of inspection, Due date of inspection & Done by – (Due date: After 1 year) (As per Factory Act)	Outer side hand railing of one of the girders
3	'Danger' Board	As per IS 2551(Relevant for application)	Protective panel cubicle front cover & Main incoming switch
4	'Caution' Board	a) Unauthorized persons are not allowed on the crane gantry b) Use Safety Helmet, Safety shoe, Safety goggles, safety jackets, Safety belt and other required PPEs while going to crane gantry	Crane gantry approach stair case hand railing
5	'Instruction' Board for boarding	a) Inform operator through bell switch before climbing the crane b) Cut off Safety switch before boarding on the crane	Near all corner boarding approach to the crane
6	Do's & Don'ts Board	Do's & Don'ts for Crane operator	Inside the operator cabin
7	Do's & Don'ts Board	Do's & Don'ts for maintenance crew	Near the panels and on the girder
8	Important Telephone numbers	Following minimum telephone number should be displayed: Fire Brigade Ambulance Security Shift Safety Control room of that area Line managers of that area Head of that area	a. In crane operator's cabin b. Near control panel/E-room
9	Hazards on the particular crane	1. Gas hazards if any 2. Fire hazards 3. Slip, trip, fall on same level and from height 4. Clearance between fixed point	a. Near the entrance of the crane b. Both sides of Girder c. Any other suitable location
10	Information about workplace	Name of the crane Capacity Make Nature of job Specification	At the entrance of the crane or any other suitable location

Note: Sl. No. 1&2 shall be painted in bold letters on the crane in such size and clarity, that it is easily visible, readable from Floor Level

- iii. Sick bay/Maintenance Bay/Hospital bay shall be provided if there is more than one crane in the same track.
- iv. Anti-collision system shall be provided to detect the other crane in the same track which in-turn shall slow and stop the crane along with Audio-Visual alarm in the operator's cabin.
- v. All outdoor type power angles shall be provided with Safety catch.
- vi. All the incoming Isolator, Circuit breaker, switches etc. shall be provided with positive isolation facility having pad locking arrangement.
- vii. Portable CO₂ fire extinguisher of 4.5Kg is to be kept in the crane operator's cabin, both sides of electric panel area/E-room & both side Girder of the crane. Crane having two Girder and no electrical room may have only near both sides of control panels.
- viii. Two-way Safety switches shall be provided at four corners of the crane, one at the outside and another at the inside of the crane to put OFF the power of complete crane. In addition, following safety switches must be provided on the crane:
 - a) one Safety switch shall be provided near the entry & exit of the crane operators cabin to put OFF the power of complete crane.
 - b) one Emergency switch shall be provided inside the crane operator's cabin to put OFF the power of complete crane.
 - c) switch shall be provided at the entry to the trolley to put OFF the power of complete crane.
- ix. One calling bell shall be provided at the entrance of the crane for communicating with the crane operator before enter or exit to or from the crane. Minimum One system shall be provided in the both side of the crane gantry.
- x. Auto closing gate shall be provided in the crane operator's walkway for the safe entry to the crane.
- xi. Safety hand railings of square bars shall be provided along and adjacent to every rail-track of Overhead Travelling Cranes or crane operator's walk-way / passage-way. Safety railing to be provided on both outside and inside of each end carriage (without compromising hook approach).
- xii. Safe access ladders with hand rails shall be provided at convenient place for the crane operator or any other person going to or coming out from the crane. All the ladders should be provided as far as possible in the center of the end tie/end carriage to avoid risk of falling to zero meters. If it is not possible to shift the ladder at the center, Side protection with hand post for ladder at end side should be provided. The entire ladder should have wider steps to avoid slip from the ladder. Other than this, ladder shall be provide in the following location also:
 - a) Crane walkway to the gantry
 - b) Crane walkway to power collector inspection platform
 - c) Trolley floor to crane walkway
 - d) Besides these, ladders shall be provided wherever found necessary

- xiii. Foot operated Switch shall be provided in the crane operators cabin to stop the Long Travel motion during emergency condition.
- xiv. Staircase should be provided in place of ladder as far as possible for easy and safe access to different location e.g. access to the cabin from the bridge girder platform shall be via a staircase. Minimum width of staircase shall be 600 mm and inclination to the horizontal shall not be more than 48 degree. For special case it can be ± 10 deg.
- xv. Provision of control stop shall be provided along with pad locking arrangement and ON/OFF LED indication for all the motions on a suitable location of the girder for use during trial purpose and other control stop activity. This shall be included in the departmental approved control stop procedure as per positive isolation safety procedure. Suitable enclosure shall be provided to protect these arrangement from adverse environmental condition.
- xvi. Other than Gong Bell an audible warning device shall be provided on the crane which shall work automatically during running of Long Travel motion to warn people working below.
- xvii. Minimum four light shall be hung from the girder of the crane so that the working area under the crane is properly illuminated. Similar light also shall be hung form the trolley.
- xviii. Two-way switch shall be provided near the both side entrance of the E-room, so that light can be put ON or OFF from any side of the E-room,
- xix. Emergency light shall be provided in the Crane operator's cabin and Electrical control room.
- xx. Provision of Light and Fan shall be provided near the power collector platform with ON/OFF switch.
- xxi. Provision shall be made to provide 220V lighting power from the Gantry during preventive maintenance or any emergency condition.
- xxii. Plug points of voltage 220 AC, 50Hz, having ELCB of 30 mA trip capacity shall be provided in the crane operator's cabin, both side of the girder, both sides of the panel and on the trolley to facilitate during maintenance work.
- xxiii. Panel nomenclature to be painted on the outer side of individual panel doors and all circuit components to be adequately labeled and all control cables properly ferruled to facilitate correct identification.
- xxiv. Provision shall be made to PUT OFF complete control and Main power from the protective panel or from the outside of the individual control panel. No work should be done inside the panel if there is any power present inside the panel.
- xxv. All the panels shall be provided with positive isolation facility having pad locking facility. Crane electrics shall be flame proof for applicable hazardous area having flammable gases and vapours.
- xxvi. All drive couplings and protruded extended shafts etc. are to be securely guarded.
- xxvii. There should be two limit switches for hoisting motion. The first one can be either a Rotary Gear Limit Switch (RGLS) or Counter Weight Limit Switch (CWLS) but the final one should be a CWLS.

- xxviii. Lower limit switch shall be provided all Hoist motion equipped with a RGLS where ever possible to define the lower position of the crane.
- xxix. Open position interlock of all Service brake/disc brake/Storm brake shall be provided. In addition, Emergency disk brake may be provided for EOT cranes operating in critical areas like hot metal handling application where planetary gear arrangement is used.
- xxx. Normally open (NO) type proximity switch shall be used. For DC application 24V to 30V DC proximity shall be used. For AC application 24V to 240V AC/DC proximity shall be used.
- xxxi. Operator cabin shall be designed so that the driver has a clear view of all work areas or so that he may adequately follow all operations with the aid of suitable equipment (e.g. camera)
- xxxii. Entrance of the operator's cabin shall be protected against accidental opening. Sliding doors, and outward opening doors of operator's cabin must lead to landings.
- xxxiii. It must be possible to clean the both sides of windows of the operator's cabin without any risk.
- xxxiv. Lock of the operator's cabin must be able to operate from inside as well as outside.
- xxxv. Spring operated or Dead man switch type Master controller shall be provided to avoid starting of any unwanted motion of the crane. Lay out and characteristics of controller shall conform IS -13558 (Part 1) and IS 13558 (Part 5).
- xxxvi. Operator's cabin shall be provided with clear head room of not less than 2000mm and shall be fitted with a guard rail of at least 1.0M height .
- xxxvii. Evaporator of the Air conditioner in operator's cabin shall be critically positioned to avoid head injury of operator.
- xxxviii. Necessary protective barrier shall be provided to avoid any accidental contact with live electrical parts. If the live parts cannot be made access proof, no maintenance job shall be carried out without full positive isolation of incoming power .
- xxxix. Load Testing: Before putting the crane into operation, it shall have all motions tested with the hook carrying (a) the safe working load, and (b) 25percent overload. During the 25-percent overload test the geared speeds need not be attained but the crane shall show itself capable of dealing with the overload without difficulty. Test should be done in accordance with IS-4137 or IS 3177 as applicable. Load testing shall be done for a newly commissioned crane. Load testing with safe working load to be done if there is any structural change made after commissioning.
- xl. Deflection test of girder with Safe working load may be carried out once in every 10 years. However annual inspection report by competent person for every crane as per Factory Act Rules to be maintained.
- xli. All the crane shall be provided with necessary rescue arrangement on the crane to rescue any person during abnormal situation.

- xlii. Locks of all the doors of E-room, Operator's cabin shall be designed to operate from inside as well as from outside of the room/cabin. Lock shall have the facility to open the door from the inside room/cabin without any key.
- xliii. All Air conditions shall be equipped with a system to eliminate falling of condensate water on the shop floor.
- xliv. Single Hook Protection for liquid handling cranes: All new cranes handling liquid metal should be equipped with Single Hook Protection using the 4 nos. load cells in the top sheave of the crane MH. The controller will see the readings of these 4 nos. load cells and compare them for appreciable difference in weighment readings. Based on the difference in weighment setting, the hoisting motion will be tripped and alarm generated in the Operator's cabin.
- xlv. Regular inspection of the cranes needs to be carried out as per IS 14473(Part 1). The record of all Crane Inspection & Testing shall be maintained properly.

3.3 EOT Crane Operational Safety aspect guidelines

3.3.1 Requirement of Crane operators: {IS 13367 (Part 5)}

Overhead crane operators must be physically able to perform their duties, and in compliance with industry standard.

The crane driver shall:

- i. be competent, which means person shall have the necessary ability, knowledge and skill for operating the crane, so that person can act effectively in a job or any situation.
- ii. be more than 18 years of age .
- iii. be fit, particularly with regard to eyesight, hearing, reflexes, the stature to operate the crane safely, ability to judge distances, heights and clearances;

(NOTE- Evidence that the driver is medically fit to drive a crane shall be obtained before appointment and recertified at an interval of not more than one year. Certificate shall be kept in the department and shall be produce as and when required.)

- iv. be trained in the type of crane being driven and have knowledge of the crane and its safety devices.
- v. understand fully the duties of the slinger and signaler and be familiar with the signal code shown in Fig. 2 and any alternative methods of relaying the signals which are to be used for the operation being undertaken in order to implement safely the instruction of the slinger or signaler.
- vi. be familiar with the fire appliances on the crane and be trained in their use.
- vii. before operating the crane, operator shall be authorized to operate the crane by a competent person nominated by the department.

- viii. be drug and alcohol free during any lifting event.
- ix. have the ability to react quickly in an emergency.

NOTE- It is also recommended that a record of the drivers training and experience is maintained. Such records should be made available to the appointed person.

3.3.2 General Safety Guideline for operators

Operator must follow the Do's and Don'ts as given below:

	DO'S		DON'TS
1.	Wear Safety Helmet, Safety shoe, Safety goggles, safety jackets, Safety belt (Where required) and other required PPEs before leaving the operator rest room for going to the crane	1	Don't operate the crane if the signal is not clear or given by more than one person.
2	Wear safety goggle in open type cabin	2	Don't operate unless the over hoist limit switch is functioning.
3	Acquire information about the crane shut down or break down.	3	Don't make oblique pull which misalign rope with hoist.
4	Know the standard hand signal.	4	Don't lift unless load slings are centered on hook or load is properly balanced.
5	Follow written instruction provided in the cabin (if any).	5	Don't move a load over people in the shop floor.
6	Pull all the controllers in 'Zero' while not in operation.	6	Don't create panic for any abnormality of the crane, stop the crane and inform the ground crew.
7	Put OFF individual hoist safety switches which is not in operation.	7	Don't use mobile phone; talk with others, read newspaper and magazine during the crane operation.
8	Ring the gong bell before starting the crane.	8	Don't operate the crane if feel sick, feeling giddiness or high Blood pressure. Inform the ground crew.
9	Watch proper rigging on load before lifting.	9	Don't try to come out from the cabin during the power failure.
10	Lift load a few inches and test hoist brake before making complete lift.	10	Don't leave operating position with suspended load on hook.

	DO'S		DON'TS
11	Move the crane knowing the ground hazards or according to the signal on the shop floor.	11	Don't leave the crane before ensuring the control power is OFF and all controllers are in 'Zero' position.
12	During L T movements ring the gong bell if automatic bell is not working.	12	Do not operate the crane by any other parts of the body. Operate the crane with the hands only.

	DO'S		DON'TS
13	Inform the concern maintenance agency immediately if any abnormality noticed like heavy vibration, jerking, heavy noise, bad smell , visible damage , smoke etc.	13	Don't operate the crane if under the influence of alcohol or drugs
14	Check the emergency light(if provided)	14	Do Not allow riders on loads or hooks.

3.3.3 Pre-operational Test

At the start of each work shift, operators shall do the following steps before making lifts with any crane or hoist:

- i. Check the condition of Pilot lamp (RED & GREEN)
- ii. Check the physical conditions of controller
- iii. Check Overall cleanliness of the Cabin
- iv. Check for any damage of window glasses and cleanliness
- v. Test communication system provided inside the cabin
- vi. Check Fan, light & Air conditioner condition(if provided)
- vii. Test the Hoist-limit switch. Slowly raise the unloaded hook block until the limit switch cuts and crane goes off
- viii. Visually inspect the hook, load lines, trolley, and bridge as much as possible from the operator's station; in most instances, this will be the floor of the building
- ix. If possible, test the lower-limit switch
- x. Test all direction and speed controls for both bridge and trolley travel
- xi. Test all bridge and trolley limit switches, where provided
- xii. Test the pendant emergency stop (wherever applicable)
- xiii. Test the hoist brake to verify there is no drift without a load
- xiv. Check the Gong bell and test the Auto alarm for LT movement
- xv. Immediately report any abnormality to shift-in-charge

3.3.4 Parking/Leaving of crane

Whenever leaving or parking the cranes, following safe practices (as a minimum) shall be observed:

- i. Raise all hooks up to limit switches.
- ii. Place all controls in the "off" position.

- iii. Place main power switch in the “off” position.
- iv. Make a visual check for any dangerous condition.
- v. Report any defects immediately.

3.3.5 Safe Practices for Signalers

- The signaler should:
- i. be competent, which means person shall have the necessary ability, knowledge and skill for giving signals, so that crane operator can act effectively in a job or any situation.
 - ii. be more than 18 years of age.,.
 - iii. be fit with particular regard to eye sight, hearing, mobility, ability to judge distances, heights and clearances.
 - iv. understand the signal code shown in Fig. 2 for the crane being operated and be able to give clear and precise signals.
 - v. be capable of directing the safe movement of the crane and load
 - vi. Only one person is the designated signaler.
 - vii. Maintain line-of-sight with the operator.
 - viii. Ensure the operator acknowledges every signal.
 - ix. Stop the operation if comprehension is lost.

3.3.6 Hand Signal

STANDARD HAND SIGNAL:-

There are nine industry standard hand signals that are used for communication between the operator in the crane's cab and the floor person. These signals are:



STOP
With arm extended—and palm down—hold position rigidly



LOWER
With arm extended downward—and forefinger pointing down—move hand in small horizontal circle



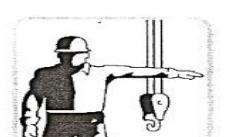
BRIDGE TRAVEL
With arm extended forward—and hand open and slightly raised—make pushing motion in direction of travel.



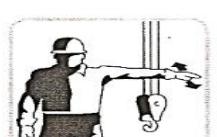
HOIST (RAISE)
With forearm vertical—and forefinger pointing up—move hand in small horizontal circle



TROLLEY TRAVEL
With palm up—and fingers closed—point in direction of motion, and jerk hand horizontally.



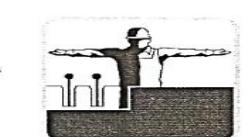
STOP
With arm extended—and palm down—hold position rigidly



EMERGENCY STOP
With arm extended—and palm down—move hand rapidly to the right and left.



MULTIPLE HOIST
Hold up one finger to indicate 1, and two fingers to indicate block. Follow with regular hand



MAGNET DISCONNECT
With palms up, crane operators spreads both hands apart

3.3.7 Daily checklist of Crane operators

Checklist for EOT crane operation

Department:

Crane / equipment name:

Date:

SI	Check Points	OK/Not OK	Remarks (if any)
1	All controllers in 'Zero' position		
2	Operation of emergency / Safety switch		
3	Status of Red / Green signal lamps		
4	Individual hoist safety switch		
5	Electric bell		
6	Communication system with ground crew (if any)		
7	Operation of Over hoist limit switches (Rotary only)		
8	Operation of Over lowering limit switch (if provided)		
9	Condition of Cabin glass panes, Seat, Light & Fan		
10	Overall cleanliness of the operator's cabin		
11	Cross travel end limit switch		
12	Operation of Brakes		
13	Under – slung lights (Girder / Trolley lights)		
14	Availability of Fire Extinguisher		
15	Locking of Hook if provided		
16	Any other abnormality.....		

3.3.8 Training of Crane Operators

Training to the crane operator shall be provided as per IS 13583 (Part 1).

3.4 Safety during EOT Crane maintenance

3.4.1 General Requirement:

- i. A Standard Operating Procedure (SOP) shall be prepared and followed for maintenance of crane during shutdown and breakdown.
- ii. Before the maintenance work on a crane is taken up, the group in-charge shall inform the operation shift in-charge regarding the nature and duration of work and take necessary work permit.
- iii. Before starting any maintenance work, a six direction hazard form shall be filled up by the group in-charge or any one person authorized by him and shall explained to all the person working in that group.
- iv. The crane which is to be shut down for maintenance and repair, shall be brought to the repair bay or to the repair platform or to any other suitable place where the crane may be shut down for maintenance with least interference to other cranes.
- v. Only the designated crane operator or a specially trained and authorized person having knowledge and skill regarding safe operation of various mechanisms of the crane shall be allowed to operate a crane during maintenance job of the crane.
- vi. When the crane is brought to the required place, the group in-charge of maintenance shall arrange for necessary barrication.
- vii. Use of scaffolding on the crane for repair maintenance work shall be prohibited except for location not otherwise possible.
- viii. Persons deployed on the crane during maintenance or supervision should have secured foothold while at work and must guard themselves against tripping, slipping or getting unbalanced. They must make use of full body harness with double lanyard wherever necessary. The group in-charge shall brief this to all persons before start of work.
- ix. The work shall not be considered complete unless all the safety guards and other safety devices are back in position and spillage of oil or grease, oily rags and other refuge are removed from the crane. When the work is completed, all the red flags and the lamps on the crane and on the ground and the rail stops shall be removed and all men must leave the crane. Then the group in-charge of maintenance shall deactivate the energy isolation and return work permit as per procedure and ask the operator to take over the crane. The crane operators of the adjacent cranes and area in charge shall also be informed of the completion of the work.

3.4.2 Safety Watcher

Following the Risk Assessment and the application of the control measures above, there may be a need to appoint a safety watcher to control the general work. This safety watcher must be a dedicated role and not an active part of the working party. The working party team leader must have the correct equipment as a suitable means of communicating to the working party and crane drivers.

3.4.3 Climbing on the running crane

- i. One calling bell shall be provided at the entrance to the crane for communicating with the crane operator before going to the crane. Minimum one calling bell or any other system should be provided in the both gantry side entrance. Crane operator, maintenance crew or any other person want to enter into the crane must communicate with the crane operator by ringing the bell or any other system.
- ii. After hearing the sound of the bell, crane operator must stop the crane within a reasonable distance. If communication is possible through eye contact then person must communicate to the crane operator regarding entry to the crane.
- iii. On getting the permission from the crane operator and/or stopping of the crane, person must put off one of the safety switch provided at the four corners of the crane and board onto the crane. After boarding same switch to be put on and again press the Calling bell for giving clearance to run the crane.
- iv. Same method must be followed during coming out from the crane

3.4.4 Trapping/hitting by Adjacent Cranes running on same track

- i. To prevent trapping/hitting by adjacent cranes, Positive isolation for other cranes on the same track or cranes working above/below shall be implemented.
- ii. For crane positioned at one side of the building (sick bay/Hospital bay/Repair bay), wheel stoppers shall be placed on both the tracks of required side at a distance of minimum six meters from the crane. In case of a middle crane, stopper shall be fixed up on both sides at minimum six meter away from the crane.
- iii. While placing or removing the wheel stopper in the track rail, it must be ensured that the other cranes should not move in that bay by placing one person in other crane operator's cabin to guide him and switching off the power of the other crane for the duration. The hazard to the person involved in placement or removal of stopper can be eliminated by using the wheel stopper.

- iv. A red flag of minimum size of 2meter X 3meter is to be hanged at the middle of the span, at least one meter from the wheel stopper towards the moving crane zone.
- v. All wheel stoppers shall be locked by positive isolation lock with the gantry and to be mention in the permit to work form.
- vi. For working on power rail or power collector, power of power rail to be positively isolated and all phase shall be shorted and grounded by metallic chain and locked. It will be over and above the positive isolation on the Tracks as mentioned in this clause.
- vii. During erection / Dismantling of cranes or when crane is required to be kept down for more than one week, double wheel stopper shall be provided.

3.4.5 Trapping by Adjacent Cranes running on parallel track/Gantry

To prevent trapping/hitting by adjacent cranes running on parallel bays/tracks following actions to be taken for planned maintenance or unplanned maintenance jobs:

- i. There should be railing at height of at least 900mm from the floor of crane gantry/passage-way on both sides, with at least two horizontal members in the railing and with toe board at a height of at least 100mm from the floor.
- ii. No one shall rest/support or put any gas cutting/welding equipment/anchor safety belt or kept any material on the railing of running crane side.

If the width between the railing of the gantry/passage way is less than 1000mm or there is a chance of dashing during working on crane under shutdown or breakdown by the running crane, positive isolation system to be implemented.

3.4.6 Trapping by Motions on the crane

- i. To prevent trapping by any of the crane motions (i.e. hoist, cross travel, long travel, and cab traverse), Isolation/ Restriction of the crane being worked must be applied. This trapping can be between a crane motion and the crane structure or a crane motion and fixed building structures such as roof trusses, gantry columns, handrails, gantry long travel buffers. All the motion other than the motion required to be tried/work shall be made OFF either from the panel or from Control stop panel provided on the gantry. Positive Isolationstandard shall be followed for that.
- ii. During any powered tasks where it is a requirement to be on the crane whilst movement takes place, necessary precautions shall be in place.
- iii. Necessary barrication shall be provided to avoid any trapping potential from open drum and ropes, pulley blocks, reeling drums, thrusters, brakes, Floating shafts and couplings.

- iv. Restriction of any stored energy must also be considered, for example, hoist assemblies and fixed masts will lower under gravity when released, spring thrusters will close/open when isolated.

3.4.7 Protection from incoming power before working in electric panels

- i. All those electrical panels or Junction Boxes, where maintenance jobs are carried out in close proximity to 415V or above incoming live voltage, live portion shall be made access proof with suitable barriers or other engineering means. If that is not possible then in such electrical panels no maintenance job shall be carried out without full positive isolation of the incoming power.
- ii. Compliance with Low Voltage safety rules and High Voltage Safety Rules, including specific Works Supplement is mandatory.
- iii. Additional control measures must be adopted during any live observational testing on moving equipment.

a) Live Power Rail

Low Voltage and High Voltage safety rules must be adhered to.

b) 690V power rail

No person should stand near 690V power rail. For observation person should keep distance not less than 6m from live power rail

Before working on power rail, positive isolation shall be done as per standard

a) Isolation – Cabin Operated cranes

Isolation of cranes for electrical work must only be undertaken by competent personnel, multiple isolators may exist for main, auxiliary, and magnet circuits.

For any type of isolation, danger boards and locks should be used in accordance with the isolation standard

Boarding Switches shall not be used for isolation; they are only to be used for accessing/egressing the cranes.

b) Isolation - Remote Control cranes

Access to remote control boxes shall be controlled through SOP.

A separate SOP shall be made for the operation and maintenance of Remote control crane

NB: The placing of personal danger boards on the transmitter is not a secure isolation in itself. The crane to be worked on must be isolated at the appropriate isolation point.

3.4.8 Inspection of hoist limits switch

Each department shall have a systems and procedures in place to inspect Hoist limit switch, minimum once in a day for those cranes which are running on regular basis. For those cranes which are running intermittently shall be checked before starting the crane and register shall also be maintained for that. Separate register shall be maintained for each crane and each motion. Any abnormality shall be mentioned in the register and shall rectify as soon as possible.

3.4.9 Fall of object from the crane or Crane gantry

If work is to be undertaken adjacent to an open edge where equipment or tools have the potential to fall, then effective measures shall be put in place to prevent such equipment falling from height, this may include hand tool lanyards, tool bags for carrying hand tools and bolt boxes for the storage and carrying of bolts, nuts etc. Controls should also be implemented to ensure personnel do not enter the danger zone below. This could include visual display, physical barriers and/or safety watcher. Materials left on the crane or crane gantry must be stored and secured safely. The level of control will be dependent on the level of the risk. The safety watcher must be posted in a safe area where they would not be exposed to the risk of falling objects.

All materials and equipment used during maintenance should be removed on completion of the task, to avoid items falling from the crane during use.

A final check of the work area, for loose objects, must be made by the working party leader before signing off the crane access control and notification sheet.

3.4.10 Work Above or Below Crane Gantry

This section details the precautions to be observed when work is carried out on gantry columns, above or below crane tracks, or anywhere in the space traversed by an overhead crane and its load. The items shown below would require a permit to work system

Definition of Work above or below crane gantries

- i. Work erecting, dismantling or on scaffolding above the height of adjacent structures in the bay.
- ii. Work erecting, dismantling or on scaffolding on or beside gantries and columns.
- iii. Work erecting, dismantling or on scaffolding on board a crane (changing lamps, etc).
- iv. Work from a temporary platform above ground level within the space traversed by EOT crane where there is a danger of being struck by that crane or load.

- v. Work from a Mobile Elevating Work Platform (MEWP), which is used to gain access to the crane or crane tracks or when the MEWP is used for other work where there is a danger of being struck by a crane or its load.
- vi. Work using a mobile crane where there is a danger of being struck by an overhead crane or its load
- vii. Work which entails bringing in mobile plant which could be struck by overhead crane or its load
- viii. During work from a fixed structure/platform, risk analysis of individual task should identify the suitable controls in place to prevent collision from the crane/load to the structure.
- ix. Warning lights must be clearly placed on any temporary structure erected in the crane working zone and left in place even when work is not ongoing. These must be visible to crane drivers traversing that area. Orange Flashing Lights indicating crane drivers proceed with caution, Red Flashing lights indicating crane drivers not to pass this point, until Red Light has been withdrawn.

3.4.11 Scaffolding

- i. If a scaffold or working platform is to be erected in a position where it could be struck by a crane or its load, the person responsible for erection, along with Person-In-Charge of Cranes must assess the risk of any protrusions into the crane traversing space. The Person-In-Charge of Cranes must ensure that the Working agency has checked that a traversing crane cannot strike the platform and any persons working on the platform.
- ii. When erecting, working from and dismantling scaffolding a person must be kept in the operator cabin of the running crane to ensure that crane shall not strike scaffolding or any person.
- iii. Once the scaffolding has been erected the working agency will determine:
 - a) Can the scaffold be struck by the crane structure – If the scaffold can be struck by the crane structure the task owner must ensure appropriate controls are in place to prevent such a collision. This may include isolation/ stop of the crane.
 - b) Can the scaffold be struck by the crane load - If the scaffold can be struck by the crane load, the working agency will assess the potential and the consequences should a collision occur between the crane load and the scaffold structure. If the level of risk is identified as 'significant' appropriate controls must be implemented to prevent such a collision.

In addition to the controls detailed in a) and b) above, the working agency will ensure that a flashing light is attached to an appropriate point to highlight the

scaffold to approaching crane drivers. This light must be effective for the duration that the scaffolding is erected.

If a scaffold is erected attached to the crane, Person-In-Charge of Cranes should ensure that a controlled pass of the full length of the bay is undertaken, to ensure clearance of the scaffold. If the scaffold could collide with a fixed building structure the crane should be prevented from travelling to that position. The Working agency should not be allowed to travel on this scaffold when the crane is moving. During the erection, removal, and whilst work is being undertaken on the platform a positive isolation system must be followed by the Person-In-Charge of Cranes.

3.4.12 Working of Mobile Cranes in the vicinity of EOT crane

Before using a mobile crane in any building or gantry traversed by an Overhead Crane, the person responsible for the work must obtain a work permit from the Person-In-Charge of Cranes.

Power rail must be isolated if any part of the crane, ropes or load are within 6m.

3.5 Unplanned Movement

Where an overhead crane could move due to wind force, track gradient, etc, effective measures must be taken to prevent any unplanned movement.

Consideration when working on hoist equipment must be made of the potential effects of gravity. e.g. blocks, fixed masts will lower if brake lifted. Wherever possible hoist equipment should be lowered to floor level and the drive chain/motion immobilised.

If it is necessary for a crane to temporarily enter a sick bay zone or inside the barrication, effective measures shall be taken by the Person in Charge of Cranes to ensure the safety of all men working within that zone.

3.6 Environmental conditions - Gas/Fumes/Dust/Heat/Molten Metal

- i. Cranes can be exposed to gas risks and air borne contamination. Conditions can deteriorate where it becomes unsafe to work and personnel should leave the area.
- ii. Access to the crane should be prevented if there is a possibility that the Environmental conditions may prevent safe egress from the crane. The working party must take Gas detector or Respiratory Protective Equipment (RPE) onto the crane if such risks are identified.
- iii. When working in High temperatures the supervisor must maintain an awareness of the workforce condition.
- iv. Single working on crane is not permitted, and if a person feels unwell he must leave the area immediately.

- v. Wherever possible, cranes must not be parked in the vicinity of poor atmospheric conditions for maintenance purposes, e.g. over furnaces, steam etc. Consideration should also be taken for hazards from weather conditions (wind, rain, etc). Risk assessments should identify the suitable precautions, which need to be undertaken.

References:

1. IS13473 (Part 1)
2. IS 13367 (Part 5)
3. IS 14473(Part 1)
4. Factory Act 1948,
5. Bihar Factories Rules, 1950
6. IPSS 1-11-015-12 “Safety guidelines for work on EOT cranes”
7. Tata Steel India Safety Standard: Safety standard for cranes, SS/ ELEC-10

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	ELECTRICAL SAFETY	Doc. No: SG/15 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

The objective is to provide a generic guideline for electrical safety practices to be observed in Iron & Steel Industries.

Associated Hazard: Electrical Shock, Electrical Flash, Electrical Burn, Fire, Slip/ Trip/ Fall, Hit/ Press/ /Cut hazard, Fall of Person or materials from height, etc.

2. Scope

This guideline is applicable to all locations of Iron and Steel Industries for generic electrical safety purpose.

3. Procedure

Electrical work can be performed safely if the rules are followed, right precautions are taken and one stays aware of the surroundings.

3.1 Definitions

Low Voltage: Where the voltage does not exceed 250 V under normal conditions.

Medium Voltage: Where voltage does not exceed 650 V under normal conditions.

High Voltage: Where voltage does not exceed 33 KV under normal conditions.

Extra High Voltage: Where the voltage exceeds 33 KV under normal conditions.

PPE: Personal Protective Equipment

ATPV: Arc Thermal Performance Value

FR: Flame Resistant

RCBO: Residual Current Breaker with Overload

DCP: Dry Chemical Powder

CPR: Cardio-Pulmonary Resuscitation

3.2 All Electrical Installations shall be installed and maintained in compliance with the Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulations.

3.2.1 Electrical Room Related Safety Measures

- i) The Electrical installations for Medium, High and Extra High voltage shall have a danger notice both in English or Hindi and local language of the district with a sign of skulls and bones.

- ii) Minimum PPE requirement, hazards & precautions to be taken, Unauthorized Access Prohibited signage, schematic layout of the Electrical Area with emergency equipment location etc. are to be displayed at the entrance of Electrical Room.
- iii) Electrical Shock Chart with instructions in English or Hindi and the local language of the district and where Hindi is the local language, in English and Hindi for the restoration of persons suffering from electric shock have to be affixed in a conspicuous place.
- iv) Single Line Diagram to be displayed inside Electrical rooms.
- v) The Emergency Action Plan with emergency contact numbers, employees' name who are trained on CPR & first aid to be displayed in electrical rooms.
- vi) First aid boxes, stretchers, Oxypack, Gas Masketc to be made available in electrical rooms or near vicinity.
- vii) The Electrical installations for high and extra high voltage shall have a running tap of drinking water and emergency safety shower with drinking water connection and proper drainage facility. In case of electric burns, the burnt portion should be cooled down using drinking water. In every manned high and extra high voltage sub section, an artificial respirator to be provided.
- viii) Good housekeeping to be maintained within the electrical room. The floor of Electrical Substation should be kept free from slip/ trip/ fall hazard like open cable riser, moving checker plate or floor board etc.
- ix) Along with the main exit door, Emergency Exit door is to be provided and should be in accessible safe condition in the 415 V and above electrical rooms.
- x) Emergency lights fed from alternate source like UPS, DG, Batteries etc. are to be made available near all the entrance, staircases and other strategic locations of electrical rooms and those emergency lights are to be easily identifiable. Fluorescent signages to be provided near the exits and strategic locations of Electrical Room.

3.2.2 PPEs to be used for Electrical Job

PPEs to be used as per electrical job requirement at different voltage level are given below:

Voltage level	PPEs to be used
Upto 650V Electrical jobs	Safety Shoes, Safety Helmet, Safety Goggles, 8.5 ~ 9 Calories /cm ² ATPV LV Arc flash suit, 12 Calories /cm ² ATPV Hand gloves, 12 Calories /cm ² ATPV Arc Face Shield
Above 650 V Electrical jobs	Safety Shoes, Safety Helmet, Safety Goggles, 40 Calories/ cm ² ATPV HT Kool coat (FR pant and FR shirt and Double layer switching coat, Hand gloves (Inner & Outer), Hard Hat is included in the HT Kool Coat Kit)

3.2.3 Electrical Equipment Related Safety Measures

- i. All the equipment used in the Electrical room shall be of sufficient current rating for its normal duty as well as during the fault current. The equipment shall be of sufficient mechanical strength to withstand the fault condition to ensure human safety.
- ii. Every switch board of Medium, High or Extra High voltage shall comply the following provisions:
 A clear space of not less than 1 meter in width shall be provided in front of the switch board. If there is any attachment at the back of the switchboard, the space shall be either less than 20 cm or more than 75 cm in width from the farthest outstanding part of the switchgear. If the space behind the switchboard exceeds 75 cm in width, there shall be passage-way from either end of the switchboard clear to height of 1.8 meters.
- iii. All disconnect switches are to be identified and labelled stating the source of the circuit and the equipment / circuit it is feeding.
- iv. Electrical equipment, machinery and work areas to be kept clean. Access to panels and junction boxes to be kept clear.
- v. Insulation mat of proper grade to be used in front of electrical switchgears of 415 V & above for the safety of operating personnel.
- vi. All panel doors must be locked, made vermin proof by sealing entry holes specially from cable entry points.
- vii. Bus coupler panel and its cubicle shall be handled with utmost care. Red painting of Bus coupler, Adaptor panel & Tie feeder panel from all sides (front, top and back) to be done for easy identification and Adaptor panel to be treated as a part of Bus coupler.
- viii. Incoming barrier of power supply and phase barrier inside the switchgear panel to be ensured.
- ix. There should not be any loose wirings, exposed joints, distribution box or junction box in cover open condition in the workplace.
- x. No High Voltage and Extra High Voltage system/ switchgear which has been kept disconnected for period of six months or more for any maintenance job shall be energized without Testing.
- xi. All apparatus, cables and supply lines shall be maintained in healthy conditions and tests shall be carried out periodically as per relevant code of practice of the Bureau of Indian Standards.
- xii. Records of all Tests, Repairs and Maintenance work of all the equipment in the Electrical Room shall be duly kept in the history registers /SAP PM system so that these records can be compared with earlier ones.
- xiii. Over Current Protection to be provided to disconnect the supply automatically if the rated current of the equipment, cable or supply line is exceeded for a time which the equipment, cable or supply line is not designed to withstand.

- xiv. Earth fault or Earth leakage protection to disconnect the supply automatically if the earth fault current exceeds the limit of current for keeping the contact potential within the reasonable value.
- xv. Gas pressure type (Buchholz relay), winding and oil temperature protection with provision of alarm and tripping shall be provided on all oil type transformers of rating 1,000 KVA and above.
- xvi. Transformers of capacity 10 MVA and above shall be protected against incipient faults by differential protection.
- xvii. Where a sub-station or a switching station with apparatus having more than 2,000 litres of oil is installed, whether indoors or outdoors, following precautions to be taken:
 - a) The baffle walls of four hours - fire rating shall be provided between the apparatus-
 - where there is a single phase transformer banks in the switch-yards of generating stations and sub-stations;
 - on the consumer premises;
 - where adequate clearance between the units is not available.
 - b) provision shall be made for suitable oil soak pit. Where use of more than 9,000 litres of oil in any one oil tank, receptacle or chambers involved, provision shall be made for the draining away or removal of any leaked/ escaped oil and special precautions shall be taken to prevent the spread of any fire resulting from the ignition of the oil from any cause and adequate provision shall be made for extinguishing any fire which may occur.
 - c) Spare oil shall not be stored in the vicinity of any oil filled equipment in any such substation or switching station.
 - d) All the transformers and switchgears shall be maintained in accordance with the maintenance schedules prepared in accordance with the relevant codes of practice of Bureau of Indian Standards.
 - e) The transformers of 10 MVA and above rating or in case of oil filled transformers with oil capacity of more than 2,000 litres are to be provided with fire fighting system as per IS – 3034 or with Nitrogen Injection Fire Protection system.
- xviii. Dry type of transformers only shall be used for installations inside the residential arid commercial buildings.
- xix. All the generators with rating of 100 KVA and above shall be protected against earth fault leakage.
- xx. All the generators of rating 1,000 KVA and above shall be protected against faults within the generator winding using restricted earth fault protection or differential protection or both.
- xxi. Following safety interlocks are essential for the safe operation of the switchgears:

- a) Isolators and controlling circuit breaker shall be interlocked so that isolators cannot be operated unless the corresponding breaker is in open position.
- b) Isolator and corresponding earthing switches shall be interlocked so that no earthing switch can be closed until the corresponding isolator is in open condition.
- c) Where two or more supplies are not intended to be operated in parallel, the respective circuit breakers or linked switches controlling the supplies shall be interlocked (electrically and mechanically to extent possible) to prevent possibility of any inadvertent paralleling or back feed.
- d) When two or more transformers are operated in parallel, the system shall be so arranged as to trip the secondary breaker of transformer in case the primary breaker of that transformer trips.
- e) Where two or more generators are operated in parallel and neutral switching is adopted, interlock shall be provided to ensure that generator breaker cannot be closed unless one of the neutrals is connected to the earthing system.

3.2.4 Safety measures to be adopted by persons working on Electrical equipment

- i. Only authorized /qualified personnel to be allowed to work on electrical job. Relevant certification to be obtained from Electrical Inspectorate as applicable.
- ii. No one should wear loose clothing, metal watch straps, bangles or finger rings while working on electrical appliances.
- iii. Any electrical appliance or machinery never to be used by user while in wet condition.
- iv. The tools & tackles like screw drivers, pliers, cleaning brushes, Hand lamps, torches etc. should be properly insulated.
- v. Cords or tools with worn insulation or exposed wires should not be used.
- vi. Only double-sided steps or stable ladders of FRP (dual support) to be used for maintenance of panels and Bus-bar.
- vii. Before any maintenance job is carried out on or near the live parts, the power source should be proved dead. All voltage indicators should always be tested on a known "Live" source immediately before and after use.
- viii. No person should carry out work including maintenance, repairs, cleaning and testing etc. on any parts of apparatus which are normally live unless such parts are proved to be dead and Permit is taken in appropriate Work Permit form & Lock Out Tag Out done.
- ix. Before touching any equipment, which has been energized and after taking precautions regarding switching off supplies, the equipment shall be earthed.
 - a) Many makes of the switchgear have special arrangements fitted to the switchgear so that bus-bars or feeders may be earthed through the

- circuit breaker. This is the safest method and should always be used if the equipment is available.
- b) If the above equipment is not available, earthing should be carried out using a covered flexible earthing lead which has been first clamped to earth bar and then touched on the parts to be earthed by a suitably insulating rod. The earthing lead shall have the cross-section area commensurate with the short circuit rating of the switchgear.
 - x. During inspection or maintenance of mechanism of Circuit breaker, care should be taken to avoid fingers being trapped in any part of the mechanism and avoid the possibility of anyone being struck by moving parts of the mechanism or the moving contacts. It is recommended to discharge the stored energy in the mechanism like release of the spring etc.
 - xi. Test should be made for the correct operation and calibration of protective devices periodically and particularly after faults. It is essential that the settings should be restored to the correct values after the test.
 - xii. In no circumstances should attempts be made to rewire a non re-wireable fuse.
 - xiii. Before charging of an electrical equipment after maintenance, its insulation resistance shall be checked and IR values shall be ensured as per relevant Indian Standard.

3.2.5 Electrical Earthing Requirement

- i. System Earthing: Neutral conductor of a 3-phase, 4-wire system and the middle conductor of a 2-phase, 3-wire system, one point of single phase supply or artificial neutral point created by having earthing transformer in 3-phase 3-wire system shall be earthed by not less than two separate and distinct connections with a minimum of two different earth electrodes or such large number as may be necessary to bring the earth resistance to a satisfactory value both at the generating station and at the sub-station. The earth electrodes so provided, shall be interconnected to reduce earth resistance.
- ii. Equipment Earthing: The frame of every generator, stationary motor, portable motor, and the metallic parts (not intended as conductors) of all transformers and any other apparatus used for regulating or controlling energy and energy consuming apparatus shall be earthed by two separate and distinct connections with earth.
- iii. All earthing systems shall be tested for resistance with the help of an "Earth Tester" on a dry day during the dry season, not less than once a year for high and extra high voltages (>650 Volts) and not less than once every two years for low, medium voltages($<=650$ Volts). The combined value of resistance to earth should not exceed 1 Ohm for all voltages.
- iv. The earth pit identification number, latest earth resistance, date of testing and due date of testing shall be displayed on every earth pit name plate.
- v. Earth pits to be properly maintained and chemical treatment of soil to be done as per requirement to keep the earth resistance to a satisfactory value.

- vi. Earth pits should be properly covered to avoid damage from man/ material/ vehicular movement. Earth Pits to be properly barricaded as and where applicable.
- vii. No material shall be allowed to be stacked/ dumped/ accumulate and debris shall not be deposited near/ within the earthing station area.
- viii. Protection against lightning shall be provided in accordance with specific guidelines given in IS: 2309 (Code of practice for the protection buildings and allied structure against Lightning).

3.2.6 Safety Measures in Temporary Electrical Wiring

- i. Temporary electrical wiring is permitted only during the period of construction, remodeling, maintenance, repair, demolition and similar activities. It shall be removed immediately upon completion of the purpose for which the wiring was installed.
- ii. The temporary electrical wiring shall be installed in such a manner that it is not subjected to physical damage. The sharp corners and projections should be avoided while laying the cable. The wiring shall be adequately protected while passing through the door ways or other pinch points.
- iii. The metallic case of temporary lighting & Lighting Distribution Boards (DBs) to be separately earthed.
- iv. Precaution to be taken so that temporary electrical cable laying at worksite should not interfere with normal Human and Equipment & machineries movement creating hazards like electrocution, electrical fire, Slip/ Trip/ Fall etc.
- v. All hand-held tools (e.g. hand held drill machine, hand held grinder etc) shall be protected through 30 mA earth fault protection (RCBO etc.) with 200 milli Seconds fault clearance time and Over-current setting as per Equipment requirement.
- vi. All Portable equipment/ tools which are not hand held (like submersible pumps, dewatering pump, 415 V & 240 V welding set etc.) shall be protected through 100 mA earth fault protection (RCBO etc) with 100 milli Seconds fault clearance time and Over-current setting as per Equipment requirement.
- vii. Periodic checking of RCBO to be conducted by trip test.
- viii. Earth leakage protection is not compulsory for double insulated tools.
- ix. Air Conditioning Ventilation System (ACVS) duct over the switchgear panels to be avoided.
- x. In case of centralized Air conditioning system, the Air Handling Unit (AHU) to be interlocked with Fire Detection & Alarm (FDA) control panel in such a way (through programming of controller, etc.) that AHU shall be stopped if fire / smoke is detected by three consecutive sensors to cut the air supply and reduce spreading of fire (operation of three consecutive sensors have been considered to avoid false tripping of AHU as there is possibility of mal-operation of sensor due to dust etc.).

3.2.7 Electrical Fire Safety

- i. Any combustible materials like grease, paint etc. should not be present in close proximity with live electrical equipment.
- ii. Fire buckets with clean dry sand and ready for immediate use for extinguishing fires in addition to fire extinguishers suitable for dealing with electrical fires (CO₂ or DCP), shall be conspicuously marked and kept in all generating stations, enclosed substations and switching stations in convenient location. Fire extinguishers shall be tested for satisfactory operations as per defined frequency and record of such tests shall be maintained.
- iii. Fire alarms to be provided in all Electrical rooms, man approachable cable vaults, cable tunnels, analyser rooms, PRS rooms and its hooter are sounded at a 24x7 manned area like control room, shift office etc. and checked at regular intervals.
- iv. Fire Retardant painting to be provided on Electrical cables to stop propagation of fire.
- v. Training to be provided on Fire Safety & CPR to electrical personnel.
- vi. Regular mock drill to be conducted for total power failure, electrocution, electrical fire etc. as per the electrical area's emergency preparedness plan and record to be maintained.

3.2.8 Rescue & First Aid Measures for Electrical shock

- i. The victim usually gets stuck to the source of the electricity, and it is important that the victim should be first separated from the electrical source.
- ii. The main power supply switch to be adequately turned off.
- iii. In certain circumstances, it may be quicker to simply pull the victim away from the electrical source.
- iv. The victim should not be touched with bare hands, or the electric current will pass through the rescuer as well. Some dry, nonconductive material such as a wood, insulated rod etc. to be used to separate the victim from the live current whatever is handy.
- v. Once the victim has been separated, it is to be checked to see if he is breathing.
- vi. If breathing has stopped or seems slow, CPR (Cardio-Pulmonary Resuscitation) to be administered immediately by a trained person.
- vii. The victim should be moved as little as possible because the person may have suffered injuries to spine and neck.
- viii. If the victim has an electric burn, the clothing from the burned area to be removed gently (unless it's stuck to the skin) and the burned area to be rinsed in cool, running drinking water.
- ix. Emergency medical attention to be called as soon as possible.

References

1. Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulations, 2010 with up to date amendments.
2. Tata Steel India Safety Standard: Working in Electrical Room (SS/ELEC-08), Electric Flash Suit (SFT/PRO-04), Inspection Testing and Maintenance of Earthing system (SS/ELEC-03), Temporary Electrical Wiring (SS/ELEC-01).

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	FIRE SAFETY	Doc. No: SG/16 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

To provide a guideline for Fire safety practices to be observed in Iron & Steel Industries.

Associated Hazards: Fire, Smoke, Heat, Flame and Explosion.

2. Scope

This guideline is applicable to Iron and Steel Industries.

3.0 Procedure

3.1 Definitions

Fire: Fire is a chemical exothermic reaction in which energy is released in the form of heat and light.

There are four classes of fire depending on the material under ignition. These can be listed as:

1. **Class A fire:** Fire in solid materials.
2. **Class B fire:** Fire in inflammable liquids.
3. **Class C fire:** Fire in gaseous and electrical installation.
4. **Class D fire:** Fire in metals.

Fire Triangle: Presence of ignition source, material and oxygen called as Fire Triangle, Fire can be extinguished by removing any one.

3.2 Fire Safety arrangement falls into two categories i.e. Fire Prevention and Fire Mitigation.

Fire Prevention

- i. Fire Prevention should be included in Design phase.
- ii. Fire risk Assessment of the site and Preventive control measures to address the hazard and its elimination.
- iii. Fire Incident investigation.

Fire Mitigation

- i. Mitigation can be ensured through installation, maintenance and testing of Fire Fighting System & equipment.
- ii. Evacuation of the building through emergency escape.

3.3 Fire Prevention

- i. Combustible materials should be avoided in the construction or fabrication of new building.

- ii. For all premises, fire risk assessment to be done and areas to be classified as per fire risk potential.
- iii. Flammable liquids, gases and oxidizing agent must be stored and controlled as per their Material Safety Data Sheet.
- iv. Smoking and use of mobile phone shall be strictly prohibited in and around the premises of flammable or combustible material storage area, ignition source, heating surface, cylinder storage area, gas prone area and near cutting/ welding job.
- v. Storage area should have proper ventilation to avoid vapour accumulation and it should be away from potential source of ignition.
- vi. Flammable material should not be stored near exits, electrical equipment or heating Equipment.

3.3.1 Fire Prevention measures during Cutting and Welding

- i. If gas cutting and welding is required on materials which is movable e.g. if two pipes are to be joined or require cutting, then materials should be moved to designated safe location which must be free from combustible materials such as grease, ideally for an area representing an 11 m radius from the point of work.
- ii. If the floor is combustible where the welding is done, then the floor shall be kept wet or covered with damp sand to prevent the risk associated with the activity.
- iii. If work is done near walls, where openings and cracks in walls are visible and can allow a big spark can pass through, then it shall be sealed to prevent the sparks from going to the adjacent areas.
- iv. Hot welding shall not be attempted on metal partitions, walls, ceilings or roofs having a combustible covering, nor on walls or partitions of combustible sandwich-type panel construction.
- v. Positive means shall be taken to confine heat, sparks and slag to the welding/ cutting activity working area.
- vi. Welding or Cutting not to be done in the presence of flammable/ combustible materials.
- vii. Appropriate fire extinguishing equipment shall be immediately available at job place. If normal fire prevention measures are not sufficient enough, additional trained personnel shall be assigned to guard against fire. At least one ABC 4 kg/ 5 kg or Dry Chemical Powder (DCP) fire extinguisher, two dry sand filled buckets, two water filled buckets shall be kept at work place.
- viii. Before welding/ cutting, ensure containers are cleaned thoroughly with water.
- ix. Welding in centrally air conditioned premise to be avoided. If it is essential to do welding in area catered by centrally air conditioning system, then AC system shall be closed during welding.

(Also refer SG-07: Safety Guidelines for Gas cutting & Gas Welding)

3.3.2 For Cutting/ Welding job on or near Gas Lines

- i. Work permit clearance - authorized personal should take permission from the authority before working on or near gas line area.
- ii. Local Fire fighting arrangement with fire extinguishers, sand, water and fire hoses shall be kept ready before starting welding / cutting job on gas lines.
- iii. Person should be trained on the use of Fire extinguishers and hydrant.
- iv. Safety net to be installed below the working zone if the area of operation is in height for easy escape.
- v. Portable CO Gas Detector to be provided to the working personnel.

3.3.3 Fire Prevention Measures at Cylinder Storage Area

- i. All gas cylinders shall be stored in a designated shed having roof top to protect from direct sunlight. Do not expose gas cylinders to temperatures above 45 °C. Overheating of cylinders can result in build up of pressure and explosion.
- ii. The shed shall be barricaded and proper nomenclature should be displayed.
- iii. Do not store gas cylinders with other combustible materials. Flammable substances, such as oil and other solvents, must not be stored in the same area.
- iv. The storage area must be well ventilated to prevent accumulation of gas in case of leakage.
- v. Flammables and oxidizers must be stored separately in the storage area. The cylinders must be separated by a distance of 6 meters or must be separated by a fire resistant wall of 30 minutes fire resistance.
- vi. LPG cylinders must not be stored within 3 m of any compressed gas cylinders (including acetylene).
- vii. Within the storage area, Oxygen should be stored at least 3m from fuel gases cylinders. The use of a fire wall may provide the required separation. If volume is greater than 200 m³, a separation distance of 5 m needs to be executed. Note: Wall must be a minimum of one metre higher than the tallest cylinder.
- viii. Compressed gas cylinders are to be secured with clamping or chain/manila rope or by use of a cylinder stand to ensure they do not fall from their vertical storage position.
- ix. Keep cylinders away from any source of heat and ignition.
- x. Gas cylinders must be stored in a manner that permits quick removal in case of an emergency. Do not store materials over or around the cylinders.
- xi. All fittings shall be of the flame-proof type and wiring shall be in robust conduit to protect it from damage.

(Also refer SG-01: Safety guideline on Storage, Handling & use of Gas Cylinders)

3.3.4 Housekeeping guidelines for fire prevention at work place

- i. Accumulation of waste combustible materials such as paper and wood should be checked at the workplace and collected in designated containers.
- ii. Combustible materials in trash containers should be covered and emptied on regularly intervals.
- iii. Leakage or spillage of flammable materials like oil, grease & flammable liquid near ignition sources/ heat surfaces shall be arrested promptly.
- iv. Maintain free access to all Electrical Control points.
- v. Chemicals should be stored safely and have proper labels. Material Safety Data Sheet (MSDS) should be provided at the site.

3.3.5 Fire Prevention Measures for Diesel Storage Tank

- i. Warning signages and MSDS shall be displayed.
- ii. Tank level indicator and capacity of tank should be mentioned.
- iii. Fire Hydrants should have adequate pressure and should be accessible.
- iv. Spill control measures should be in place.
- v. Standard Operating Procedure (SOP) for loading and unloading of oil and emergency preparedness should be in place.
- vi. Combustible and flammable materials should not be stored at nearby tank area.
- vii. Electrical fittings should be flame-proof.
- viii. Ensure proper earthing and bonding.

3.3.6 Fire Prevention Measures for Propane Installation

- i. Warning sign should be displayed.
- ii. Provision to be made to ensure to discharge Static Electricity.
- iii. All Electrical fittings should be flame proof.
- iv. Ensure proper earthing and bonding.
- v. Fire hydrant & Water Spray system installed should be pressurized all the time.
- vi. Do not use mobile inside the plant.
- vii. Unloading of bulk Propane transported through bulk tank trucks shall be carried out under the supervision of a responsible person.
- viii. The tank truck shall have suitable spark arrestor of make and design approved by PESO (Petroleum & Explosive Safety Organisation), Nagpur properly fixed to exhaust.

- ix. Lever indicating close and open status for Quick closing of manifold valve shall be present on the tank truck.
- x. All electrical boxes of the tank truck shall be properly sealed.
- xi. The electrical wiring of the tank truck shall be insulated and provided with suitable over-current protection.
- xii. The cabin of the tank truck shall have a readily accessible master switch for switching-off the engine.
- xiii. No hot/ cold work shall be carried out in the vicinity of unloading operation.
- xiv. Checks shall be carried out for each Tank Truck prior to unloading of Propane.
- xv. Excess flow check valves of the tank shall be functioning.
- xvi. Operator should check the connection for tightness.
- xvii. Check from Roto Gauge that the level of liquid does not exceed more than 90% in the storage tank by level.
- xviii. After making sure that all the valves are closed for liquid and vapour, slowly remove the hose pipe. The liquid hose may have little liquid left in it which will be vented through venting system.
- xix. After removing the hoses, mobile tanker should not be started for at least 10 minutes.

3.3.7 Fire Risk/ Prevention at Overhead Electrified Engine (OHE) on Load Corridor

- i. Provision of Fire extinguisher on Loco Engine to be made to prevent fire from engine, fire on diesel storage tank & on tarpaulin used during rainy season etc.
- ii. Remove all dry leaf/ tree branches etc. near OHE area.
- iii. Never spray water near overhead power lines. Spray water after getting the power clearance from department.
- iv. Do not keep any combustible and flammable materials on loco.
- v. Never climb power poles or transmission towers without valid permit.
- vi. Never climb trees near power lines & overhead line.
- vii. Ensure proper earthing and bonding.
- viii. Never drive over a cable lying on ground or under a low-hanging line.
- ix. Stay away from power cable lying on ground. Maintain a safe distance from the Danger.

3.3.8 Fire Prevention in Heavy Earth Moving Machineries (HEMM)

- i. Oil- bearing hosepipes should be housed separately and away from the hot parts of the engine like turbocharger, exhaust and manifold.
- ii. OEM of HEMM should provide suitable type of fire detection and suppression system with periodical testing procedure and maintenance

schedule. Maintenance of such fire detection and suppression system should be carried out by the experts / trained personnel.

- iii. All high pressure hydraulic hose fitted in the engine room must conform to the specification as laid down by the OEM and their quality to be ensured. The hoses shall be replaced at the prescribed interval or earlier if there is any sign of deterioration.

3.3.9 Fire Prevention in Coal Chemical Handling

- i. Coal chemicals should be stored in an area reserved for highly flammable liquids.
- ii. Storage tanks should be situated in the open air and their vent pipes should be fitted with flame arresters.
- iii. Tanks should be discharged by means of a pump.
- iv. All metal parts of the tank installation should be earthed and earthing terminals should be provided for attaching to tankers during transfer operations.
- v. Tanks should be situated well clear of process plant and buildings, any fixed source of ignition and boundary fences.
- vi. Naked flames, hot elements and all other ignition sources should be eliminated; smoking should be prohibited; reduced-sparking tools should preferably be used.
- vii. The air in the storage and working areas should be regularly sampled with a gas detector in order to check for leaks. In the event of a serious leak, the areas should be evacuated immediately.
- viii. Electrical equipment for use in atmospheres which may contain flammable concentrations of chemical vapor should be intrinsically safe.
- ix. Metal parts of process and handling machines should be electrically bonded together and earthed to prevent the accumulation of static electricity.
- x. Mechanical seal shall be provided for product pumps used for pumping of highly inflammable materials.

3.3.10 Fire Prevention in Sulphur Handling

- i. Sulphur storage area shall be segregated and sulphur should be stored in a cool well-ventilated space.
- ii. Sulphur should not be stored along with chlorates, nitrates, other oxidizing materials, mineral acids or metal powders.
- iii. Sulphur powder should be handled in such a way as to avoid formation of dust clouds.
- iv. Explosive proof light fittings should be used.
- v. Smoking and the use of naked flames should be prohibited in places where sulphur dust may be present.

3.3.11 Fire Prevention in Sulphuric Acid Handling

- i. Storage tanks should be in the open. They should be protected from external corrosion by coating them with a suitable material such as bitumen.
- ii. Storage tanks should be provided with:
 - a) A bund capable of retaining the acid in the event of leakage.
 - b) A liquid indicator. A glass float indicator or a remote-reading pneumatically operated gauge is recommended.
- iii. Sulphuric acid should not be stored with chemicals with which it reacts, or with flammable liquids, gas cylinders, or readily combustible solids.
- iv. The vessels should be protected from the direct rays of the sun.
- v. All storage vessels and storage areas should be clearly marked.
- vi. When there is a danger of hydrogen formation from the acid reacting with metal in processing or in storage:
 - a) Rooms should be well-ventilated.
 - b) Naked flames, hot elements and all other ignition sources should be eliminated.
 - c) Smoking should be prohibited.

3.3.12 Fire Prevention in Coal Yards

- i. Coal to be stacked up to a maximum height of 15 m.
- ii. Stacking to be done in trapezoidal stock pile.
- iii. Temperature monitoring of the pile to be done.
- iv. Hot spots above 70°C shall be removed.
- v. Coal piles shall be segregated from other area.
- vi. Coal screening, crushing and other operation shall be done in well ventilated area.
- vii. Storage shall be limited for short duration.
- viii. Housekeeping shall be of high standard.
- ix. Smoking shall be prohibited.

3.3.13 Fire Prevention in Coal/ Hot Coke/ Hot Sinter handling Conveyors

- i. The belt conveyors installed for handling coal, sinter and other raw materials shall be of enclosed type.
- ii. Accumulated heat, dust and muck shall be cleaned regularly and worn out parts shall be immediately replaced.
- iii. The major fire hazard is from the ignition of coal dust and from deposits built-up on the internal surfaces, walkways etc. of the conveyor's junction towers, often ignited by maintenance activities.

- iv. Care must be taken to ensure that hot coal which may have heated up spontaneously while in storage, is not loaded on the belt. The belt must also not be overloaded.
- v. Water spray system may be installed for coal coke and sinter conveyor fire prevention. It is a special fixed pipe water based fire protection system connected to reliable source of water supply and equipped with open type water spray nozzles for specific volumes of water discharge and distribution at surface or area to be protected. Piping system is connected to the water supply through an automatically or manually actuated Deluge Valve, which initiates flow of water through spray nozzles. The actuation of the deluge valve is achieved by operation of automatic detection equipment such as Quartzoid bulb detection systems, electrical linear heat sensing systems.

3.3.14 Fire Prevention in Conveyor Galleries

- i. Accumulated heat, dust and muck shall be cleaned regularly and worn out parts shall be immediately replaced.
- ii. There is also a significant fire hazard associated with the conveyor drive unit due to a combination of brake faults, failure of fluid couplings and overfilling of the drive gearboxes as well as that due to an overheated motor which has become inadequately cooled in service due to the build-up of coal / raw material dust.
- iii. The primary causes of conveyor fires fall into following main areas:
 - a) Maintenance activities involving the use of electric or gas welding, gas cutting equipment, or similar activities.
 - b) Failure of part of the conveyor system (usually an idler or a pulley) can lead to localized overheating and eventually, to the ignition of the coal dust, conveyor belting or lubricating oil and greases associated with the plant.
 - c) Rubbing of a belt (running out of center) with steel work resulting in localized overheating and eventually belt catching fire when stopped.
 - d) From the ignition of a quantity of spilt coal dust, either by self ignition or other causes.
 - e) Also ignition of the conveyor belt while transporting hot sinter / hot coke without undergoing proper quenching.
- iv. Care must be taken to ensure that hot coal, which may have heated up spontaneously while in storage, is not loaded on the belt. The belt must also not be overloaded.
- v. Regular maintenance of the conveyor shall be undertaken to ensure freedom from friction due to the spillage of belt over the drive or idle roller and/ or its becoming misaligned or slipping off the roller and becoming jammed.

3.3.15 Fire prevention in handling of Molten Metal and Slag

- i. Ladle shall not be overfilled.

- ii. Alignment of rails used for transportation of hot metal shall be uniform.
- iii. Rail cars carrying hot slag and hot metal shall be in good condition.
- iv. Refractory of the ladle shall be in good condition.
- v. Ladle & thimble shall be heated before pouring of hot metal.
- vi. Dumping of molten slag shall be avoided over accumulated water.
- vii. Care shall be taken to avoid metal reaction in twin hearth furnace
- viii. Standard Operating Procedure (SOP) shall be strictly followed during handling of hot metals.

3.3.16 Fire Prevention in Transformer Substations

- i. Every oil filled apparatus such as transformer, static condenser, switchgear or oil circuit breaker having an individual or aggregate oil capacity of 200 liters or more shall be housed in a locked, weather and fire resistance building.
- ii. A minimum clearance of 750 mm shall be provided between the transformer and other apparatus and enclosing or separating walls.
- iii. Substations and switchgear rooms shall only be used to house the intended equipment. Storage of any kind or any repair work shall not be permitted therein.
- iv. Cable trenches inside substations shall be filled with sand, pebbles or similar non-flammable materials or covered with incombustible slabs. If a number of cables are taken in the trench, it is desirable that cables are taken on racks.
- v. All control gears shall be protected against rodents, reptiles and insects.
- vi. All transformers shall be equipped with Over-current relay protection.
- vii. Gas pressure type (Buchholz relay), winding and oil temperature protection to give alarm and tripping shall be provided on all oil type transformers of rating 1,000 KVA and above.
- viii. Where a sub-station or a switching station with apparatus having more than 2,000 litres of oil is installed, whether indoors or outdoors, following precautions to be taken:
 - a) the baffle walls of four hours- fire rating shall be provided between the apparatus-
 - where there is a single phase transformer banks in the switch-yards of generating stations and sub-stations;
 - on the consumer premises;
 - where adequate clearance between the units is not available.
 - b) provision shall be made for suitable oil soak pit. Where use of more than 9,000 litres of oil in any one oil tank, receptacle or chambers involved, provision shall be made for the draining away or removal of any leaked/ escaped oil and special precautions shall be taken to prevent the spread of any fire resulting from the ignition of the oil from

- any cause and adequate provision shall be made for extinguishing any fire which may occur.
- c) Spare oil shall not be stored in the vicinity of any oil filled equipment in any such substation or switching station.
 - d) All the transformers and switchgears shall be maintained in accordance with the maintenance schedules prepared in accordance with the relevant codes of practice of Bureau of Indian Standards.
 - e) The transformers of 10 MVA and above rating or in case of oil filled transformers with oil capacity of more than 2,000 litres are to be provided with fire fighting system as per IS – 3034 or with Nitrogen Injection Fire Protection system.
 - ix. The bushings, insulators and contacts of tap changing gears shall be kept scrupulously clean at all times.
 - x. The level and dielectric strength of the transformer oil shall be checked at periodic intervals.

3.3.17 Fire Prevention in Cable Tunnels, Cable Cellar, Cable Spreader, Cable Vault, Cable Galleries and other Cable Premises :

Electrical cables are usually insulated with polyvinylchloride, which contributes to the rapid spread of fire. The insulation also give-off highly toxic products of combustion including corrosive gases, when it is exposed to intense heat or is involved in fire. Fire in cable runs can spread as fast as 20 m/min.

The critical areas are as under:

- Immediately after end termination or joints up to a length of not less than 1 m in either direction.
- Crossing or T-crossings or joints up to a length of not less than 1 m in either direction.
- Cable passing through high temperature area/ high vulnerable area.

Precautions to be taken are:

- i. Ensure HT & LT cable in different racks.
- ii. Ensure Temperature monitoring of cables.
- iii. Ensure Good forced ventilation.
- iv. Compartmentation of cable tunnels to be done.
- v. Sealing of entry and exit points of cables to be done.
- vi. Use of good quality cable joints to be done.
- vii. For cables above 230 Volts, fire resistant coating should be applied just below the end termination up to a length of one meter inside the panel (if space available), just below the panel entry up to a length of one meter, joints up to a length of one meter in both directions and on entire exposed vertical length like connecting different floors etc. Motor terminal box are excluded, but Transformer terminal box included. For cable of voltage 33

- kV and above, cable entry to the panel should also be protected with Fire Stop along with fire resistant coating as above.
- viii. For all cables, fire protective paint should be applied on entire length if passing through Fire Prone Area.
 - ix. Cable above 230 Volts in cable tunnels/ cable trays should be painted up to a length of one meter at an interval of every 30 meter. Cable entry into the vault should be protected with fire barrier/ fire stop. If cable below and up to 230 volt (like FO, Control, Instrument, telephone, Power cable etc.) is also passing along the same route within the vicinity of 2 meter from cable >230 Volt should also be treated as above.
 - x. The wet film thickness of fire resistant coating should be such that after drying 1.6 mm is achieved (Dry film thickness) uniformly on all exposed sides and also there should not be variation in coating across length than specified.
 - xi. Cables above 230 volts in cable tunnel / cable vaults/ cable trestle should be protected by automatic fire alarm system.
 - xii. LHS (Linear Heat Sensing cable) may be used as a fire detection system for cable tunnel /cable vault / cable trestle. However, additional fire detection measure as smoke cum heat detectors, flame detector shall also be provided, wherever necessary.
 - xiii. Fire rated doors shall be installed inside cable premises and at each entry / exit in to the cable premises.

3.3.18 Fire Prevention in Oil Cellars

- i. Stop valves should be provided at strategic positions to cut-off a dangerous leak of oil.
- ii. Self extinguishing grades of oil should be used to minimize fire risk.
- iii. Use of flexible piping should be avoided.
- iv. Pumps working in oil cellars should be periodically checked for faulty bearings and inadequate lubrication.
- v. Either electric or gas welding should not be permitted in the oil cellars.
- vi. Leaks from joints and glands should be attended without delay.
- vii. Spillage of any lubricants, fuel oil, should be cleared by spraying sand and cleaning the surface.
- viii. Spark proof lighting should be provided. Loose wiring or temporary wire connections should not be permitted.
- ix. Wooden doors or windows and partitions should not be allowed.
- x. Waste cotton should be disposed in the bins filled with water so that the cotton will be wet and therefore will not catch fire.
- xi. Smoking should be strictly prohibited. "No Smoking" sign should be displayed at appropriate locations.
- xii. The cellars should not be used as store.

- xiii. Unauthorized persons should not be permitted to enter in cellars.
- xiv. The entry and exit to the oil cellars should not be the same and they should be provided in opposite directions and free from any obstruction.
- xv. Multiple criteria type smoke cum heat detector, temperature detectors and flame detectors may be provided for fire detection and alarm system inside oil premises.
- xvi. The Oil cellars, oil premises may be provided with Fixed Piping Type High Expansion Foam Flooding System to extinguish fire as per applicability.

3.3.19 Fire Prevention in Cryogenic Liquids

- i. Outside storage shall be protected against the extremes of weather.
- ii. Cryogenic tanks shall be equipped with pressure-relief devices to control internal pressure.
- iii. Do not plug, remove, or tamper with any pressure-relief device.
- iv. Oxygen must be separated from flammables and combustibles by 20 feet or a half-hour fire wall.
- v. Use only oxygen compatible lubricants.
- vi. Boiling and splashing always occur when charging or filling a warm container with cryogenic liquid or when inserting objects into these liquids. Perform these tasks slowly to minimize boiling and splashing.
- vii. Never touch un-insulated pipes or vessels containing cryogenic liquids.
- viii. Use wooden or rubber tongs to remove small items from cryogenic liquid baths.
- ix. Cylinders should not be filled to more than 80% of capacity since expansion of gases during warming may cause excessive pressure buildup.
- x. Liquid oxygen shall not enter the oxygen gas pipe line.

3.3.20 Fire Prevention in Gantry Cranes

- i. The control circuit voltage shall not exceed 600 volts for AC or DC.
- ii. Electrical equipment shall be so located or enclosed that live parts will not be exposed to accidental contact under normal operating conditions.
- iii. Electric equipment shall be protected from dirt, grease, oil, and moisture.
- iv. Oil cans, oil soaked jute, extra fuses, and other articles shall not be permitted to store in cranes.
- v. Over filling of oil in reducers shall be avoided.
- vi. Leakages from reducer shall be arrested.
- vii. Housekeeping in cranes shall be of high standard.
- viii. 4.0 kg Dry Chemical (BC Type) Powder Portable Fire Extinguishers as per IS: 15683 shall be provided in Operator's cabin of Gantry Crane.

3.4 Fire Mitigation

- i. Effective means for detecting an outbreak of Fire and warning people must be established.
- ii. Suitable and Sufficient firefighting and escape equipment and devices should be determined through Fire Risk Assessment.
- iii. Audit and Fire Risk assessment records should be maintained for the minimum period of 3 years.
- iv. Each unit should do internal fire risk assessment audit in an interval of at least three years.
- v. Fire risk assessment should be done by a competent person who understands the principal of fire safety.
- vi. Fire fighting equipment and evacuation route should be easily accessible and free from obstruction.
- vii. Adequate Provision must be made for the evacuation of disabled persons.
- viii. Where it is necessary to disable fire Protection & detection system, fire department should be intimated and clearance should be taken from the fire department.
- ix. All regular employees shall be educated regarding use of fire extinguishers and available fire fighting arrangements in and around working area.

3.4.1 Fire Extinguishers

There exist different kinds of fire extinguishers for extinguishing different classes. These can be listed as:

- i. **ABC Pressurized type Fire Extinguishers:** This type of fire extinguisher is applicable for Class A, B & C type of fire. When extinguisher is squeezed, powder is ejected from the extinguisher.
- ii. **Foam type Extinguishers:** Gas/ air bubbles are trapped by a foam binding solution in water. These extinguishers are used for fire of Class A & B.
- iii. **Dry chemical Powder (DCP) Extinguishers:** Sodium based chemical powders are usually used in these kinds of extinguishers. Fire belonging to Class B & C can be extinguished using these extinguishers.
- iv. **CO₂ Fire Extinguishers:** A cylinder is filled with CO₂ gas under pressure which when released displaces the air supporting and surrounding the combustion. These extinguishers are applicable for Class B & C Fire.
- v. **Clean Agent:** In this type of fire extinguisher, liquid is stored under pressure that turns to gas on discharge to air. Clean Agent is effective on Class B and C fires typically petrol, oil, etc.

Application of Fire Extinguishers

Class of Fire	Type of Extinguishers
A. Fires in ordinary combustibles (wood,	Gas expelled water type and stored pressure type extinguishers and water buckets

Class of Fire	Type of Extinguishers
vegetable fibres rubber, plastics paper and like)	
B. Fires in flammable liquids, paints, grease, solvents and the like.	Foam type fire extinguisher, Carbon Dioxide, dry powder type & Clean Agent.
C. Fires in gaseous substances under pressure including liquefied gases and live Electrical.	Carbon dioxide, dry powder types, Clean agent and sand buckets.
D. Fires in reactive chemicals, active metals and the like.	Special type of dry powder extinguishers and dry sand buckets.

N.B. Where energised electrical equipment is involved in a fire, the non-conductivity of the extinguishing media is utmost importance and only extinguishers expelling dry powder or carbon-dioxide (without metal horn) shall be used. Once the electrical equipment is de-energised, extinguishers suitable for class A, B, C may be used safely.

Fire Extinguisher guidelines

- i. Fire extinguishers should be placed as near as possible to Exit / Entry doors.
- ii. Extinguishers should be placed in such a way that it shall be available within 15 meters at any point of place.
- iii. Extinguishers shall be installed on the wall in hanging position. The height of the extinguisher bottom portion shall be 1 (One) mtr. above the floor.
- iv. Extinguisher should not be placed in a position where it is likely to be impacted by Direct Heat, Sun Rays, Rain, moisture etc.
- v. In a confined space, it is generally advisable to place the extinguisher outside the confined space.
- vi. Fire extinguishers should always be accessible.
- vii. Floor Plan with location of Fire Equipment and type of extinguishers should be placed at prominent place/entrance of the Plant.
- viii. Fire extinguishers should not be placed in the Transformer room. It should be placed just outside the room.
- ix. Each and every location allotted for Fire Extinguishers should be marked with Department-wise Serial Number.
 - a) The number should start with FE/1 and so on (FE stand for Fire Extinguisher).
 - b) The type of Extinguisher should also be marked e.g. DCP, CO₂, W/CO₂, and FOAM.
 - c) All letters should be painted by Fluorescent paint of 9 Cm. sizes in White Colour on Red background (30 X 21 Cm.).

- x. One copy of the Master list of the Fire extinguishers with location should be available in department and a copy should be submitted to the Fire Brigade.
- xi. After refilling the fire extinguisher, inspection card indicating the serial numbers of the extinguishers, date of initial charging and the next due date of refilling should be pasted.
- xii. Record of the date of inspection, refilling date, etc., should be maintained.
- xiii. Inspection & Maintenance shall be done quarterly as per the guideline.
- xiv. The HP test of DCP/ ABC type Fire Extinguisher shall be done once in 3 years @ 35 kg/ cm² for 2.5 minutes & the CO₂ Fire Extinguisher shall be HP tested once in 5 years @ 250 kg/ cm² for 2.5 minutes.
- xv. All employees should be trained on the Operation of Fire Extinguisher with the help of Fire Brigade. Department should ensure that refresher training should be given to the employees time to time.

3.4.2 Fire Hydrant

Fire Hydrant is a discharge pipe with a valve and nozzle at which water may be drawn from the fire water mains.

Hose: A fire hose is a high - pressure hose used to carry water to extinguish fire.

Nozzle: Provides an outlet to the high pressure water coming through the hose and directs it towards the fire.

Hose Pipes and Nozzles

- i. Hose boxes/ hose shall be cleaned internally and externally quarterly.
- ii. Damaged hoses should be removed immediately.

Hose Reel

Once in a year the hose reels should be completely run out and subjected to operational water pressure to ensure that the hose is in good condition and that the coupling joints are watertight.

Pump & Fire Fighting Pump Room / House

- i. Independent water source / Static water tank shall be provided for minimum 2 hrs. continuous fire fighting.
- ii. If Pump Room is not manned for 24 hours, then it shall have Fire Detection & Alarm system. 24 Volt battery is to be provided to give back up in case of power failure.
- iii. Two (2) independent source of power shall be provided for the Pump operating panel.

Fire Hydrant System

- i. At least one hydrant point shall be provided for every 30 M distance (for both ordinary & high hazards)
- ii. Necessary Cut-Off / sectionalizing valves shall be provided for easy

- maintenance of the system.
- iii. Height of the hydrant outlet point shall be 1 M from floor level.
 - iv. For farthest / remotest location (horizontal position), the minimum pressure at all the hydrant outlet shall be 5.5 kg/ cm².
 - v. For highest / top most hydrant point, the minimum pressure at the hydrant outlet shall be 3.5 kg/ cm².
 - vi. Hydrants for the protection of the Fire like combustible/ flammable liquids storage tanks shall be provided as per the respective norms such as per IS and OISD (Oil Industry Safety Directorate) Guidelines.
 - vii. Fixed water monitors shall be provided for the structures having a height more than 15 M (Hydrogen Vessel, Nitrogen Vessel, Coke Oven Gas Desulphurisation, Furnaces installation etc.) and a site having Propane bullet and for the protection of conveyor belt on the ground.
 - viii. Fire Hydrant water shall not be used for other purpose like tapping, gardening etc.
 - ix. Fire hydrant layout plan with Fire Hydrant Number and location shall be available and displayed at prominent places and layout copy to be submitted to Fire Brigade.

Fire Hydrant Inspection, Checks and Maintenance

Hydrant System

- i. Availability of proper P&ID diagram, Equipment Layout of Fire Fighting Pump House and Fire Hydrant and Spray Yard Piping Layout of Fire Hydrant System shall be ensured.
- ii. Fire hydrant point shall be checked and test quarterly. The record of all such inspections should be maintained.
- iii. All hydrant valves shall have wheel, lugs & washer in place, so that it can be quickly connected to hose for firefighting.
- iv. Hydrant points shall be kept free from any obstruction as well as Emergency Exists.
- v. The Painting (Signal Red) of Hydrant post and Line shall be carried out annually.
- vi. All the Hydrant points must be numbered.
- vii. All Cut-off / Isolating Valve shall be maintained.

Pumps

- i. Pump sets shall be run for at least 5 minutes every week by department representative.
- ii. Diesel Pump shall be run for at least 5 minutes once in a week by department representative.
- iii. Before running the Pumps, two Hydrant Points shall be open.
- iv. Records shall be maintained for the above testing.

v. Fire Fighting Pump Room shall be checked once in a month.

3.4.3 Fire Detection Systems

Fire detection systems are designed to discover fires early in their development when time will still be available for the safe evacuation of occupants. Early detection also plays a significant role in protecting the safety of emergency response personnel. Property loss can be reduced and downtime for the operation minimized through early detection because control efforts are started while the fire is still small. Most alarm systems provide information to emergency responders on the location of the fire, speeding the process of fire control.

Addressable Fire Alarm System: In an analog Addressable system detectors are wired in a loop around the buildings with each detector having its own identity. System may contain one or more loops depending upon the size of the building. An addressable fire alarm system provides an exact location of the fire. This minimizes the response time of emergency services and first responder.

Conventional Fire Alarm System: In conventional fire alarm system detectors give information about specific circuits (zones). System is not applicable for large buildings having too many rooms.

Photo electrical smoke detector: Photo electrical detectors are of two types:
A. Photoelectric Light Obscuration.
B. Photoelectric Light Scattering.

A. Photoelectric Light Obscuration Smoke Detection - The principle of using a light source and a photosensitive sensor onto which the principal portion of the source emissions is focused. When smoke particles enter the light path, some of the light is scattered and some is absorbed, thereby reducing the light reaching the receiving sensor. The light reduction signal is processed and used to convey an alarm condition

B. Photoelectric Light-Scattering Smoke Detection - The principle of using a light source and a photosensitive sensor arranged in such a way that the rays from the light source do not normally fall onto the photosensitive sensor. When smoke particles enter the Light path, some of the light is scattered by reflection and refraction onto the sensor. The light signal is processed and used to convey an alarm condition.

Linear Heat Sensing Cables: Linear heat sensing cables detect heat anywhere along the length of the cable. The cable is comprised of two zinc-coated spring steel conductors, individually coated with a heat-sensitive thermoplastic polymer engineered to melt at fixed temperatures. Once the polymer melts, the conductors initiate contact with one another and communicate with the control panel to sound alarms or activate suppressing systems. This detector is suitable for cables galleries and conveyor system.

Auto dialer

An automatic device that can automatically dial telephone numbers to communicate between any two points in the telephone, mobile phone networks. Once the call has been established the auto dialer will announce verbal messages to the called party.

Fire Detectors Installation

The choice of the initiating devices shall be dictated by the application, type and characteristics of fire risks in the protected area.

SN	Type of Building	Type of Fire System/ Detector
1	Office Building- Upto Ten (10) rooms	Conventional/ Addressable detector
2	Office Building > Ten (10) rooms.	Addressable Fire System
3	Electrical installation	Addressable System/ Smoke cum Heat detector
4	Computer Server Room	Addressable System /Smoke cum Heat detector
5	Cable Tunnel, Cable Cellar, Cable Spreader, Cable Vault, Cable Galleries and other Cable Premises	Addressable System/ Smoke cum Heat detector/ Linear Heat Sensing Cables
6	Conveyor System	Linear Heat Sensing Cables
7	Large Halls above 10 m height	Beam Type
8	Cellar (having potential of fume particle generation leading to false alarm phenomenon)	Multi-sensor detector – This type of detectors detects both Heat and Smoke. It combines the characters of two types of detectors, each of which responds to different physical and or chemical characteristics of fire. The purpose of combining sensors in this way is to enhance the performance of the system in detection of fire or its resistance to at least certain categories of false alarms or both. There is significant potential for reduction of many types of false alarm. It is also possible to disable an individual sensor depending on the circumstances at the place of installation.

- Ionization detectors shall not be installed as it contains radioactive element.
- Detectors shall not be in a direct airflow nor closer than 3 ft. (1m) from an inlet or forced ventilation.

Checking & Cleaning procedure for fire detectors:

Persons involved in checking and cleaning of detector shall be well trained.

Checking:

- i. Spray the aerosol fluid on the detectors and observe the detector LED, if the LED turns into red or green and alarm is activated then detector is OK. If LED doesn't respond, replace the detector.
- ii. Blow hot air on the Heat detector and observe the detector LED. If the LED turns into red or green and alarm is activated then detector is OK. If LED doesn't respond, remove and clean the detector with vacuum cleaner with brush attached to it. Mount the detector on its base and check again through heat gun. If LED blinks then detector is OK, or else change the detector.
- iii. Check battery condition with respect to battery voltage. The voltage level shall not fall below the level specified. If the voltage falls below the level specified, corrective action shall be taken and the battery shall be retested otherwise replace the battery.
- iv. Detectors which are not having LED, give signal to the panel. Detector will work if an alarm signal comes to the panel.

Cleaning:

- i. Remove the detectors (PHS, HT & OSD) from the base and see that its indication as an open fault is coming on the panel or not. The entire detector should be checked one by one.
- ii. After removing, clean the detector with vacuum cleaner with brush attached to it. Restore the detector and spray aerosol to re-confirm its correctness of connection. Heat detector should be cleaned same as other detectors.
- iii. Disconnect AC supply and ensure that system has been changed over to stand-by (battery) power supply.
- iv. Check all the manual call point and see their indication on the panel.

To ensure the healthiness of FDA System, Audit of FDA System should be done by the line manager preferably every 6 months. Evacuation Mock drill can be conducted by activating Fire Alarm System. Line Manager is responsible to maintain the healthiness of the FDA System.

3.4.4 Emergency preparedness

- i. Fire Detection & extinguishing system should be inspected, tested and maintained by competent agency at regular frequency as specified in the guideline. For e.g. Fire Extinguisher & Fire Hydrant should be checked on Quarterly basis. FDA should be checked Bi-monthly and quarterly based on the location. Records of same should be maintained.
- ii. Persons carrying out checking and maintenance of fire equipment should be certified by the fire department.
- iii. Each site/ premise should include risk of fire scenario in their emergency plan and appropriate measure for:
 - a) Raising the alarm.
 - b) Evacuation of personnel to the safe area.

- c) Containment of fire until arrival of emergency services

References:

- 1) Tata Steel India Safety Standard: Fire Prevention (SS/GEN-36), Fire Extinguishers standard (SS/GEN-33), Fire Hydrant Safety Standard (SS/GEN-35), New Fire Detection and Alarm System Safety Standard(SS/GEN-37), Fire Safety in Cable Runs (SS/ELEC-09), Compressed Gas Cylinder safety management system Code of Practice (SS/GEN-57).
- 2) Fire mitigation management in SAIL (Committee's report for framing comprehensive guidelines for Modern, Water Tight Fire prevention, control & response system in SAIL).

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
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1.0 Objective

This guideline is meant for providing the safety precautions and protective systems from excavation hazards such as-

- a) Falling of persons into excavation pit.
- b) Collapse of excavation sides and falling of excavated material onto persons working in excavation pit.
- c) Collapse of temporary structure made to support sides of excavation.
- d) Collapse of adjacent building or structure due to an excavation made nearby.
- e) Persons working in excavation pit, struck by parts of machine, falls of spoil from excavator buckets and other objects dropped on them.
- f) Striking underground electric cables with resulting flash burns and electric shock.
- g) Striking and breaking other underground service lines – gas (fire and explosive hazard), water (flooding), and sewage (toxic gases).
- h) Fire and explosion from flammable gases heavier than air and vapors, especially LPG, entering excavation.
- i) Poisoning from gases heavier than air such as hydrogen sulphide or carbon dioxide present in ground itself, or entering the excavation from outside.
- j) Poisoning from carbon monoxide produced from torches, burns, etc. used in excavation with insufficient ventilation, or from exhaust gases produced by plants and machinery used in connection with the excavation, including pumps for dewatering.
- k) Toxic and radioactive hazards from the ground itself, usually resulting from its previous occupancy.
- l) Flooding with risk of drowning.
- m) Accidental explosion through use of explosive in excavation. Falling of workmen through bottom of excavation into disused mine shaft or other cavities in the ground. (**Refer Annexure-I: Illustrations for Cave-in Hazards**)

2.0 Scope

The scope of work covers all steel plants in Iron and Steel sector.

3.0 Procedure

3.1 Definitions

- i) **Bell-bottom Pier Hole:** A type of shaft or footing excavation in which the bottom is made larger than the cross section above to form a belled shape.
- ii) **Benching (benching system):** A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.
- iii) **Cave-in:** The separation of a mass of soil or rock material from the side of an excavation, or loss of soil from under a trench shield or support system, and its sudden movement into the excavation in quantity that it could entrap, bury, injure, or immobilize a person.
- iv) **Competent person:** One who can identify existing or predictable hazards in the surroundings that are unsanitary, hazardous, or dangerous to employees. Also has authorization or authority by the nature of their position to take prompt corrective measures to eliminate them. The person shall be knowledgeable about the requirements of this part.
- v) **Drilling:** Work performed above grade with small tools in order to make holes on any "blind" surface.
- vi) **Cross braces:** The horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or walls.
- vii) **Excavation:** Any man-made cut, cavity, trench, or depression in the earth's surface, formed by earth removal.
- viii) **Failure:** The breach, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.
- ix) **Hazardous atmosphere:** A atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.
- x) **Protective system:** A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.
- xi) **Qualified person** - One who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his or her ability to solve or resolve problems related to the subject matter, the work, or the project.
- xii) **Ramp:** An inclined walking or working surface that is used to gain access to one point to another, and is constructed from earth or from structural materials such as steel or wood.
- xiii) **Sheeting:** The members of a shoring system that retain the earth in position

and in turn are supported by other members of the shoring system.

- xiv) **Shield (shield system):** A structure that is able to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses.
- xv) **Shoring (shoring system):** A structure such as a hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.
- xvi) **Sloping (sloping system):** A method of protecting employees from cave-ins by excavating to form sides of an excavation that is inclined away from the excavation so as to prevent cave-ins. The angle of inclination required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.
- xvii) **Stable rock:** A natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a qualified / competent engineer.
- xviii) **Structural ramp:** A ramp built of steel, usually used for access. Ramps made of soil or rocks are not considered structural ramps.
- xix) **Support system:** A structure such as underpinning, bracing or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.
- xx) **Trench (trench excavation):** A narrow excavation in relation to its length made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 4.5m.

3.2 Classification of soil

From construction point of view, soil can be classified in four groups viz. Stable rock, Type-A, Type-B and Type-C. Stability is greatest in stable rock and decreases through Type A and B to Type C, which is the least stable.

Stable rock is defined as natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Type-C soils include the following-

- i) Granular soils including gravel, sand and loamy sand.
- ii) Loose backfilled soil.
- iii) Submerged soil or soil from which water is freely seeping.
- iv) Black-cotton soil – This type of soil is expansive in nature and swells when in contact with water. When dried up, cracks can be observed. This type of soil generally appears on the upper strata of the ground up to a shallow depth.

- v) Mica-schist – This type of soil can be identified by light yellowish colour and presence of shining mica particles. Mica-schist swells when in contact with water and has negligible shear strength when wet. This type of soil is frequently found inside Plant. Collapse of excavated pit in such soil is almost certain and special care must be taken to prevent excavation failure during construction.

Type-B soils include the following-

- i) The soil has been previously disturbed.
- ii) Soil that is fissured (cracked).
- iii) The soil that is subject to vibration from heavy traffic, pile driving or similar effects.
- iv) Dry rock that is unstable, found in hilly area.

Type-A soils include the following-

- i) Cohesive soils with very high strength.

4.0 General protection requirements

Many excavation accidents are the direct result of inadequate initial planning. The construction engineer is responsible for planning the job. He or she must involve the site's competent person in planning all phases of the work. Every effort should be made during the design stage of the excavation to ensure safety by providing necessary protective systems.

4.1 Planning

The steps to be followed for excavation planning are given below.

- i) Prepare a layout of the excavation showing plan and cross-sectional elevation of the proposed excavated pit as per requirement.
- ii) Identify and mark all nearby structures, buildings, drains, sewer lines, railway tracks, roads, slope of an existing embankment etc. on the layout. Underground drains and sewer lines can be identified by locating the manholes over ground.
- iii) Identify and mark all nearby overhead utilities like power cables, water and gas lines etc. if any.
- iv) Identify and mark nearby water bodies like ponds, lakes etc. if any.
- v) Collect information regarding the depth of foundations of nearby structures and underground drains and sewer lines. Show this in cross-sectional elevation of proposed excavated pit.
- vi) Collect information regarding the presence of any underground utility lines, electric cables, fiber-optic cables, telephone cables etc. This may be done by referring to the GIS map of the concerned site, if available and by discussion with the concerned owner department.

- vii) Identify all sources of vibration nearby e.g. movement of railway wagons, traffic movement on road, vibrating equipment, balling operation, pile driving etc.
- viii) Collect information regarding the type of soil by visual inspection or by soil test report of the site. Classify the soil as stable rock, type A, type B or type C, as per the criteria given above.
- ix) Weather condition: During rainy season, soil will be wet and weak. Also, there is a possibility of rising of ground water table.

4.2 Minimum Precaution

Following minimum precautionary measures must be taken by the construction engineer, before starting an excavation.

- i) All persons in an excavation site must use appropriate PPEs. (*Refer SG-18: Safety guideline for Personal Protective equipment*)
- ii) Erect either warning barricades or rigid, protective barricades. If warning barricades are used, place them at minimum of 1.5 meters distance from the edge of excavation. A spoil pile of minimum 1 meter high can be used as a barricade on one side of the excavation. Barricades must be marked with warning lights if they are in or near walkways or roadways. (*Refer SG-11: Safety guideline for Barricading*)
- iii) Provide warning systems such as barricades, hand or mechanical signals, or stop logs to alert operators of mobile equipment that they are approaching the edge of excavations.
- iv) Keep spoil dirt and any light material or equipment that may fall into an excavation at least 1 meter from the edge.

4.3 Surface encumbrances

All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

4.4 Underground installations

i) Locating underground installations – Trial Trench

The location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be located prior to opening an excavation. Supervisor shall obtain excavation clearance from respective departments before start of the work so as to prevent the hazards due to the underground installations (**Refer Annexure-II for Format of Excavation Clearance**). After obtaining the excavation clearance, the excavation area is examined by cable/metal detector to identify underground cables/utilities and then trial trench excavation shall be undertaken by manual means only.

The layout of the trial trench shall be such that it exposes every cable loop/utilities inside the excavation area. Trial trench of 1.5 meter depth shall first be cut, below the ground surface. This job will be done manually with every precaution, anticipating presence of underground cables/utilities etc. If presence of cables/utilities is not detected mechanized excavation up to a depth of 1.2 meter may be permitted.

For excavating further down, cable/metal detector shall again be deployed to look for presence of cable/utilities at level below 1.5 meter. Again trial trench shall be cut manually for an additional depth of 1.5 meter with the same pre-cautions as above. In case no cable/utility is detected, mechanized excavation can be permitted up to 2.7 meter from the ground level. This sequence shall be continued till the final depth of excavation is reached. In case cables/utilities are detected at any level, necessary precautions shall be taken to avoid any damage to these cables/utilities, and these should be adequately supported.

For Green Field Project sites or in areas where there is no underground installations, trial trench may be avoided with due approval from a competent person or Competency Team on excavation (**Refer Annexure-III for Format for approval**). For piling job, trial trench may be restricted up to the bottom of pile cap.

- a) While the excavation is open, underground installations shall be protected, supported, relocated or removed as necessary.
- b) If needed, shoring should be done in the trial trench, to protect the workmen from collapse of soil.

4.5 Stability of adjacent structures

- i) Where the stability of adjoining buildings, walls, or other structures is endangered by excavation, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures.
- ii) Excavation below the level of the base of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted without approval of site in charge.
- iii) Possibility of collapse of soil, adjacent to and below the foundations shall be checked by the approver giving the excavation clearance.

4.6 Excavation near HT lines

Care shall be taken while excavating near power lines, so that no excavator comes close to power lines. Stability of towers shall be ensured before starting excavation. Minimum clearance to be maintained from the nearest HT line shall be as per Indian Electricity Act. A knowledgeable electrical engineer may be contacted for this.

4.7 Protection of people from soil collapse

Side wall collapse of an excavated pit is a common phenomenon. This leads to injury of people and equipment inside a pit. In many cases, due to lack of adequate protective system, collapse of side wall lead to fatality. Therefore,

adequate protection system must be in place, before allowing people inside a pit.

Side wall collapse in an excavated pit happens due to four major factors viz.

- i) type and condition of soil
- ii) size of excavation
- iii) seepage of water, and
- iv) vibration.

Appropriate protective system to prevent soil collapse shall be ensured considering the site conditions.

4.8 Protection from hazards associated with water accumulation

- i) Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless necessary precautions have been taken to protect people against the hazards posed by water accumulation. The precautionary measures necessary for protection of people vary from site to site. These include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.
- ii) If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be regularly monitored to ensure proper operation.
- iii) If excavation work interrupts, the natural drainage of surface water such as streams, drain etc., diversion ditches, dikes, or other suitable means shall be adopted used to prevent surface water from entering the excavated pit. Required drainage of the area adjacent to the excavation shall be provided. Excavations subject to runoff from heavy rains will require a thorough inspection prior to start work.

4.9 Protection of people and equipment from loose rock or soil

Required protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection shall consist of removal of loose material from side wall and edge of excavated pit; installation of protective barricades at intervals as necessary on the face to stop and contain falling material; or other means that provide equivalent protection. Safety net if provided on the side walls for protection against fall of boulders and loose materials must be well anchored at the top.

4.10 Protection of people from hazardous atmosphere

- i) In case of presence of harmful gas, necessary arrangements for ventilation shall be provided to restrict the exposure within safe limits. Such tests shall be carried out frequently.
- ii) Explosive mixed gases may also be present in the trenches; air containing more than 1.5 percent of flammable gases by volume is dangerous.

- iii) Air shall be considered unfit for workmen to breath, if it contains any of the following:
 - a) Less than 19 percent of oxygen by volume.
 - b) More than 1 percent of carbon dioxide by volume.
 - c) More than 0.01 percent of carbon monoxide by volume.
 - d) More than 0.0025 percent of hydrogen sulphide gas by volume and More than 0.002 percent of nitrous oxide by volumes.
- iv) No internal combustion engine should be operated in a trench unless adequate ventilation measures are taken for discharge of exhaust gases.
- v) Dusty Atmosphere: When the excavation activity causes dust generation which can be harmful to the employees, necessary action must be taken to suppress it (e.g. spraying water) or employees must wear proper PPE while working in such atmosphere.

4.11 Access and Escape

- i) It is recommended that one ladder should be provided for every length of 15 m or fraction thereof, in the case of hazardous work, and 30 m of length or fraction thereof, in the case of relatively less hazardous work.
- ii) Ladder shall extend at least 1 meter top of the cut to provide a hand hold when stepping on or off.
- iii) Quite often the pathways become slippery due to accumulation of mud, sand or gravel. This should be avoided. Further, the pathway should be strong enough to withstand the intended use. Similarly gangway should be of superior construction.
- iv) The planks used should be strong and parallel to the length of the gangway and fastened together against displacement. They should be thick and have cleats for safe walking. Gangways should be kept clear of excavated material and other obstruction.

4.12 Exposure to falling loads

No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand at least 5m away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped.

4.13 Excavations as Confined space

If the competent person feels that the excavation has the hazards of confined space then all the necessary precautions must be taken which are applicable while working in confined space. For this *SG-03: Safety guideline for working in confined Space shall be refereed*.

4.14 Emergency rescue

- i) The supervisor or foreman shall make the employees aware about the location of the First Aid box/Competent First Aiders and about other medical facilities.

- ii) Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

4.15 Fall protection

Walkways shall be provided where employees or equipment are required or permitted to cross over excavations. Adequate barrier for physical protection shall be provided at all remotely located excavations. All wells, pits, shafts, etc., shall be barricaded or covered. Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc., shall be backfilled.

4.16 Cathode Protection Systems

These systems are used to prevent corrosion of certain underground piping. Special cathodes and/or anodes are used to circumvent corrosive damage to the pipeline by use of electrical currents. If these systems are in the vicinity of an excavation, they must be de-energized and positively isolated.

4.17 Inspections

- i) Daily inspections of excavations, the adjacent areas, and protective systems shall be made for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the responsible person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee's exposure can be reasonably anticipated. Format for inspection report is shown in [Annexure-IV](#).
- ii) Where the responsible person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, employees working there shall be asked to evacuate the area until the necessary precautions have been taken to ensure their safety.

4.18 Excavation involve Blasting

- i) In case excavations involve blasting using explosives, an appropriate safety zone must be maintained around the blasting site to prevent injuries due to fly rock and blast over-pressure.
- ii) In case excavations involve blasting using explosives, blasting should NEVER be carried out during stormy weather and/ or lightning.
- iii) In case excavations involve blasting using explosives, warning siren must be sounded prior to blasting.
- iv) In case of underground excavations safety procedures recommended by Director General of Mines Safety (DGMS) must be strictly followed.

5.0 Protective systems

5.1.1 Personal protective system

The worker shall be provided proper briefing about the Cave-in and other Hazards before proceeding to work by supervisor. Safety helmet and Shoes shall be worn by all persons entering trench/ excavation site.

- i) Tools or materials such as wheel borrow, shovels, picks, tiles, cement, lumbar shall not be kept close to the edges of the trench.
- ii) Warning notices shall be displayed at the site. All excavations must be provided with Guard rails or Metal Plank Guards as per safety standard on barricades.
- iii) Every accessible part of an excavation, pit or opening in the ground into which there is a danger of falling of person, shall be suitably fenced with a barrier as shown in standard sketch of barricades

5.1.2 Prevention of soil collapse in trenches

Soil collapse in a trench can be prevented either by side slope or by benching of side wall or by shoring. Selection of a particular method is made depending on the site and soil condition.

- i) **Side slope:** Soil collapse can be prevented by cutting the side of an excavated pit in slope as shown in **Figure-1**. The slope will be decided by the site engineer, considering the type and condition of the soil and the depth of excavation.

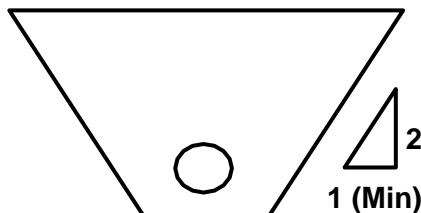
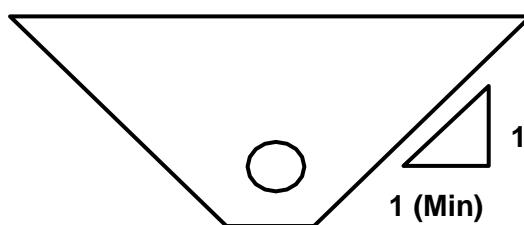
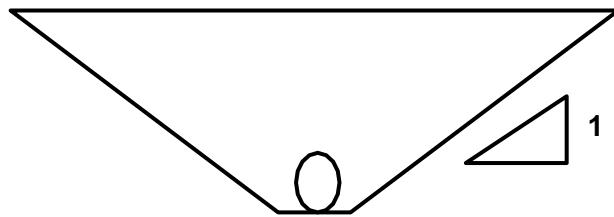
Side slope for Type-A soil**Side slope for Type-B soil****Side slope for Type-C**

Figure-1 : Side slopes in different kinds of soil

- ii) **Benching:** If sufficient space is available on the sides of a trench, benching is the preferable method for slope stability. Benching is to be done considering the type of soil and the depth of excavation as per **Figure-2**. If depth of excavation is less than 1.5m, then benching may not be required and cutting in slope may be sufficient. However, when the depth of excavation is more than 1.5m, one bench must be provided at a height of 1.5m from the bottom of excavation. Number of additional benches required will be decided by the site engineer, depending upon site condition and depth of excavation. For the required benching width, designer shall be consulted. However, minimum 1m benching width is to be provided.

However, sometime sufficient space may not be available for benching or providing side slopes. In such cases, side of a trench is to be protected by shoring.

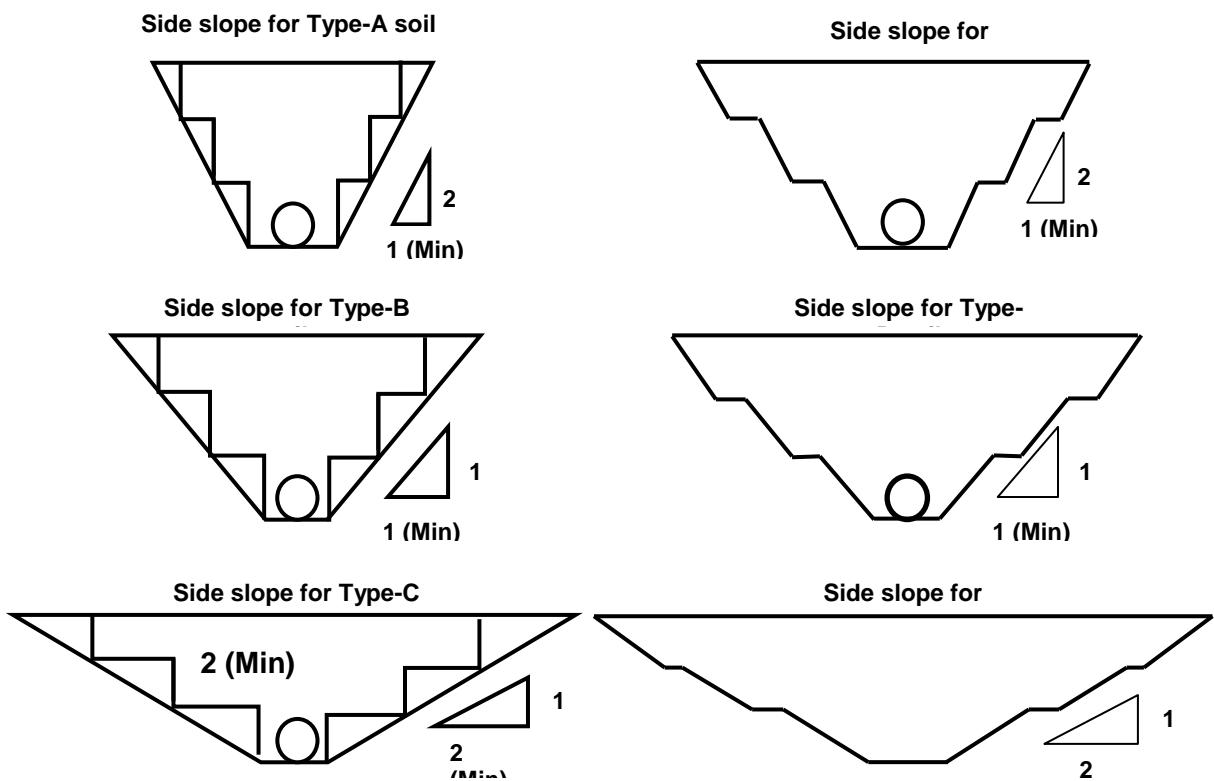


Figure-2 :Benching for different kinds of soil

- iii) **Shoring:** Unless the side of an excavated pit is protected by providing adequate slope on sides or by benching, shoring must be done to protect the side of an excavated trench against collapse. Following guideline is to be followed:
 - a) All trenches deeper than 1.5 m shall be securely shored. In case of Type-C soil shoring may be required even for depth less than 1.5 m. A typical shoring arrangement is given in **Figure-3**. However, shoring arrangement is to be approved by a competent person.
 - b) All trenches in friable or unstable rock exceeding 2 m in depth shall be securely shored and timbered.
 - c) In case of any doubt with respect to the safety of the work, the requirement for providing shoring shall be carefully considered, even in trenches less than 1.5 meter or 2 meter in depth, and decision should be taken accordingly.
 - d) Where the sides of trenches are sloped, as specified above but not to within 1.5 m of the bottom, the vertical sides shall be shored and the

shoring shall extend at least 30 cm above the vertical sides of the excavations. Care to be taken to prevent material rolling down the slope and falling into the part of the trench.

- e) Shoring and timbering shall be carried along with the opening of a trench but when conditions permit, protection work, such as sheet piling may be done before the excavation commences.
- f) Approved quality of Sal wood should be used for shoring and timbering a trench. Any other material can also be used, but shall not have the strength less than the Salwood.
- g) Cutting shall be done from top to bottom. No undercutting of side of excavation shall be allowed. In case, where undercutting is a must, written approval from a competent engineer shall be taken.

Vertical cut in trench with shoring

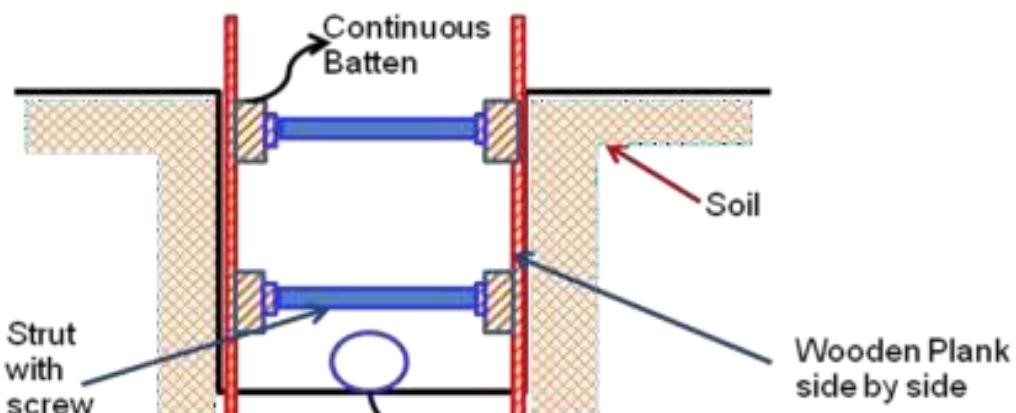


Figure-3: Shoring in trench

- iv) **Timber Shoring:** As far as possible, the installation of shores should be done from the surface, that is, vertical shores should be placed from surface and the first horizontal braces should be installed just below the surface from above. The operator should go down in the trench with the help of a ladder which is long enough to install the next lower brace or trench jacks, etc. Thus, the trench is made safe for him to descend to install additional horizontal braces. The trench jacks or horizontal braces should never be used as a ladder for getting in or out of a trench, as they are not designed to take vertical load. (The erection of shoring and timbering shall be as per IS:3764 for Hard Soil, Soil which may crack or crumble, loose sandy or soft soil or soil which has been previously excavated, soil under hydraulic pressure respectively).
- v) **Sheet Piling:** In case of deep and wide open cut excavation, sheet piling may be followed for side protection. The piles may be of timber, concrete or composite material depending upon the depth of excavation and life of

sheet piles required (the sheet piling shall be done as per IS:2314)

- v) **Removal:** When the removal of shoring is planned, the possible collapse of trench sides should be anticipated. The newly installed utility line will then be safeguarded in the normal course by being covered with loose or compact fill before shores are removed. If the trench is likely to cave or shelter in on removal of the shores, it can be filled up to the bottom of the horizontal braces. It is a safe way for the workers to go down on the ladder and remove this brace, after which additional trench space can be filled up to the next horizontal brace or screw jack.

If the trench is to stay after the removal of shoring, the latter should not be removed till all work within the trench is completed and the newly installed utility line has been protected or covered.

A worker can then use a ladder to descend to the bottom of the horizontal trench jack and remove it. The remaining horizontal jacks should be removed as he ascends the ladder. The removal of shoring is a hazardous work. A worker should never be permitted to engage in this work single handed.

- vii) **Minimum Berm:** A provision of clear berm of a width not less than one-third of the final depth of excavation is recommended to keep away the excavated material from falling into the trench.

In areas where this width of the berm is not feasible, the reduced berm width of not less than 1 meter should be provided. It is always better to provide substantial toe board to prevent roll back into the trench.

- viii) **Plant and Machinery:** The excavating equipment should be parked at distance of not less than the depth of the trench or at least 6 m away from excavated sides for trenches deeper than 5m.

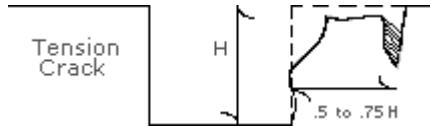
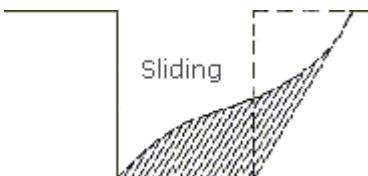
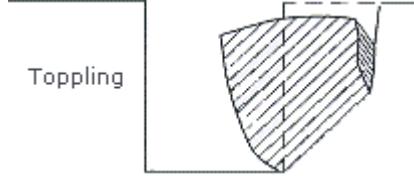
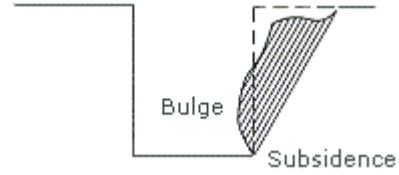
With the use of power shovels, the banks of trenches become unstable and thus dangerous for the persons working nearby. These conditions should be watched and suitably remedied.

The vehicles should not be permitted to be driven too close to the pit. Care should be taken for loading roads leading to or from the pit. While loading manually, the vehicle should not be taken too near the wall of the pit. Use of stop logs or blocks will reduce risk of accidents where the vehicle is reversed for loading.

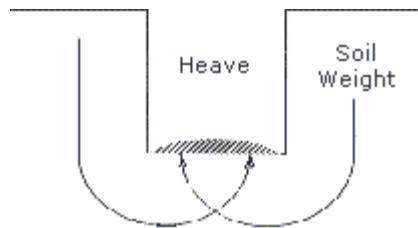
Reference:

- a) TSL Safety Standard, SS/ENGG-04
- b) SAIL Plant Safety manual

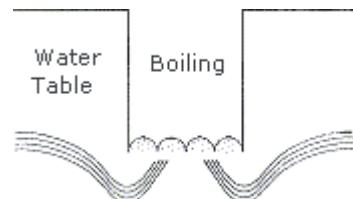
ANNEXURE-I**CAVE-IN HAZARDS**

<p>a) TENSION CRACKS. Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench, measured from the top of the vertical face of the trench. See the accompanying drawing for additional details.</p>	
<p>b) SLIDING or sluffing may occur as a result of tension cracks, as illustrated below.</p>	
<p>c) TOPPLING. In addition to sliding, tension cracks can cause toppling. Toppling occurs when the trench's vertical face shears along the tension crack line and topples into the excavation.</p>	
<p>d) SUBSIDENCE AND BULGING. An unsupported excavation can create an unbalanced stress in the soil, which, in turn, causes subsidence at the surface and bulging of the vertical face of the trench. If uncorrected, this condition can cause face failure and entrapment of workers in the trench.</p>	

e) HEAVING OR SQUEEZING. Bottom heaving or squeezing is caused by the downward pressure created by the weight of adjoining soil. This pressure causes a bulge in the bottom of the cut, as illustrated in the drawing above. Heaving and squeezing can occur even when shoring or shielding has been properly installed.



f) BOILING is evidenced by an upward water flow into the bottom of the cut. A high water table is one of the causes of boiling. Boiling produces a "quick" condition in the bottom of the cut, and can occur even when shoring or trench boxes are used.



ANNEXURE-II**CLEARANCE FORM FOR MECHANISED EXCAVATION**

Project / Job :						
Location :						
Drawing indicating Under Ground Services in the area						
Sl.No.	Drawing Number			Remarks		
1						
2						
Excavation plan showing the layout of trial trench						
Sl.No.	Drawing / Sketch Number			Remarks		
1						
2						
Note : Excavation plan is to be prepared by the Contractor and to be approved by Consultant and Plantengineer						
Use of Cable Detector						
Used before start of Trial Trench					Y / N	
Used inside trial trench, bottom and side wall					Y / N	
Findings by visual inspection of trial trench and/or by cable detector						
Electric Cables	Y / N	Supported/ Diverted / Defunct		Telephone Cables	Y / N	Supported / Diverted / Defunct
FO Cables	Y / N	Supported / Diverted / Defunct		Water Pipe lines	Y / N	Supported / Diverted / Defunct
Storm water pipes	Y / N	Supported / Diverted / Defunct		Sewer Line	Y / N	Supported / Diverted / Defunct

Declaration

Trial trench excavated up to a minimum depth of 1500 mm manually. Clearance is hereby given to the contractor to proceed with mechanized excavation/grading up to a depth of 1200mm, after ensuring cables/pipes/structuresinuse do not exist in the area earmarked for excavation.

Department	Name	Signature	Date	Remarks
Electrical				
Mechanical				
i) Other departments				
ii) Other departments				
ITS				
Telecommunication				
Consultant				
Executing agency				
It is possible that in spite of tests and investigations conducted, there may still be certain services remain in the area .The contractor shall therefore, be vigilant during mechanized excavation and shall inform Plant/Consultant on finding any services in course of excavation/grading.				

ANNEXURE-III**APPROVAL COMPETENCY TEAM ON EXCAVATION**

Project / Job :			
Location :			
Check before Excavation			
Items	Remarks		
Foundation Drawing and other related civil drawings			
Soil test report and recommendations of soil testing agency			
Soil condition – Loose, Backfilled, fissures, Rain cuts etc.			
Adjacent Structures			
Foundation drawings of adjacent Structures			
Adjacent Water bodies			
Adjacent railway trucks or HT Lines			
Plan for excavation equipment			
Plan for protection against potential soil collapse			
Work schedule for excavation and concreting inside pit.			
Recommendations :			
Name:		Signature	Leader
Name:		Signature	Member
Name:		Signature	Member
Name:		Signature	Member
Name:		Signature	Project Team Representatives
Name:		Signature	Consultant

ANNEXURE-IV**EXCAVATION INSPECTION REPORT**

Project / Job :				
Location :				
Depth of excavation				
SOIL		SOIL		
LOOSE		HARD		CRACKED
BACKFILLED		SOFT		RAIN-CUT
MICA-SCHIST		WET		UNDER CUT
COHESIVE SOIL		DRY		
GRANULAR				
DRY ROCK				

EXCAVATED PIT				
	GOOD	REJECTED	N/A	REMARKS
SLOPE RATIO				
SHORING				
SHIELDING				
BARRICADES				
WATER REMOVAL				
TRAFFIC CONTROL				
SPOIL PILE				
SIDE WALL OF PIT				
STABILITY OF ADJACENT				
RECOMMENDATIONS :				
SIGNATURE:		NAME:		
		DATE:		

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	PERSONAL PROTECTIVE EQUIPMENT (PPEs) MANAGEMENT	Doc. No: SG/18
		Rev no. : 00 Effective Date : 14.10.2019

1. Objective

The purpose of this guideline is to outline requirement for the usage, handling and maintenance of Personal Protective Equipment (PPEs) to be observed to ensure optimal level of protection arisen from hazards like physical, mechanical, flammability, chemical, electrical, biological, hygiene, radioactivity etc. as a result of work place activity and processes.

2. Scope

This guideline is applicable to all locations of Iron and Steel Industries as per applicability.

3. Procedure

3.1 Definitions

Personal Protective Equipment: Personal Protective Equipment (**PPEs**) refers to protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. It is considered as the last line of defense in hierarchy of controls. Usage of PPEs depends upon the vicinity of hazard as well as hazard associated with specific job or activity.

PPE Free Zone: Specific locations where use of PPEs is not mandatory are called PPE Free Zones.

3.2 Roles & Responsibility related to PPEs

The line manager shall:

- i) Select and ensure that their employees including contract employees use the appropriate type of PPEs for the personal protection from the hazards identified at work places or in his job. All PPEs shall be of good mechanical construction, sound material and adequate strength of safe design for the work to be performed conforming to EN/ ANSI/ IS standards.
- ii) Ensure that PPEs fits well and are correctly used by employees.
- iii) Display applicable PPEs at the entrance of each section of shop floor.
- iv) Explore other hierarchy of controls for mitigation of risk related to that hazard considering PPE as last line of defense.
- v) Ensure that a system of feedback and reporting about quality of PPE has been established and reviewed regularly in departmental safety committee.

Contractors shall:

- i) Provide and ensure that their employees use PPEs which is specified by the organization they are working for.
- ii) Ensure that PPE fits and is correctly used by employees.
- iii) Ensure that all PPEs shall be of good mechanical construction, sound material and adequate strength of safe design for the work to be performed conforming to EN/ ANSI/ IS standards.

Employees shall:

- i) Use all applicable PPEs for the protection from hazards and know the correct way of usage.
- ii) Give correct feedback about PPEs related to its hazard protection and comfort.

Training: The line manager shall provide training to each employee who is required to use PPEs, as per the following:

- i) When PPE is necessary,
- ii) What PPE is necessary,
- iii) How to properly don, doff, adjust, and wear PPE,
- iv) The limitations of the PPE,
- v) The proper care, maintenance, useful life and disposal of the PPE,
- vi) Each affected employee shall demonstrate an understanding of the training and the ability to use PPE properly, before being allowed to perform work requiring the use of PPE.

3.3 PPE Requirement for Head to Toe Protection

PPEs requirement for head to toe protection is described in the following subsection.

i) Head Protection

Purpose: To protect the head from injury due to falling or moving objects, impact on stationary objects and from impact due to falls.

Requirements:

- a) Safety helmets must be worn where recognized potential for the injuries described above exists.
- b) Safety helmets shall not be modified or painted as this may affect the integrity of the helmet.
- c) In order to allow safety helmet colours to be used to differentiate personnel and visitors from other personnel and to make personnel visibility different colours should be reserved and followed:
- d) Helmet should be made up of FRP which should meet the standard IS: 2925 or EN 397.

- e) Helmets should be cleaned by dipping in hot water (140 °F) with good detergent for 1 minute and scrub.
- f) It should be periodically inspected for any scratches, wear and tear.

ii) Eye Protection

Purpose: To protect eyes from damage due to impact, penetration, burns, splashes and flying particles and ultra violet radiation.

Requirements:

- a) Safety goggles must be worn at all times in all secure boundary areas except while inside an office, amenity, cabin or fully enclosed vehicle. If the employee has power in eyes (myopic/ hypermetropic), power industrial glasses shall be used. In absence of well suited power industrial goggles, over goggles with prescription glasses shall be used.
- b) Selection of goggles must be done on the basis of type of job/ environment.
- c) Different type of goggles should be used for chemical splashes, dusty environment, heat prone areas, for oven inspection or while looking at the red molten metals.
- d) Safety Goggles should be made up of polycarbonate material & meet the Standard ANSI Z87.1 2003 or EN166.
- e) For cleaning Polycarbonate glasses, they should be washed with water and then wiped off to avoid scratches.

iii) Hearing Protection

Purpose: To conserve the hearing of personnel by use of hearing protection appropriate for reducing the received sound energy levels of noisy equipment and processes to acceptable levels.

Requirement:

- a) Specified hearing protection i.e. ear plug or ear muff shall be worn if the noise level is above 85 decibel. All areas requiring the wearing of hearing protection shall be clearly sign posted.
- b) Ear muff & Ear plug should meet the Standard EN 352.
- c) Disposable ear plugs should be discarded after every use or as it gets dirty.

iv) Hand Protection

Purpose: To protect the hand from injuries such as cuts, grazes, burns, ingress of chemicals & electric shock.

Requirements:

- a) The personnel should wear hand gloves as per the hazard other than general purpose cotton hand gloves or knitted hand gloves while performing their job/ task as mentioned in the SOP.

- b) Hand Gloves should meet the standard EN 420 for general requirement, EN 388 for mechanical hazard, EN 407 for molten metal splashes and heat applications.
- c) Selection of hand gloves should be done on basis of application.
- d) Before use, they should be checked for punctures, tears or other defects and discarded if found not OK. Chemical-use gloves should be tested for leaks periodically by inflation with air and immersion in water. Do not use this test for polyvinyl alcohol gloves as they are water soluble.
- e) Disposable gloves should not be reused. Contaminated gloves must be disposed in an appropriate manner and should not be placed in the regular trash. Always store gloves in a clean, accessible area. Never store contaminated gloves – dispose of them in the appropriate manner.

v) **Foot Protection**

Purpose: To protect the feet from risks ranging from crush and impact injuries to slips, cuts, penetration wounds, electric shock and splashes with liquids and molten metal.

Requirements:

- a) Personnel working inside the plant must wear ISO /EN approved safety footwear, in good condition.
- b) To ensure footwear quality, personnel are required to wear prescribed company issued safety footwear, in good condition, while working in the plant.
- c) The personnel should worn Heat resistance boot if the surface temperature is more than 100 Degree Celsius in their work place.
- d) The personnel should wear PVC Gum boot if they have to perform their job in muck/ mud or leg can dip into above the ankle.
- e) Safety shoes meet the standard ISO 20345.

vi) **Respiratory Protection**

Purpose: To protect all employees (of the company as well as of the contractors) against respiratory hazards through the use of respiratory protective equipment.

Requirements:

- a) The primary control of contaminated air shall be maintained through engineering methods by confining processes, providing exhausts, or providing substitution of less toxic materials. Where engineering remedies are not feasible or are not available, or while they are being evaluated or implemented, and when the atmospheric exposure to a toxic material may exceed the recommended ceiling or time-weighted average limit for a given pollutant, respiratory protection will be required to protect the health of employees.

- b) Suitable respirator will be provided to the employee by the department in consultation with Safety expert and manufacturer (if required).
- c) While selecting a respirator for a particular job environment following factors to be considered
 - Severity of hazard
 - Expected activity of the wearer
 - Degree of protection required
 - Ease and comfort with which it can be worn
 - People using the equipment should understand its operation and necessity of use.

vii) Body Protection

Purpose: To protect the body from injuries such as cuts, grazes, burns and the effects of exposure to heat, cold and ultra violet radiation & collision from moving machines.

Requirements:

- a) Persons working in the plant are required to wear right industrial clothing in good condition. Clothing must fully cover the legs and arms. If specified in Departmental Standard Operating Procedure (SOP), it may be acceptable to wear short sleeved shirts in specific plant areas or for specific tasks.
- b) Specific PPE should be used if person is exposed to hazard of molten metal splashes, electric flash, high heat, radiation, chemical splash complying to relevant EN/ ANSI standards. Clauses like E for molten spatter protection in EN 11612 shall be applicable.
- c) Chemical protective clothing should be used when there may be exposure to chemicals presenting a skin contact hazard, for example, when transferring chemicals from one container to another, when opening or entering systems such as pipelines, reactors, filters, or storage tanks, or when connecting or disconnecting cargo tanks.
- d) When working with mixture of chemicals, the best material for some components of the mixture may be totally inadequate for one or more of the remaining components. TECP (Totally Encapsulating Chemically Protective suits), face shields, goggles, aprons, footwears shall be adopted as per application.
- e) High visibility jacket complying to EN 471 or equivalent should be used to make personnel more visible to avoid collision from heavy vehicles and moving equipment Machines.
- f) Rail crew jackets should be worn for people working on or near rail tracks.
- g) Double Lanyard Full Body Harness to be used while working at height.

viii) Electric Arc Flash Protection

- a) Arc Flash Suit: Ref. NFPA-70E clause 3-3.9.5. Flash suit and their closure design shall permit easy and rapid removal. The entire flash suit,

including the window, shall have energy absorbing characteristics that are suitable for arc-flash exposure.

- b) Arc Thermal Performance Value (ATPV): ATPV is the minimum energy causing the predicted onset of second-degree burns.
- c) Break down threshold energy EBT: It is the average of the five highest incident energy exposure values below the stoll curve where the fabric does not exhibit break open. EBT is reported when ATPV cannot be measured due to FR fabric break open.
- d) Factors affecting the worker injury when exposed to electric Arc: Electric arc intensity depends on fault current, system voltage, electrode gap, number of phases involved, open arc configuration or enclosure, electric Arc duration, distance of the worker from the electric Arc, Type and fit of the clothing worn, Age and health factors.

- **Guideline for High Voltage Arc Flash Suit (above 600 volts) suitable for hazard risk category-4 as specified in NFPA-70E:**

The electric Arc flash suit shall consist of Flame Resistant (FR) pant and FR shirt and Double layer switching coat (It is assumed that operator shall wear cotton underwear beneath the Arc flash suit). The combination of both should be suitable for hazard risk category-4 as defined in NFPA-70E. The total weight of the complete Arc flash suit should be in the range of 24-30 oz/yd². The Minimum Arc Thermal Performance Value (ATPV) or breakdown threshold energy (E_{BT}) rating of complete Arc Flash suit should be 40 cal/cm² as specified in NFPA-70E. Hand gloves (Inner & Outer), Hard Hat as per NFPA 70E requirement to be supplied along with the HT Electric Arc Flash Suit Kit.

- **Guideline for LV Arc flash Jacket / FR Jacket (8.5 ~ 9 Cal/cm²) for use in system >260V <=690V:**

The Electric LV Arc flash Jacket / FR Jacket (8.5 ~ 9 Cal/ cm²) shall be worn continuously by all the persons entering the sub-station, while working on the any electric equipment inside the sub-station or anywhere outside at Shop floor. This Jacket is mandatory even if person is standing in front of the LV panel (indoor/ outdoor) and not doing the work. The LV Arc Flash jacket/ FR Jacket must be worn with full sleeves ON and all buttons closed.

- **Guidelines for uses of Arc face shield and Electrical safety hand gloves in system voltage>260V <=690V:**

Mandatory use of Arc Face shield of 12 Cal/Cm² for the jobs listed in Note-1 for the voltage >260V <=690V:

The list given in Note-1 is not exhaustive; Engineer in-charge can add some more jobs as per the site requirement but cannot omit any of the listed jobs.

Note-1: The List of Jobs- a) Rack in and rack out of the modules like ACB/MCCB/SFU etc. b) Inspection of Power rail (DSL for Cranes, Power lines for Coke oven machines etc.).

Mandatory use of 12 Cal/Cm² Safety Hand gloves for the voltage >260V <=690V for the jobs listed Note-2 if isolation of power with Positive Isolation at least at two levels is not done.

The list given in Note-2 is not exhaustive; Engineer in-charge can add some more jobs as per the site requirement but cannot omit any of the listed jobs.

Note-2: The List of Jobs- a) Rack in and rack out of the modules like ACB/MCCB/SFU etc. b) Inspection of Power rail (DSL for Cranes, power lines for Coke oven machines etc. c) Working on Bus bar / Conductor / Power line / Motor Terminal Block etc. d) Switching on and off of SFU and Isolators e) Power testing f) Earthing etc.

(Full form: ACB-Air Circuit Breaker, MCCB- Moulded Case Circuit Breaker, SFU- Switch Fuse Unit, DSL- Direct Supply Line)

3.4 Clothing Policy

Employees and contractors working in the plant are required to wear right industrial clothing in good condition.

- i. Clothing must fully cover the legs and arms. Where specified in Departmental SOP, it may be acceptable to wear short sleeved shirts in specific plant areas or for specific tasks. Employees coming to and from work, office based workers, and visitors to the plant are permitted to wear short sleeve shirts remain within non plant areas or defined safe walkways in plant areas. Preferably all employees should wear cotton clothes.
- ii. Loose fitting or “baggy” clothing must not be worn around machinery as it increases the risk of garments being caught and the wearer being dragged into the machinery. For example, ties should be removed but may be tucked into the shirt between the second and the third buttons. Vests should be close fitting and fastened. Shirts should be buttoned and tucked in. Loose clothing can get caught in the moving parts of machinery and may pull the employee into the hazardous area. Make sure loose clothing is not worn around moving machinery or open flame construction areas. Loose clothing like Dhoti/ Kurta/ Pajama/ Sari/ Salwar-Suit is not allowed on shop floors or at construction sites.
- iii. Rings, bracelets, dangling pierced earrings, and long neck chains, shall not be worn machinery or where mechanical/ electrical/ construction work is being performed.
- iv. Long hair can be a hazard around moving machinery. It can get caught in moving parts and pull the employee into the hazardous area. Restraine long hair in a hair net or style it to ensure that it will not get caught in the machinery.
- v. While working near moving parts of machine/ equipment hand gloves shall not be worn. If at all required for protection from burrs/ chips/ cuts high dexterity (proper fit) gloves may be used.

- vi. Loose winter clothing like muffler/ loose woolen jackets are not allowed at shop floors or construction sites.
- vii. High visibility jacket shall be used in yards like shipping & dispatch yard so that person moving in the yard shall be visible to crane drivers, trailer, truck drivers. It shall be used by the pedestrian & cyclist while moving in roads.
- viii. Areas where there is potential to burn injury due to molten metal splash employees including visitors/auditors must have to wear FR Jacket & FR trousers.
- ix. For activity like lancing or gas cutting/ welding employees have to wear FR Jacket & FR trousers.

3.5 Rejection of the PPE

The PPE should be inspected by an employee before use to ensure that it is in reliable condition to perform the intended function at all the time otherwise it should be rejected. All PPE should be discarded whenever it gets damaged.

References

- 1) Tata Steel India Safety Standard: Personal Protective Equipment & clothing standard general specification (SS/GEN- 58), Electric Flash Suit (SFT/PRO-04).
- 2) IS: 2925 'Specification for Industrial Safety Helmets'.
- 3) American Standards ASTM F2413-05, ANSI Z87.1, NFPA 70E, ASTM -F1506, ASTM-F1958/F1958M-99
- 4) European Standards EN 344, EN 345, EN 346, EN 347, EN 11612, EN 1486, EN420, EN 388, EN421, EN 374, EN 60903, EN 407, EN 659, EN 381, EN 511, EN 166, ISO 20345

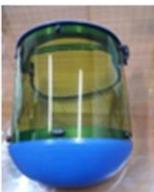
Annexure: Sample Photograph of PPEs

S.No.	Item Description	Hazard/ Application	Sample Photograph of PPE
1	FRP safety helmet	Head protection	
2	Safety Goggles with Clear Glass	Eye Protection: Use for general purpose gives protection from dust ,mist fumes	
3	Clear polycarbonate face shield	Full Face protection: Full Face protection from heat, dust, flying particles	
4	Welding & gas cutting shield	Full Face protection: Use while Gas cutting & welding, gives Full face protection heat, flying particle & radiation hazard	
5	Dust respirator	Respiratory Protection: Protection against dust, mist, fumes.	

S.No.	Item Description	Hazard/ Application	Sample Photograph of PPE
6	Ear plug	Hearing Protection: Protection against noise	
7	Ear muff	Hearing Protection: Protection against noise	
8	Kevlar hand gloves	Hand Protection: For handling hot objects	
9	Leather cum hand gloves	Hand Protection: For Material Handling	
10	Cut resistant hand gloves	Hand Protection: For protection against cut while handling sharp objects	
11	welder's Gloves	Hand Protection: For welding & gas Cutting.	

S.No.	Item Description	Hazard/ Application	Sample Photograph of PPE
12	Nitrile hand gloves	Hand Protection: For handling oil/grease/chemical etc.	
13	Leg guard with two protective rib	Body Protection: For protection of shin of the leg if they strike against sharp objects.	
14	FR Jacket	Body protection from molten metal Splashes & High temperature Environment (above 50 Degree Centigrade)	
15	FR Trouser	Body protection: Protection from molten metal Splashes & High temperature Environment (above 50 Degree Centigrade)	
16	PVC Apron	For protection against chemical splash	

S.No.	Item Description	Hazard/ Application	Sample Photograph of PPE
17	High Visibility Vest	Body protection: For High Visibility	
18	High Voltage Arc Flash Suit (above 600 volts)	Protection For protection against HV Electrical flash	
19	Double density PU sole Safety shoe	Foot protection: For general purpose use.	
20	PVC Gum Boot	Foot protection: For protection of foot in steel toe muck/mud & oil where the foot can dip into	
21	Double Lanyard Full Body Harness	For protection against fall harness while working at height	

S.No.	Item Description	Hazard/ Application	Sample Photograph of PPE
22	LV Arc Flash Jacket	For use in the system voltage >260V <=690V (For persons entering the sub-station, while working on the any electric equipment inside the sub-station or anywhere outside at Shop floor)	
23	Electrical hand gloves	For Arc flash and cut protection for the voltage >260V <=690V	
24	Arc Face shield kit	Arc face shield kit of 12 Cal/Cm2 for the voltage >260V <=690V	

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	OPERATION & MAINTENANCE OF CONVEYOR BELTS	Doc. No: SG/19 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

This safety guideline is meant for safe working in conveyor belt system during operation, maintenance and belt changing activities preventing hazards like getting caught/ pressed between objects, injury due to entanglement of clothing, cleaning devices, body parts etc. with running parts of conveyor system, falling of material from height, falling from height, snapping of belts etc.

2. Scope

This guideline is applicable in entire Iron & Steel industry in various areas such as Raw Materials Handling Plant, Coal & Coke Handling Plant, Sinter Plant, Blast Furnace, Steel Melting Shop, Power Plant, Rolling Mills etc. where conveyor belts are used for material handling purpose.

3. Procedure

3.1 Definitions

Conveyor belt: A belt to carry materials and transmit the power required to move the load being conveyed.

Belt Sway: A belt is considered to be aligned properly, when under full load or in no load the edges of the running belt consistently remain within the width of the pulley faces and within the confines of other rolling components, such as idlers. If the running belt deviates from the above definition of aligned tracking, it is called as 'belt sway'.

Spillage: The fall of material from the belt conveyor.

Joint Preparation: Making of new joint in a belt conveyor.

Joint Repairing: Repairing of a damaged joint.

Pulley Lagging: Mounting/ fixing of layer of ceramic or rubber material on the face of a pulley.

3.2 General

- i. Before starting any activity in a conveyor belt, hazards & associated risks to be identified and addressed. In all the activities, the worker must wear the necessary PPEs.
- ii. There must be proper illumination at the working area/ zone in the conveyor belt.
- iii. All the necessary tools and tackles should be checked prior to use in the job.

- iv. During working at height, necessary protections should be taken as per the SG-02: Safety Guideline for Working at Height.
- v. During working in Gas hazardous area necessary protection should be taken as per the Gas safety standard.
- vi. Follow all norms of permit to work system as per SG-04: Safety Guideline for Permit to Work (Operation & Maintenance).

3.3 Safety Precautions during maintenance work in a Conveyor Belt

3.3.1 Conveyor Drive

- i. Stop the conveyor belt, when it is empty. Never stop the belt in load.
- ii. Ensure permit to work system is followed before starting of work as per SG-04: Safety Guideline for Permit to Work (Operation & Maintenance).
- iii. Only designated persons shall operate, repair or service the conveyors.
- iv. As an additional safety precaution, one or two pull cord switches should be kept in pulled position so that even if the conveyor is powered on, it will not run.
- v. Before changing/ replacing of any component of the drive (coupling, gearbox or motor), do the positive isolation of potential energy source (take-up unit) of the belt by holding it with a pair of suitable chain blocks. Select the chain blocks from [table-1](#). To hold take up, lift it by 6-8 inches to take GTU (Gravity Take-up Unit) load by chain blocks. It is also desirable (although not a must) to place the 'I' beam/ channel at correct position under the gravity take up. Internal inspection of gearbox components should be done through the provided inspection cover only and its top cover should not be opened at site.
- vi. The oil level in fluid coupling should be maintained as per mentioned quantity in its manual. The slip in fluid coupling should be less than 3%.
- vii. In the pin-bush and gear couplings, the minimum gap between the flanges should be maintained as per the recommended value according to their size as per OEM.
- viii. All the moving/ rotating components of the drive should be covered by standard safety guards.

3.3.2 Counter Weight

Follow steps i, ii, & iii of section 3.3.1.

- i. Spillage material accumulated on counter weight should be removed on regular intervals.
- ii. A counterweight and its pulleys suspended above the floor or ground, in an area where an employee could walk, shall have an enclosure around the area of impact or a catch pan under the counterweight of such strength and design

- to hold the counterweight and pulley from dropping to the ground, floor or platform.
- iii. The concrete slab type counter weight should be replaced by box type closed counter weight.
 - iv. The rope of the counter weight should be checked at regular intervals for its strands condition and bulldog grip looseness.
 - v. When two wire ropes hang the counter weight, the wire ropes should be of opposite lay. This will avoid twisting of counter weight about its vertical axis.
 - vi. There should be proper gap (minimum 2 mm) clearance between the 'L' shaped guide clamp and the guideposts of the counter weight.
 - vii. The weight of the GTU should not be increased/ decreased without consulting the designer/ expert of the conveyor belt.
 - viii. There should be minimum 2.5 m to 3.0 m clearance between the counter weight and ground.
 - ix. Sufficient volume of sand may be ensured to take care of the impact of counterweight if rope is broken.
 - x. Wire Mesh guard to be provided around the GTU.

3.3.3 Chute (Receiving or Discharge chutes)

Follow steps i, ii, & iii of section 3.3.1.

- i. Before starting any job in receiving chute, power of the preceding belt or feeding device must be isolated. Similarly, before starting any job in the discharge chute, power of the succeeding belt must be isolated. In addition the chute must be checked for loosely held material inside and cleaned before entering.
- ii. The side skirt rubber should not be kept in contact with the belt. This may create longitudinal groove on belt top cover and increase friction also.
- iii. The inside space between side skirt boards (left and right sides) should be two third of belt width.
- iv. Never use metal plate or piece of belt as a side skirt(s) as it may damage the belt.
- v. An inspection cover/ window should be given in chute at the non impact-wall. The inspection window can be used for dislodging the jammed material on impact walls or inspection of inside condition of chute.
- vi. To protect the mother plate of a chute, the hard faced liner / wear resistant liner plate / deflector plate should be fixed at the impact zone of chute walls.
- vii. Before executing the welding or gas cutting job in chute, the belt below the chute must be covered by a fire resistant cloth. For welding or gas cutting work follow the safety standard of as per SG-07: Safety Guideline for Gas cutting & Gas Welding.

- viii. There must be proper clearance between the pulley (discharge pulley or tail pulley) end face and the inside wall of the chute.
- ix. If the dust content in the material handled is high, a dry fog or Dust Extraction system should be installed at the receiving chute.
- x. Heavy or long chute shall be made in pieces and flanged joint at position.
- xi. 24 volts hand lamp only should be used for inspections as well as performing any job inside the chute.
- xii. For performing job inside the chute, all the precautions for confined space work to be taken as per SG-03: Safety guideline for Working in a Confined Space.

3.3.4 Belt joint (Vulcanized or Mechanical)

Before starting the repairing or preparing of belt joint follow steps i, ii, & iii of section 3.3.1.

- i. Fix the jam angle with deck plate/ stringer at a sufficient free length (3 m to 5 m from the joint), towards head end of the conveyor belt.
- ii. To pull the loose belt, it should be clamped with a pair of angles (also called as pulling angles) at a distance of 3 to 5 m from the joint & towards tail end.
- iii. Pull the belt from the pulling angles with the help of suitable chain blocks & slings.
- iv. Clamp the belt with a pair of jam angles and hold it with deck plate/ stringer. This should be at a suitable distance from the pulling angles & towards tail end of the conveyor belt. Before applying the adhesive the joint surface must be cleaned thoroughly and the surface should be made free from moisture.
- v. In case of mechanical joints of belt, proper selection of fastener and bolt tightening should be done.
- vi. If there is pocket formation at joint or the edge of the joint is found uprooted, it should be repaired immediately.
- vii. After joining and curing time, the counterweight shall be released slowly to load the belt gradually. After full counterweight is released, the conveyor should be run in no load to observe the performance of the joint.

Precautions: In case of short length belt where tilting of belt is not possible, exact length of belt to be spliced to avoid the dressing.

3.3.5 Pulley

- i. Pulley should be checked for its lagging condition (if lagging is present), axial shift and its bearing condition on regular intervals.
- ii. Weld-joint condition of the disc with hub and shell of the pulley should be checked at every six month.

- iii. Before starting the repairing or checking inspection work, where pulley is required to touch, the steps explained in section 3.3.1 must be followed.
- iv. Entrapment of material between tail pulley and return-side belt should be avoided by fixing an inclined plow/ scrapper on the belt at return-side.
- v. If the bearing temperature of the pulley is found above 70 °C, the grease quality, quantity and radial clearance of bearing should be checked. Always close the greasing points after completion of greasing.
- vi. The tail pulley of a conveyor belt should be guarded as per as per SG-09: Safety Guideline for Equipment & Machine Guarding.
- vii. Ceramic lagging on bend pulley should be avoided as it increases the friction and overall tension in the belt. If lagging is required, preferences to rubber lagging should be given.

3.3.6 Idlers

- i. The jammed or damaged idlers should be replaced immediately, as they have high potential of damaging the belt (specially the belt joint).
- ii. The space between two idlers should be maintained as per standards, based on belt width and bulk density of material. For example, for a belt of width 1,200 mm and carrying material of bulk density 1.2 t/m³ the distance between two troughing idlers should be 1.0 m and that for return flat idlers should be 3.0 m. Distance between two idlers below the chute to be 0.5 m to avoid belt sag which should not be more than 2%.
- iii. The minimum distance between two troughing-trainer idler should be 15 m and that for return trainer should be 30 m.
- iv. For better control on belt sway, the 'tru-trac'/ self aligning idlers can be used, such as, In return side, fix the idler (i) at 4.0 m away from the tail pulley. (ii) At about 2.0 m towards head end from the bend pulley of GTU and (iii) In return side, at 4.0 m away from the head pulley.
- v. Rubber lined impact idlers should be used at belt loading point.

3.3.7 Deck plate

- i. Deck plate must be given below the troughing belt. It protects the entrapment of spillage material between the rotating pulleys and the belt.
- ii. The locations where the conveyor gallery is passing over the road or working area, the deck plate below the return belt must be provided.
- iii. Continuous deck plate to be made for conveyors inside the building/ unit.
- iv. Seal plate shall be provided for belt conveyors.
- v. For repairing or fixing of a deck plate, as per SG-07: Safety Guideline for Gas Cutting & Gas Welding should be used.

3.3.8 Belt safety switches (Zero Speed Switch, Belt Sway Switch, Pull Cord Switch)

- i. The ZSS switch should be cleaned thoroughly at regular intervals.
- ii. The length of lever of 'belt sway switch' should be in the range of belt during belt sway.
- iii. The 'pull cord switch' with LED indicator should be used and distance between two pull cord switches to be maximum 30 mtr. If length of the belt is less than 30 mtr., it should be 15 mtr.
- iv. All the belt safety switches should be tested periodically (at suitable frequency) for proper functioning.
- v. Before repairing or changing of belt safety switches, the step i and ii of section 3.3.1 should be followed.
- vi. Electro-mechanical brake or ratchet device should be provided in drive system of conveyor belt in order to prevent roll back while tripping/ stopping of conveyor of conveyor under load condition.

3.4 Safety Precautions during Operation work in a Conveyor Belt

3.4.1 Belt sway (Belt Tracking)

- i. Avoid working near the conveyor with wearing loose clothing or jewelry. Do not put your hands on a moving conveyor belt.
- ii. Provide proper illumination at the working zone.
- iii. Ensure the 'OK' condition of pull cord and emergency stop switch of the conveyor belt by schedule inspection.
- iv. Keep one skilled person with 'walky-talky'/ Appropriate Communication system near the pull cord/ emergency switch.
- v. Communicate with control room before aligning/ tracking the running belt.
- vi. Move the trainer idler by pushing/ pulling its frame from the ends only.
- vii. Do not try to move any damaged/ jammed trainer idler.
- viii. Stay away from any rotating parts of conveyors.
- ix. Scrapper condition shall be checked at regular intervals.

3.4.2 Spillage recovery/ cleaning

Follow step i and ii of section 3.3.1.

- i. Do not stand /walk on the belt.
- ii. The spillage material accumulated below the return side-belt or on the deck plate should be cleaned by hand scrapers only.
- iii. The spillage material should be collected in bucket and it should not be

thrown down from conveyor gallery.

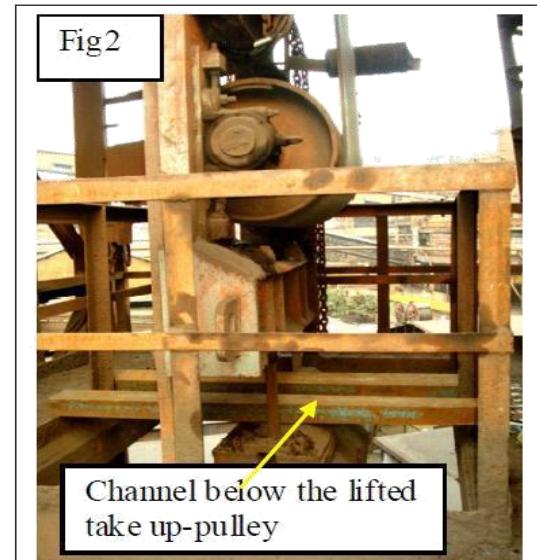
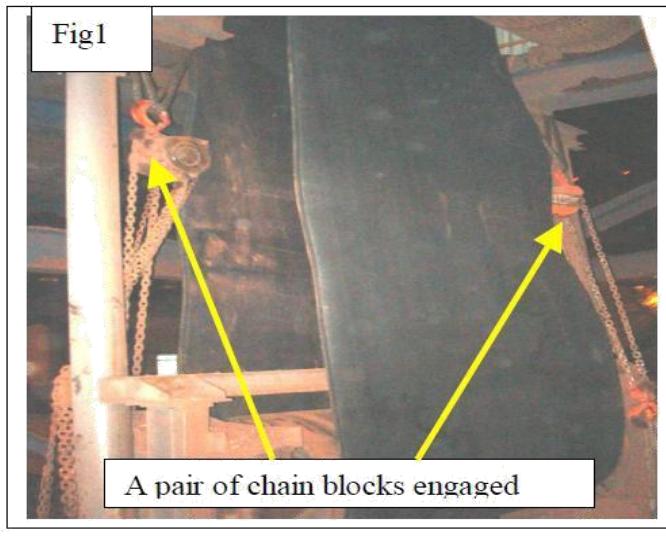
- iv. Throw the collected spillage material on belt, only from those positions, where the safety guards are provided on belts.
- v. Never heap up the spillage material at the tail end of the conveyor.
- vi. If the spillage material is in large amount (more than one ton), the conveyor should be taken in local operation mode. Start the belt in empty condition. Keep one person at pull cord. Communicate with control room and start throwing the collected spillage material by bucket on the running belt from the safety guard positions only or station made for this purpose.

3.4.3 Start/ Stop of belt

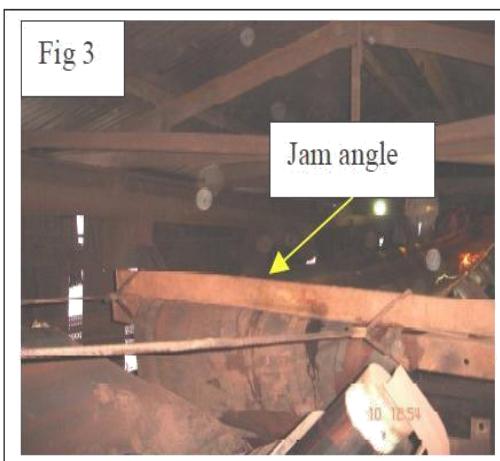
- i. Sequential start/ stop shall be ensured for conveyors except in emergency to avoid spillage.
- ii. Ensure proper Pre-start warning/ Alarm system before starting of any conveyor with minimum 30 seconds delay.
- iii. If a conveyor belt needs stopping, it should never be stopped in loaded condition, except emergency.

3.5 Belt Changing job

- i. New belt roll should be put on a fabricated & heavy stand and roll shaft to be locked from top on supporting points. The stand should be sufficiently heavy and stable to avoid tilting of stand while the belt is being changed.
- ii. Belt changing area should be properly barricaded by safety ribbon and a safety observer should be deployed throughout the job (Follow as per SG-11: Safety Guideline for Barricading).
- iii. Follow steps i, ii and iii of section 3.3.1.
- iv. Belt conveyor should be put under local mode, if running of motor is required for belt changing activity.
- v. Before starting any activity in conveyor belt, do the positive isolation of potential energy source (take-up unit) of the belt by holding it with suitable chain blocks. Lift the Take-up by 6-8 inches (Refer Fig. - 1).
- vi. Take-up must be lifted and held with two numbers of suitable and tested chain blocks. Selection of chain block to be done as per the [table-1](#).
- vii. It is also desirable to place the 'I' beam/ channel at correct position under the gravity take up, to avoid the free fall of take up. (Refer Fig. - 2).

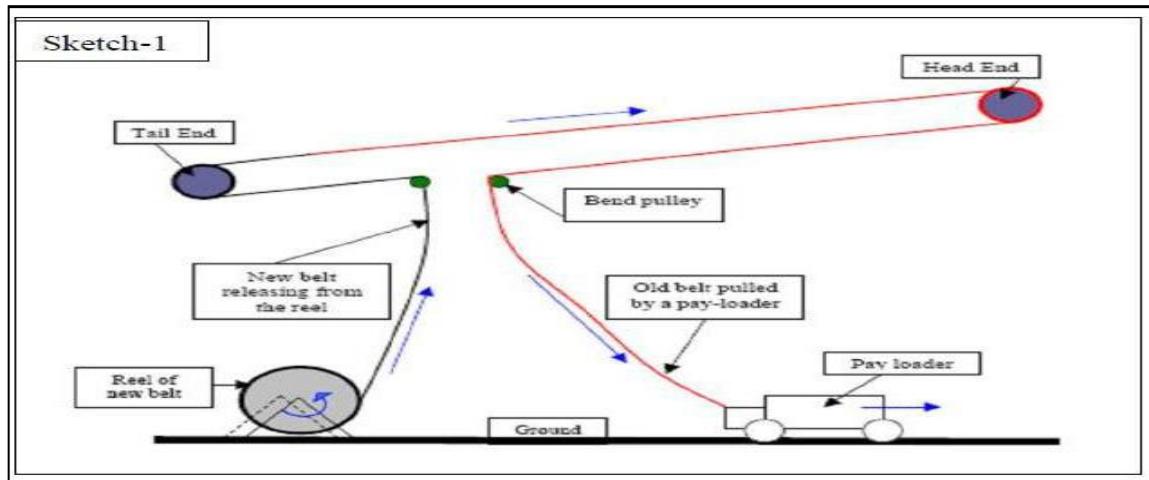


- viii. Before cutting of old belt, it should be clamped properly with conveyor deck plate by 2 nos. of jam angles (refer [Table 2](#)) on both side of the cutting position. (Refer Fig. - 4).



- ix. To avoid slip or damage of conveyor belt, a rubber piece should be inserted in between the jam angle & conveyor belt.
- x. One end of new belt should be joined with old belt by plate-fasteners. During jointing, no of fasteners should be as per the given [table 3](#).
- xi. The other end of old belt, which is supposed to be pulled out, should be clamped with holding T-shape plates. (Refer Fig. - 5).
- xii. Positioning the belt at a suitable place for joining the belt and stop the conveyor belt.
- xiii. Do the positive isolation of all the electrical power sources of conveyor system (including preceding and succeeding conveyors)

- xiv. Holding plate with D-shackle should be tied with sling and hook to the pulling device.
- xv. Release the jam angles and pull the old belt manually or by some external pulling device (Like winch or pay loader). The new belt to be pulled from reel by inching drive with local switch. (Refer Sketch-1).

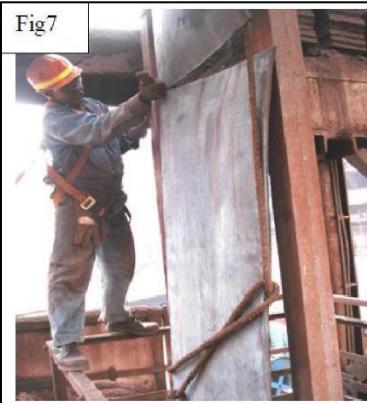


- xvi. The speed of pulling device should be very slow max. 15 meter/ min.
- xvii. If belt is longer (more than 250 mtr. and at height), three persons should co-ordinate through Walky-Talky. One with local switch operator, second with the pulling device and the third along with joint movement.
- xviii. If belt gallery is at more than 15 m height from ground, when about 5 to 8 m of new belt remains in the wooden reel, pulling of belt to be stopped.
- xix. Belt to be held in gallery at any point to avoid any movement in the belt.
 - a) Open/ un-wrap the new belt from reel and hold the free end of the new belt with 'T' shape plates & wire rope. (Refer Fig. - 5 & sketch-1). The rope length should be more than the height of gallery from ground.
 - b) Wrap the rope with a fixed and robust structure.
 - c) Holding of the belt in gallery to be released. Now pulling the belt and releasing rope to be done simultaneously.
- xx. The old belt should be pulled slowly and after complete replacement of old belt, both ends of new belt to be joined with plate fasteners (Refer Fig. - 6) and the joint to be positioned in required place for vulcanizing by using belt drive.



- xxi. After all these activities are performed & belt changing is complete, power cut-off clearance to be taken and positive isolation locking to be done properly.
- xxii. If there is excess new belt before cutting, it should be held with rope and other end of rope should be fixed / anchored with robust structure at upper level. (Refer Fig.-7)
- xxiii. After vulcanizing, idlers to be set in their position release the take-up and put tension on the belt.
- xxiv. Once again inspection to be done to see “Is any jam angle left intact with belt?” If not, Job completion clearance to be given.
- xxv. Ensure provision of suitable Power Outlet at suitable location for facilitating connection to hand lamp, Grinders, heaters etc.
- xxvi. Ensure suitable fire fighting arrangements like fire extinguishers, Fire Hydrants, Sprinklers etc. at job site.

Fig7



References

- a) IPSS: 1-11-026-16 “Safety Standards on Opn. and Maint. of Conveyor Belts in Steel Industry”.
- b) Relevant Indian Standards IS: 7155-1986.

Table – 1: Table for selection of Chain block

Belt width (mm)	Belt length (m)	Chain Block Size (Ton)
Up to 800	Upto 600	2 T + 2 T
1000	Upto 300	2 T + 2 T
	Above 300 – up to 600	3 T + 3 T
	Above 600 – up to 1300	5 T + 5 T
1200 - 1600	Upto 300	2 T + 2 T
	Above 300 – up to 500	3 T + 3 T
	Above 500 – up to 800	5 T + 5 T

Note: The size of chain pulley block for holding the counter weight shall have a capacity of 1.5 times the weight of counter weight, along with take up pulley and pulley frame.

Table – 2: Table for selection of Jam Angle

Length of angle	Cross section of angle	Remarks
1.5 X Belt width (mm)	90 X 90 X 8 (mm)	<ul style="list-style-type: none"> 1. Fasteners: Size-M20 grade 8.8, Quantity: 2 + 2 2. To avoid slip or damage of conveyor belt, at the point where jam angle has to be fixed, a rubber piece should be inserted in between the jam angle & conveyor belt.

Table – 3: Table for selection of Belt fastener

Belt width (mm)	Minimum no. of fasteners	Distance between two clip-fasteners
800	10	Approx. - 75 mm
1000	12	Approx. - 75 mm
1200	16	Approx. - 75 mm
1400	20	Approx. - 75 mm

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	OXYGEN & NITROGEN GAS LINES	Doc. No: SG/20 Rev no. : 00 Effective Date : 14.10.2019

1 Objective

The objective of this guideline is to provide safe working procedure while carrying out jobs on Oxygen & Nitrogen system in Iron & Steel Industry and to prevent from the major hazards such as fire & explosion in oxygen service and Asphyxia in case of nitrogen gas lines.

2 Scope

This guideline covers the safety requirement for safe handling and working with Oxygen & Nitrogen gases in pipe lines in iron & steel Industry. This guideline does not cover the aspects of handling and working with oxygen & nitrogen gases in cylinders.

3 Procedure

- 3.1 **Protocol** - It is a document which lists the activities sequentially for the work to be taken up along with the persons responsible for that particular job with a view to ensure safety.

A protocol shall include the following:

- i. Nature of the work.
- ii. Time of commencement and expected duration of the work.
- iii. Name of the coordinating department for the work.
- iv. Name of the person In-charge for execution of the work.
- v. List of preparatory jobs to be done prior to the commencement of the actual work and the name of person/ department to carry out the work.
- vi. List of safety provisions and facilities like rescue gadgets, Ambulance and fire safety equipment to meet any Emergent situation.
- vii. Sequence of the activities for carrying out the work with name of person responsible for each activity.
- viii. List of safety precautions to be taken/ observed by the working personnel with the name of the supervisor who will ensure the compliance.
- ix. A sketch or schematic diagram showing the gas path and indicating the location of each activity and affected portion/ section.

- 3.1.1 A protocol shall be prepared for carrying out any maintenance activity on charged or uncharged gas lines and associated system after discussions amongst the relevant/ concerned persons and/ or departments.

- 3.1.2 If the work falls within one department, the protocol shall be proposed by the executing agency under whose charge the work is to be carried out. It shall be signed by them, maintenance agency, departmental safety officer and connected person from the safety engineering department, Fire Service department and Energy Management Department and shall be approved by the head of the department. In case of other departments are affected/ involved, the signature of the HOD of concerned department shall be taken and the protocol shall have the signature of approval by the divisional head. In

case the work involves larger area or the entire plant, the signature of the heads of all the affected/ involved departments shall be taken on the protocol and shall be approved by the head of the plant/ work.

- 3.1.3 If the work is of repetitive nature, a standard protocol may be used every time after revalidation by the HOD or the head of the Division or the head of the plant, as the case may be, with fresh signature and date.
- 3.2 **Work** - The activity related to the handling and working with the gas_(Oxygen, Nitrogen).

4 General Safety Requirements

- 4.1 All maintenance jobs on a charged (de-pressurized Nitrogen only)/ isolated gas lines or associated system shall be carried out as per approved protocol.
- 4.2 Danger Boards shall be displayed at conspicuous locations in the hazardous gas installation and gas pipeline areas, to draw the attention of the persons entering the area, about the imminent danger. Barricading shall be done around area of work and entry of unauthorized persons shall be prevented.
- 4.3 All standard operating, maintenance and repair procedures as approved by the plant management shall be followed.
- 4.4 Gas handling systems which are not in use shall be isolated by blanking from the working system properly, with its manholes and purging system open.
- 4.5 Gas charging/ commissioning of equipment shall be carried out during daylight hours. In case of exigencies when the work is to be carried out after the daylight hours, it shall be done with the approval of the competent authority and under the supervision of an authorized executive.
- 4.6 Personnel shall not be allowed to work with empty stomach, on gas pipe lines/ systems for blanking, de-blanking jobs etc.
- 4.7 No rest rooms, canteens, office building etc. to be located close to the gaseous area.
- 4.8 Rest/ sleeping in gaseous areas shall be strictly prohibited.
- 4.9 Gas masks shall be used while working in and around the hazardous gas area.
- 4.10 All first aid and fire fighting facilities shall be readily available during working on pipelines.
- 4.11 Smoking of Bidis/ Cigarettes shall be strictly prohibited.
- 4.12 Safety briefing / Tool Box Talk / Pep-Talk shall be given to all workers daily before start of work.
- 4.13 Proper ventilation shall be provided in control rooms having gas pipelines and impulse lines.
- 4.14 Provision of fixed gas monitors in control rooms having gas pipelines and impulse lines shall be made.
- 4.15 Gas safety equipment shall be kept separately with mark for checking and refilling.

- 4.16 Pipe lines and associated equipments shall be periodically inspected as per procedure (see S. No. 5) approved by the competent authority and shall be recorded.
- 4.17 Minimum two persons shall work in gas hazard areas and they should carry a calibrated portable CO/ multi-gas detector.
- 4.18 Impulse lines from gas mains to instruments shall be cleaned with compressed air / Nitrogen after ensuring proper isolation of the gas line.
- 4.19 Lighted gas burner in enclosed space shall not be left unattended.
- 4.20 Gas impulse lines shall not be repaired under pressure.
- 4.21 Gas impulse lines shall not be blown out with mouth.
- 4.22 All gas pipe lines shall be distinctly marked with colour code as per relevant Indian Standard.

5 Safety Provision In Standard Operating Procedure (SOP)

SOP shall include the following:

- i. Sequential description of process and details of equipment's operating parameters.
- ii. Frequency of inspection of instruments, protection schemes and control systems.
- iii. Characteristics, MSDS and proportion of gases.
- iv. Description of hazards, their safeguards & Job Safety Analysis.
- v. Procedure for start-up, shutdown (Isolation, blanking, purging etc.) for the process & equipments.
- vi. Steps to maintain normal regime/ parameters of the process.
- vii. Methods to handle high and low pressures, fire, leakages, power failure and equipment breakdown in the associated systems and process.
- viii. Disaster combat plan / Emergency Action Plan.

6 Safety Provisions in Standard Maintenance Procedures (SMP)

SMP shall include the following.

- i. Equipment specifications and details.
- ii. Scope, type and frequency of inspections.
- iii. Type of lubricants to be used with needed frequency of their change.
- iv. Identification of critical spares and inventory management plan.
- v. Schedule of maintenance activities (with description).
- vi. Description of hazards, their safeguards & Job Safety analysis.
- vii. Procedure for record keeping.

7 Training

- 7.1 All persons working on gas lines/ equipment shall be trained in gas safety and rescue operations and shall be deputed for training to periodic refresher program.
- 7.2 The Operation and Maintenance Personnel Shall be adequately trained in SOPs and SMPs.
- 7.3 Training for handling cryogenic gases as applicable.

8 Specific Safety Requirements for Oxygen

- 8.1 No work shall be carried out over charged section of Oxygen gas lines. Complete isolation and purging with nitrogen gas of the working part shall be ensured before start of work.
- 8.2 Work shall be carried out after isolating the line/ equipment by putting a blank after the isolating valve.
- 8.3 The isolated pipe shall be purged to bring down Oxygen level to 22% maximum.
- 8.4 All tools to be used in the work shall be washed in Tri Chloro Ethylene (TCE) before starting the work to ensure absence of inflammable sticking substances on them. Following shall be marked on the Containers with Trichloroethylene and other solvents:
 - a) "Poison"
 - b) "Keep away from source of heat or fire".
- 8.5 The pipeline and associated equipment shall be cleaned and degreased thoroughly before charging the line/ equipment
- 8.6 Housekeeping in the vicinity of oxygen pipe line shall be proper and so arranged as to ensure smooth working and ease of execution of disaster combat plan {see S.No. 5.1 (h)}.
- 8.7 The functioning of pressure relief valve shall be checked by a competent person at least once a year and record maintained.
- 8.8 The protection system between liquid and gaseous oxygen shall be checked at least once a month for ensuring their proper isolation.
- 8.9 Grease and oil shall not be used in Oxygen handling installations. Hydrocarbon shall not be stored in areas having fittings on the oxygen line.
- 8.10 Oxygen line shall not be used for cleaning the dust from the body/ dress. It is very dangerous.
- 8.11 Oxygen line shall be properly cleaned and made dust free before charging.

9. Specific Safety Requirements for Nitrogen

- 9.1 The work shall be started only after isolating the line/equipment by putting a blank after the isolating valve.
- 9.2 A person shall be allowed to enter a vessel or area adjoining a pipeline for work only after ensuring presence of minimum 19.5% oxygen is there and after the written clearance of the competent person (head of department, division or plant as the case may be, reference to Clause 3.1.2).

9.3 People working in the area should carry a portable oxygen monitor.

Reference

1. IPSS: 1-11-002-19 "Safety Procedure For Oxygen, Nitrogen and Fuel Gases"
2. IPSS: 1-06-034-17 "Code of Practice for Oxygen Gas Pipeline"
3. IS: 309 – 2005 "Compressed Oxygen Gas"

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	HANDLING FUEL GAS	Doc. No: SG/21
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1 Objective

Objective of this Safety guideline is to outline basic safety requirements in handling fuel gases such as BF gas (BFG), CO gas (COG), LD gas (LDG) & their mixtures (MG) and Liquid Petroleum Gas (LPG)/ Propane. It describes the precautions to be taken, safety appliances to be available and their use in working with above gas lines to prevent from their main hazards of fire, explosion & gas poisoning, Nitrogen exposure etc.

2 Scope

This guideline is applicable for working with above fuel gases in iron & steel industry.

3 Procedure

3.1 Salient Properties of BFG, COG, LDG & MG

Table 1 – Salient Properties of BFG, COG, LDG & MG				
Limit	BFG	COG	LDG	MG
Toxicity	Highly Toxic	Toxic	Extremely Toxic	Highly Toxic
Flammability	Inflammable	Inflammable	Inflammable	Inflammable
Carbon Monoxide %age in volume	23 - 27	6 – 10	60 – 70	10 – 60 Depending on composition
Explosiveness	Explosive	Explosive	Explosive	Explosive
Lower Explosive Limit (LEL)	35% in air	6 % in air	15 % in air	10 – 30% Depending on composition
Higher Explosive Limit (HEL)	73.5 % in air	31 % in air	72 % in air	35 – 70% Depending on composition
Identification of gases (by smell)	Odourless	Burning Tar Rotten Egg or Rotten Fish	Odourless	Odourless

3.2 Effect of Carbon Monoxide (CO) on Respiratory System

The carbon monoxide when breath in along with air is absorbed by the blood and deprives the blood of oxygen carrying capacity and forms carboxy hemoglobin in place of oxyhemoglobin. Hemoglobin has 200 to 300 times more

affinity for carbon monoxide than oxygen. The body tissues suffer from anoximia (lack of oxygen).

Symptoms of gas exposure: Headache, Nausea, Vomiting, Feeling of giddiness, difficulty in breathing, Impaired Judgment.

3.3 Effect of Various % of CO in Blood

CO in Blood (%)	Effects
0-10	Shortness of breath on exertion
10-20	Increase in shortness of breath and slight headache
20-30	Headache is more pronounced, irritable, judgment impaired, vomiting
30-40	Becomes confused, faint
40-50	Above symptoms are intensified with increased pulse rate respiration
50-60	Unconsciousness
60-70	Respiration may fail, death may occur

3.4 Fire in gas lines



3.4.1 Fire due to fire source

It needs presence of ignition source in the vicinity from gas cutting welding spatters, electrical sparking, sparking from tools and tackles, or thunder etc. Standard practices to be taken for hot work in gas line.

i. Prevention

Before commencing and/ or executing any work in and around the gas line one should ensure:

- There should not be any naked power cabling near gas lines.
- No leaky flammable gas lines nearby. Inform the owner of the gas lines if any leakage is found from the pipe, fittings or flanges. Start the job only after the gas line owner attends the leakage.
- The tools and tackles to be used for gas line maintenance should be non-sparking, non-ferrous material.

- d) Ensure availability of ambulance & Fire Tender, Sand Bag to encounter of casualty / fire hazard.

3.4.2 Fire due to Hot Work (Cutting/ Welding/ Grinding/ Drilling Job) near Charged Gas Line

i. Prevention

- a) Thorough analysis of the job to address the potential source of fire with meticulous prevention and mitigation plan.
- b) Check physically the pipe thickness before start of welding job on gas line.
- c) Check for presence of CO% in the working area / vicinity of job less than equal to 50 ppm.
- d) Check for presence of explosive mixture before start of job.
- e) Put clay/ POP (Plaster of Paris) in the joints of all nearby gas lines and cover with fire-proof ceramic cloth.
- f) Gas cutting torch flame should not "hit" the charged gas pipelines.
- g) No inflammable material should be present below the working area.
- h) Do not use gas pipe/ gas pipe supporting structure for earthing the welding m/c. Earthing should be near the welding spot.
- i) Continuous CO monitoring should be done throughout the job.
- j) Keep ready the fire hose with nozzle at the job point.
- k) Keep sufficient nos. of DCP/ CO₂ type fire Extinguisher at site (at least 2).
- l) If the presumed severity of fire is very high, make the fire tender stationed at the site.
- m) During welding on live gas line, % oxygen present in the gas to be monitored on regular basis and should be less than 1%.
- n) During the welding on live gas line the current should be kept under control all the time (70 – 100 amps). Suitable welding rod is to be used and the current should be adjusted so that the parent metal does not get punctured. The welding should not be done in continuous run rather it should be staggered.
- o) Falling of spatters from height must be prevented.
- p) While hot work on gas line, a positive pressure must always be maintained inside the gas line to prevent entry of atmospheric air. If required, Nitrogen shrouding at the welding tip must be arranged by providing N₂ in hose.
- q) Fire retardant cloth shall be wrapped over all the nearby joints.

3.4.3 Fire in COG lines even if there is no hot work

- i. At times, spontaneous ignition is experienced (in the form of white smoke or fire of Coke Oven Gas (COG) deposits either on the ground or inside the pipe laid overhead.
- ii. Most commonly, this occurs during shutdowns when COG pipelines are opened for inspection or maintenance.
- iii. This happens due to presence of Pyrophoric Iron Sulfide (PIS), which is formed by the conversion of Iron Oxide (rust or corrosion deposits) into

Iron Sulfide in an oxygen-free atmosphere where Hydrogen Sulfide gas is present having concentration more than Oxygen.

- iv. The PIS, when exposed to the atmospheric air, oxidizes exothermically. This results in the formation of excessive heat oxidation and which can ignite nearby flammable material, substances or fuel-air mixtures.



v. Prevention

PIS fires can be avoided by preventing the PIS from contacting air. This can be achieved by maintaining a continuous layer of liquid or inert gas between the material and the air.

- a) Always purge the gas line, preferably with Nitrogen, before dismantling it.
- b) Immediately after dismantling the pipes, cover the open ends thoroughly to prevent air ingress inside the pipe.
- c) Keep the deposits (inside the pipe) immersed in water, if end capping is not possible.
- d) If possible, maintain a positive pressure inside the pipe preferably with nitrogen supply.

3.5 Job Safety Analysis, Hazard Identification and Risk Mitigation Planning

- i. Define the scope of job with the help of P&ID or rough sketch.
- ii. The P&ID or rough sketch must show all the components of the gas line like, branch connections, drip pots, water seals, isolating valves, vents, purge points and instruments etc.
- iii. Determine applicability of appropriate safety standards.
- iv. List down the requirements of the applicable safety standards.
- v. List down the hazards related to job.
- vi. Carry out the site survey and identify site specific hazards.
- vii. Assess the load of pipe, considering the muck inside the pipe, for proper selection of suitable crane.
- viii. Determine the positioning of crane with the consultation of crane

- operator & the area owner.
- ix. Barricading of the work site to be done.
 - x. Determine the counter measures to safeguard the workmen and the property damage against the identified hazards (Job specific as well as site specific); HIRA (Hazard Identification and Risk Analysis) to be prepared.
 - xi. Quantitative Risk Assessment (QRA) should be carried out whenever a system change or change in operational conditions is initiated in the system based on P&ID of the pipeline network for the Most Credible Accident Scenario.
 - xii. Based on periodical QRA, “High Hazard Probability Zones” should be identified around to minimize risk factors at site, which may lead to hazard initiation.

3.6 Preparation of Checklist Based Standard Operating Practice (SOP)

SOP to be made in details considering the following points:

- i. Sequence of activities.
- ii. Isolation of pipe segment to be replaced with layout diagram.
- iii. Gas isolation document and positive isolation process.
- iv. Monitoring (preferably with the manometers) and controlling the line pressure during purging.
- v. Prepare the checklist as per Checklist based Execution under clause no. 3.13.
- vi. Proper protocol (For definition, refer “Glossary of terms related to safety & abbreviations”) to be made before execution of the job.

3.7 Training and Communication

- i. All the persons working near or on the gas line must undergo General safety training and gas safety training conducted by Safety department.
- ii. A competent person of the department must explain the hazards and risk associated with the job (and site) to the Working agency supervisors through SOP.
- iii. Working agency supervisor will explain the similar thing to all their workmen before starting the job on daily basis.
- iv. Line Manager will hold the communication cum review meeting, preferably a day before the job execution, to communicate vital safety related points to all Working agency employees and review the preparation for job execution.
- v. Line manager will hold the tool box meeting before starting the job.

3.8 Work permits and necessary clearances

- i. Job shall only be started after getting all the clearances and work permits as per SG-04: Safety Guideline for Permit to work (Operation & Maintenance).
- ii. The executing agency shall issue the written gas clearance as per

protocol.

- iii. Area clearance shall be given by the area owner as per protocol.

3.9 Isolation of gas mains

i. Means of Isolation

- a) Combination of isolation valve (Double Disc Gate Valve) & Water Seal (U Seal/ Quick Dump Seal)
- b) Blanking
- c) Goggle Valves (GV)

ii. Isolation with Water Seals and Water sealing breaking

(Refer Figure 1 - General arrangement of U Seal)

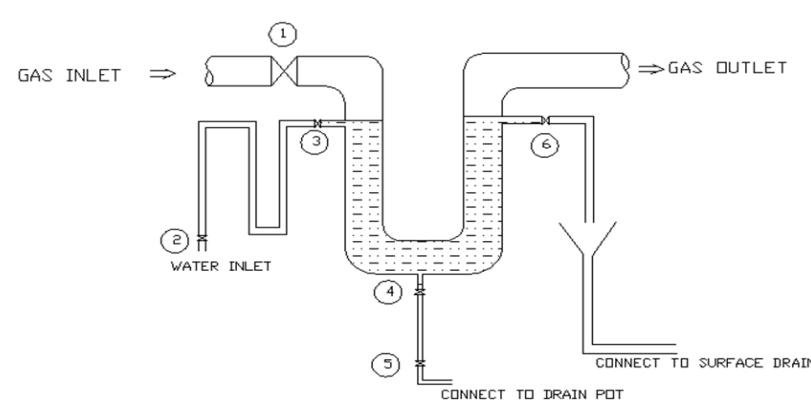


Figure 1 – General Arrangement of U-Seal

A. Water Sealing

- a) Close the Gas isolating valve '1'.
- b) Close the drain valve '4' & '5' and additionally put a blank below the valve '4'.
- c) Ensure sufficient water pressure in the water inlet line.
- d) Open water inlet valves '2' and '3'.
- e) Open water overflow valve '6'.
- f) As soon as water starts coming from overflow line, adjust the water inlet valve '2' so as to ensure continuous trickling through water overflow line.
- g) Water sealing of U-seal is now complete.
- h) Watch from time to time the flow of water trickling from overflow line.

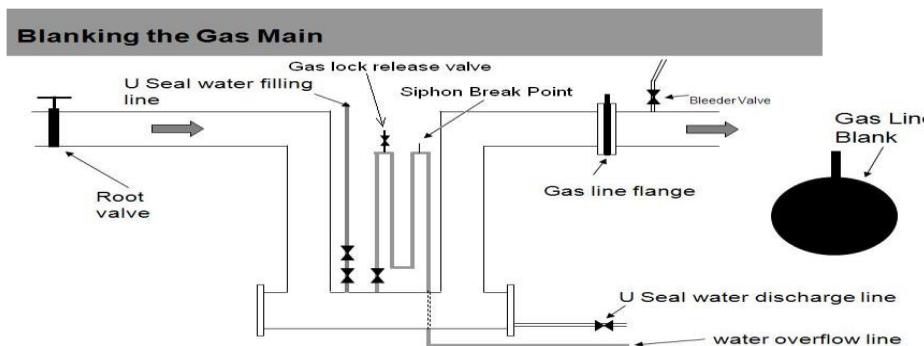
Note: To ensure the proper working of U-seal while maintenance works are ON, a man shall be posted there to check the water overflow.

B. Water Seal Breaking (after necessary purging of gas line)

- a) Close the water inlet valves '2' and '3'.
- b) As soon as water trickling from overflow line stops, close the overflow valve '6'.
- c) Remove the blank below drain valve '4' and open drain valve '4' & '5'.
- d) Ensure water supply to seal pot.
- e) Open the gas isolating valve '1'.

- f) Water seal breaking is now complete.

iii. **Blanking**



(Figure 2 - Arrangement showing the blanking of COG main)

- a) Select an appropriate and safe location for putting the blank in the gas line preferably with Nitrogen flooding arrangement.
- b) Provide standard scaffolding with suitable platform, toe-guard, railing and proper approach.
- c) Arrange for suitable gas mask / Breathing apparatus (as required) to be kept at site to meet any emergency situation. For doing any blanking job, self contained gas mask shall be used. One CO detector should be kept near the suction point of the blower during use to ensure that no CO is sucked in the blower.
- d) Arrange for fire brigade to be stationed near the blanking site.
- e) Check for any possible presence of ignition source in the vicinity, if there is any, it should be taken care of.
- f) Blank of the right size to be kept ready along with gasket/ceramic rope/ ring joint.
- g) Close the gas line isolation valve after getting clearance from consumer.
- h) Do the water sealing of the respective gas line and depressurize the gas line by opening end bleeder at approachable safe location.
- i) N₂ purging of gas line must be done before doing blanking job to evacuate the toxic gas from the line (Follow steps for purging the gas line 3.10 below).
- j) Open out the nut-bolts by easing them. Never do gas cutting or chiseling, instead use Nut-splitter.
- k) Ensure that isolation valves are fully closed, the amount of concentration of gas leakage if any should be under permissible limit (50 ppm). In case the blanking is being done with gas leakage, it is to be done by using gas mask.
- l) All persons engaged for blanking/ de-blanking job should wear fire-retardant cloth.
- m) Use non-ferrous tools for making gap between the flanges. Hydraulic Flange Spreader may also be used for this purpose.
- n) While putting blank, people working in the vicinity should untie their safety belt and stand away from the flange joint on the scaffolding platform. This is to ensure that they can flee away in case of any untoward fire.

- o) While blanking/ de-blanking, plenty of water should be sprayed over the flange joint.
 - p) After Blank is put inside the flange joint and nut bolt is put, the working people in the vicinity should tie their full body harness to do the further job.
 - q) Gasket/ rope should be put on both sides of the blank.
 - r) Same precautions are to be followed during removing of blank from gas line.
 - s) Job to be done under and by the knowledgeable persons and supervisor.
- iv. **Exemption for the job without blanking**
- a) Stringent SOP to be made for such job and approval to be taken from Head of the Deptt. and Safety.
 - b) Closing of the Isolating Valve & putting the tags/ locks, and Water sealing shall be considered as positive isolation with the condition that all the water seals will be manned (having a suitable means of communication) throughout the job execution. The deployed person shall ensure:
 - ✓ that water is continuously over-flowing from the U-Seal.
 - ✓ that make-up water valve for the U-Seal is open
 - ✓ that U-Seal drain valve is closed and locked/ tagged.
 - c) The blanking of nitrogen purge line and locking of the same after nitrogen purging is over.
 - d) If there is no Gas isolation valve before the U-Seal, operation in charge of Gas pipeline should ensure in writing that the design of U-Seal is such that it will not blow off in any abnormal condition or present operating condition.
 - e) The owner of the gas line should ensure that pressure downstream of the U Seal does not affect the overflow of U seal.
- v. **Gas main isolation with the help of Goggle Valves:** Refer SOP on Operation of Goggle Valve (SOP to be developed by user).

3.10 Purging of gas line (after positive isolation)

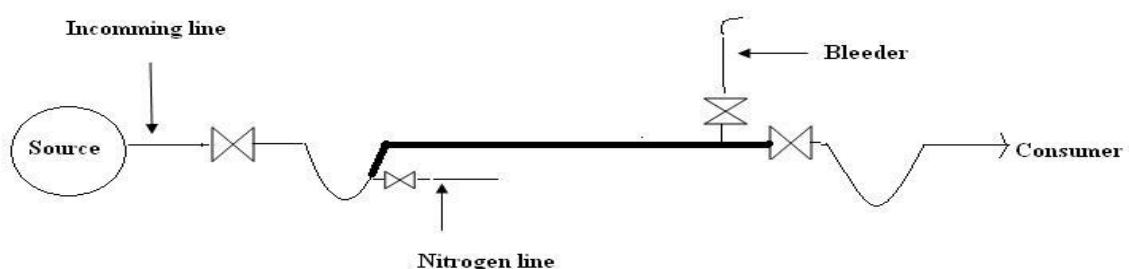


Figure 3: Purging with Nitrogen

- i. Close the gas incoming line valve, if provided.
- ii. Close the outlet gas line valve (consumer's side), if provided.

- iii. Do water sealing in incoming line as per 3.9 above.
- iv. Do water sealing in outlet line (consumer side) as per 3.9 above.
- v. Open the bleeder/ vent valve, just before 1st isolation device (valve or U seal) of downstream line of all consumers to depressurize the gas line & ensure the line is completely depressurized before purging preferably with N₂.
- vi. During purging the gas line preferably with nitrogen, no person to be allowed to stay near the vicinity of end bleeders as high concentrations of nitrogen will not support life.
- vii. Check and ensure the availability of nitrogen or other inert medium for purging.
- viii. Open purging valve nearest to the isolation point.
- ix. Monitor and control the line pressure by installing a manometer in one of the drip pots. The manometer should not be fixed very near to purge in and vent out point to ensure accurate monitoring. Line pressure must be controlled either by throttling the purge in or vent out valves. Drip pot where manometer is fixed should not be used as vent out for controlling the line pressure.
- x. Continue purging till CO concentration at bleeder becomes less than 50 ppm. During checking of CO concentration at bleeder, use suitable gas mask.
- xi. When CO concentration at bleeder becomes less than 50 ppm, close the N₂ purging valve. Purging is now over and gas line job to be carried out from outside. No man should enter inside the gas line to perform the job.
- xii. If any job which requires entry of man inside the gas line, trapped gas to be purged out with air (with the help of suitable mechanical means (e.g. portable compressor or exhaust fan) till O₂ comes above 20%. This is applicable especially for BFG & LDG mains only, as per the requirement of SG-03 Safety Guideline for Working in a Confined Space.
- xiii. In no case man should enter inside CO gas line. However, for entering CO gas line, separate detailed SOP to be developed and followed.

3.11 Job Execution

3.11.1 General

- i. Make a safe approach to working points by scaffolding.
- ii. Give prior information to all the consumers likely to be affected by the job.
- iii. On shutdown day, take written clearance from all the consumers that they have isolated themselves with the affected mains.
- iv. Put equipment tags/ locks to all the isolating points, including that of consumers.
- v. Keep calibrated CO detector with each working group.
- vi. Use Gas Mask if CO PPM is more than 50 PPM.
- vii. Make adequate area illumination arrangement if job is to be continued after day light or in night.
- viii. Workmen can anchor their safety harness at the working platform as long

as hot work is not started. But, before starting any hot work or opening the gas line flanges, the harness should be untied so that workmen can leave the workplace unharmed, in case of any fire.

- ix. Keep capping arrangement ready at site to cover the open ends of the old pipes (dismantled pipes as well as the pipes left at height at their position).
- x. Keep ready the tarpaulin sheet of sufficient size at site to collect the gas line sludge.
- xi. Care must be taken that gas line effluent and contaminated water does not go into the drain or the soil to prevent ground water and land pollution.
- xii. Barricade the working area as well as the crane swing area.
- xiii. Take the road & track clearance, if required.
- xiv. A display board with emergency contact numbers (such as Fire Brigade, First Aid, Gas Safety, Energy centre, Job In-charge working agency etc.) should be kept at the site.
- xv. Make rain protection arrangement at the working point if the job is to be done in the rainy season or the weather is cloudy and it is likely to rain.
- xvi. The crane must be positioned on a rigid and leveled surface. If required, use rigid wooden blocks and steel plate of sufficient size.
- xvii. If any muck/ sludge/ effluent is generated during job execution, same has to be collected on the tarpaulin, filled up in the gunny bags and disposed-off suitably.
- xviii. Any steel scrap (old pipes, drip pots, valves, stubs, structural etc.) generated during the job execution should be disposed-off suitably.
- xix. Clean the area with Water and sweeping, removing all the litters.

3.11.2 Emergency Preparedness

- i. Rescue arrangement to be used whenever anchoring point is possible for using rescue chair. Or, keep scissors' lift for emergency evacuation.
- ii. Ensure availability for the rescue arrangement.
- iii. Key persons working on gas line should be trained, shall know how to wear breathing set and should be trained on rescue management conducted by Fire Brigade department.
- iv. Artificial respirators and gas mask to be kept at site.
- v. Proper accessibility and emergency escape route shall be there.
- vi. If the gas line is likely to catch fire during job execution, keep Fire tenders stationed at the job site or pre-inform the Fire Brigade department to be ready for any emergency call. Additionally keep water and Nitrogen hoses at the working points in ready to use condition. Relevant clauses indicated in SG-16: 'Safety Guideline for Fire Safety' to be adhered.
- vii. First aid along with ambulance & fire fighting arrangement (water, sand, and clay) should be there and people should know how to use it.
- viii. Mock drill shall be conducted periodically as per disaster plan of the plant/ unit.

3.11.3 Off-line Patching/ Cladding

- i. Isolate and purge the line.

- ii. Determine the size of plate depending upon the extent of damage and thickness of pipe where welding is to be done.
- iii. Fix the preformed patch plate and weld it. Avoid continuous run of the weld (should be staggered).
- iv. Soap bubble test to be conducted at working pressure.
- v. In case of any leak, depressurize the line and rectify it.
- vi. In case of no leak, start post purging and charge the gas line.

3.11.4 Online Leakage Repair of Gas Line

(This is an indicative method, however other suitable methods can be adopted)

- i. Use gas masks (preferably self contained); clean the affected surface by nonferrous tools (brush, scrapper or sand paper).
- ii. Plug the hole if leakage is more than pin hole with the help of wooden plug, piece of rubber, waste cloth soaked with cold-weld compound, etc.
- iii. Apply cold-weld compound all around the plugged hole.
- iv. Apply some pressure and hold the putty against the hole for sometime till it gets cured.
- v. Tie ceramic rope over the pipe to hold the cold welding material tightly against the damage portion of the pipe.
- vi. Apply Plaster of Paris (POP).
- vii. If the leak is not repairable by plugging the hole, place a piece of rubber sheet followed by a metallic clamp to arrest the leakage. Apply cold-weld compound all around the rubber sheet to completely stop the leakage.
- viii. Check and ensure no leakage from the repair and repeat the above mentioned steps, if required.

3.11.5 Replacement of Stubs/ spool piece of Vent valve/ Drain valve

- i. Isolate the line and purge the line.
- ii. Maintain a positive pressure in the gas line by throttling the purge medium.
- iii. Gas cut the defective stub piece.
- iv. Fix stub piece and weld it.
- v. Fix up the valve.
- vi. Soap bubbles test the weld joints at working pressure.
- vii. In case of any leak, depressurize the line and rectify it.
- viii. In case of no leak, proceed for gas charging in the line.

3.11.6 Inside cleaning of gas line

- i. Isolate the line either by operating the Goggle Valve or putting a blank at suitable location. THIS JOB SHOULD BE DONE ONLY ON WATER SEAL ISOLATION.
- ii. Purge the line preferably with N₂ till CO ppm becomes nil.
- iii. Purge the line with Air till O₂ becomes >20%
- iv. Open the manhole cover or cut an opening in the pipeline at a suitable location for entry & exit of workmen.

- v. Take confined space clearance as per protocol.
- vi. Issue work permit for the workmen to carry out the job inside the gas line.
- vii. Depute one person with Safety Register, who is solely responsible for monitoring and recording of:
 - a) O₂ concentration, in %, inside the pipe, to be checked periodically.
 - b) Entry and exit time of each person going inside the pipe. No person should be allowed to work more than 30 min. inside the confined space.
 - c) Communicating continuously with the persons inside the confined space.
- viii. Clean the pipe manually or with the help of water jet.
- ix. Hot work inside the pipe is not allowed.
- x. After the job is over, close the manhole cover or patch weld the opening.
- xi. Soap bubble test to be conducted at working pressure.
- xii. In case of any leak, depressurize the line and rectify it.
- xiii. In case of no leak, proceed for gas charging in the line.
- xiv. For CO gas and mixed gas pipeline, pipe shall be properly wetted by water throughout the cleaning process.

3.11.7 In-situ Maintenance of Valve (Goggle Valves, shut-off valves, control valves)

- i. Isolate & purge the line and put blank on both side of the valve.
- ii. Purge the bonnet and body of the valve till CO at vent becomes nil.
- iii. Isolate the energy sources as per SG-22: Safety Guideline for Energy isolation.
- iv. Carry out the maintenance job as per Standard Maintenance Procedure (SMP) guidelines.
- v. Once the job is over, revert back following above-mentioned steps in reverse order.
- vi. Leak test all the joints at working pressure and rectify the defect, if found any.
- vii. Charge the line.

3.11.8 Pipe Replacement

- i. Ease out flange bolt one day before to reduce shutdown duration. Ease out of bolts shall be done only after ensuring positive isolation at the upstream side.
- ii. Isolate and purge the line.
- iii. Position the crane appropriately.
- iv. Loosen and take out alternate flange bolts during crane placement.
- v. Hold the pipe with the help of crane and take out remaining flange bolts.
- vi. Dismantle the pipe, cap the open ends and keep it on the pre-decided location on the ground.
- vii. Lift the new fabricated pipe with the help of crane and position it between the flanges.
- viii. Rest the pipe on saddle after matching the hole of flange.

- ix. Insert the flange bolts.
- x. Insert the sealing rope/ gasket and tighten the fasteners with hand.
- xi. Tighten the fasteners with suitable torque wrench (Hydraulic / pneumatic / manual) in star pattern up to 50% of torque setting.
- xii. Torque the fasteners in star pattern, starting 180^0 opposite to that followed in step xi above up to 75% of torque setting.
- xiii. Now torque the fasteners up to 100 % setting in star pattern that was followed in step 'xi' above.
- xiv. Retighten the fasteners in clockwise direction till 100% uniform torqueing of all the fasteners is achieved.
- xv. Leak test, post purge and charge the line.

3.11.9 Cleaning of Gas line without lowering

- i. Isolate the line.
- ii. Make a suitable "water filling and quick draining" arrangement and fix up it directly either with drip pot drain pipe or down comer pipe.
- iii. Fix up a fire hose, connected with HP water system like fire hydrant, fire tender or HP water jetting m/c.
- iv. Fill the water in the gas line through drip pot and drain through adjacent drip pot, vent, and fittings or through the specially made arrangement. Water filling shall not exceed the design load condition, generally it shall be 20 – 30% of pipeline volume.
- v. Continue till clean water starts coming out from the outlets.
- vi. Charge the line.

3.11.10 Cleaning of Gas line after lowering the pipe

For cleaning the pipe by lowering it, follow the steps explained in 3.11.8 above.

3.11.11 Drip pot root valve poking online

- i. Ease out the valve before poking activity.
- ii. Close the root valve and disconnect the down comer pipe.
- iii. Open the root valve, wearing suitable gas mask.
- iv. Ensure the gas line is not in negative pressure (suction or vacuum). Maintain a positive pressure inside the pipe preferably by injecting nitrogen.
- v. Poke the root valve with the help of long wooden stick or non-metallic rod.
- vi. Once all deposit material (Muck) gets clear, close the valve & connect the down comer pipe.

3.12 Charging of gas lines

- i. Once the job is over, get back all the work permits from the working agencies.
- ii. Pressurize the line preferably with Nitrogen to the working pressure. Pressure can be controlled by throttling Purge In valve, Vent or the drip pot drain valve.
- iii. Ask the working agencies to check all the points, with the help of soap solution to ensure leak-proof joints.
- iv. Hammer the weld joints with wooden mallets to remove any weld slag and expose the weld defects.
- v. If any defect is found, depressurize the line and rectify the defect.

- vi. Repeat the process till no defect is observed.
- vii. Reduce the pressure to throttling the Purge In valve, Vent or the drip pot drain valve.
- viii. Keep on monitoring the O₂ at the vent near isolation point. When O₂ reaches at <1 %, break the water seal from the other extreme end.
- ix. Close the Purging valve.
- x. Keep on monitoring the presence of gas with the help of CO detector at the vent near isolation point, wearing suitable gas mask. As soon as the CO reaches at 1,000 ppm, close the vent.
- xi. Inform Energy Centre and return the clearance to all the consumers, asking them to charge the gas in their system.

3.12 Specific Safety Requirements for Fuel Gases (Blast Furnace Gas, LD Gas, Coke Oven Gas and Mixed Gas)

- 3.12.1 Following maintenance/ repair/ replacement works shall be carried out only in complete isolation of the portion under which work is to be taken up:
 - i. Blanking & De-blanking
 - ii. Valve, compensator repair/ replacement
 - iii. Major repair/ replacement of part of the pipe

NOTE: Wherever, the chance of gases coming in contact with air/ ambient, work shall be carried out with complete isolation of the parts under subject.
- 3.12.2 No personnel shall be allowed to work in or go to the area where fuel gases are present.
- 3.12.3 If the Carbon Monoxide content in that area is more than 50 PPM, use gas masks in such Emergency situation.
- 3.12.4 Online monitoring system with alarm for Carbon Monoxide concentration shall be provided in the areas around equipment/ process handling these gases. Performance of online monitoring system shall be checked once in a month for its proper operation and record maintained.
- 3.12.5 Non sparking tools shall be used while working on charged pipeline and gas handling system.
- 3.12.6 No personnel shall be allowed to work on charged system (where there is possibility of presence of fuel gases) without gas masks.
- 3.12.7 Proper escape route and scaffolding shall be provided while working on charged system at height.
- 3.12.8 The welding current shall not exceed 100 A while welding on charged gas system.
- 3.12.9 Cutting or welding job shall not be allowed on isolated system without analysis and written clearance of the competent person. It shall be done only by trained welders in presence of competent gas safety man. A minimum level of 19.5% oxygen shall be ensured.
- 3.12.10 Proper electrical jumpers shall be provided between flanges and equipments before a gap is created between them.
- 3.12.11 Platform and adjoining structures shall be covered with Ceramic blanket / Fire resistant clothes while blanking and de-blanking and the personnel working shall not be allowed to wear nylon or other synthetic fabric/garments.
- 3.12.12 Fire brigade shall be kept as standby at the place of work in charged system, especially in case of Coke Oven Gas and Mixed Gases. Running steam line shall also be provided during welding.

- 3.12.13 Lime water shall be poured after loosening the bolts of flanges in Coke Oven Gas lines/ equipments at the time of blanking or de-blanking or opening the manhole covers.
- 3.12.14 The deposits/ incrustation in coke oven & other gas lines and associated equipment shall be kept wet either by steam or by water, after the system has been isolated and opened to atmosphere.
- 3.12.15 Cutting in Coke Oven lines and associated equipment shall be carried out after cleaning of the deposits. In case, it is not possible, deposit shall be kept wet and a running steam hose shall be kept in readiness to prevent a fire. Also, ingress of fresh air shall be prevented by blanking the rejected gas lines.
- 3.12.16 All jobs within a radius of 40 m which could be a source of fire/ ignition shall be stopped and unauthorized persons shall not be allowed to remain in the area while shutting down the gas system.
- 3.12.17 Lighting in enclosed area shall be done with portable spark proof electric lamp of 24 V or explosion proof fittings.
- 3.12.18 All pipelines/ systems shall be checked for leakage after completion of repair job. The leakages shall be detected by soap solution and all leakages shall be rectified before charging the system. Steam shall be supplied along with compressed air while testing old Coke Oven and Mixed Gas lines/ systems after repair of leakage.
- 3.12.19 Blanking/ de-blanking jobs on gas lines shall not be taken up at the time of extreme bad weather conditions when the possibility of thundering/ lightning exists.
- 3.12.20 Drain pots and other auxiliaries of gas lines shall be inspected for proper operation at least once a month and record maintained.
- 3.12.21 Permanent connections for purging by steam/ Nitrogen shall be blanked after purging requirements are over.
- 3.12.22 There shall not be any discontinuity in blanking/ de-blanking. Once started it shall be completed at a stretch.
- 3.12.23 Testing of leaks of running mains of Coke Oven, Blast Furnace & Mixed Gases shall be done only by soap water.
- 3.12.24 Persons required to work in gaseous atmosphere shall be trained in First Aid and methods of giving artificial respiration.
- 3.12.25 Water seals/ Drip pots should be installed above ground level and continuous overflow of water should be monitored for ensuring its proper functioning.
- 3.12.26 The Drip Pot/ water seal area shall be fenced to avoid unauthorized entry.

3.13 Checklist based Execution

3.13.1 PPEs:

- i. People are wearing “comfort fit” clothes (i.e. no loose clothes).
- ii. People are wearing cotton clothes.
- iii. People are wearing fire retardant jacket while working near or on gas line.
- iv. People are with proper safety shoes, Safety glass, helmet with chinstraps, hand gloves & Shin guards.
- v. Gas Cutters are equipped with good conditioned long hand gloves.
- vi. Welders are equipped with good conditioned insulated hand gloves.
- vii. Welders are equipped with “hands-free” welding screens in good

- condition.
- viii. Gas Cutters are equipped with good condition cutting goggles.
 - ix. Welders/ Gas Cutters are equipped with fire resistant aprons.
 - x. People are equipped with calibrated Gas detectors.
 - xi. Gas detectors are tested by Bump test before usage.
 - xii. Artificial Respirators is made readily available at site. Artificial Respirators is must wherever gas clearance is required.
 - xiii. Artificial Respirators must be full of oxygen.
 - xiv. People must know how to use Artificial Respirators.
 - xv. Suitable Gas mask & Breathing Apparatus needs to be used,

3.13.2 Fire Safety & Process Safety

- i. Relevant clauses indicated in SG-16: Safety Guideline for Fire Safety and SG-22: Safety Guideline for Energy isolation shall be followed.
- ii. While carrying out gas cutting works, safety guidelines indicated in SG-07: ‘Safety Guideline for Gas Cutting & Gas Welding’ shall be used.
- iii. Fire extinguisher has been kept at site with valid dates.
- iv. People know to operate the fire extinguishers ergonomically.
- v. Fire Hydrant hose pipes have been connected & crack opened for readily usage.
- vi. The trial of fire hydrant water pressure to be taken by opening of the valve so that water reaches at the destination.
- vii. During Blanking/ De-blanking, flange joints or gap at flange joints are being kept wet for elimination of chances of fire.
- viii. Anti-spark (non-sparking) tools are to be used for creating gap at flange joints for elimination of chances of FIRE.
- ix. Isolate the executing portion of gas lines completely from the process from all ends by putting blanks. So, not only the inlet line, but, the outlet line also needs to be blanked. There are cases where, many blanks are required to isolate completely from the system/ process.
- x. During erection / dismantling of Gas pipes, ensure the working pipes as “close ended” as there are potential of fire hazards. Ensure the “deposits/ mucks (inside the pipes) wet” by spreading water and then the open ends are needed to be closed 100% to avoid any cross ventilation. One can use non-metals like ceramic clothes or metallic blanks to “eliminate” cross ventilation.
- xi. During dismantling of Gas pipes, ensure the dismantled pipes as “close ended” as there are potential of fire hazards. Ensure the “deposits/ mucks (inside the pipes) wet” by spreading water and then the open ends are needed to be closed 100% to avoid any cross ventilation.
- xii. In the fire prone zone, or where there are every chances of fire, following things are to be done:
 - ✓ Keep fire hydrant hoses ready for use.
 - ✓ Keep fire extinguishers.
 - ✓ If the presumed severity of fire is very high, make the fire brigade stand at the site.
 - ✓ Isolate the pipeline completely.
 - ✓ An escape route to be ensured.

- ✓ Before this gas cutting, make sure of proper/ perfect load distribution for enhancement of the mechanical integrity. As, this water filling will increase the weight.
- ✓ Proper scaffolding/ working platform to be ensured.
- ✓ Proper barricading of area to be ensured.

3.13.3 Thumb Rules for Working at Height

- i. Guidelines as per SG-02: 'Safety guideline for Working at Height' shall be followed.
- ii. People must climb up & down the ladder by using full body harness.
- iii. People must tie up all the hand tools & tackles with thin but strong threads to arrest their falling from height during usage.
- iv. People must use container to contain the spares, tools & tackles to arrest their falling from height.
- v. The area beneath the working zone must be barricaded to restrict people movement.

3.14 For Liquid Petroleum Gas (LPG)/ Propane

3.14.1 Synonyms are LPG, Propane, Butane, Propylene, Purofax, Bottled Gas. LPG is a mixture of commercial butane and commercial propane having both saturated and unsaturated hydrocarbons. LPG marketed in India shall be governed by Indian Standard Code IS-4576 – 1999. Handling of Propane gas is similar to that of LPG.

3.14.2 Physical & Chemical Characteristics

Characteristics of LP Gas: LP gas is usually stored as a liquid under pressure. When released into the atmosphere at any temperature above its boiling point, -42° C for propane and 0° C for butane, it will change from a liquid to a vapor. LPG on bare skin causes frostbite. LPG is considered to be nontoxic but may have some anesthetic effect if inhaled in high concentrations. LPG at atmospheric pressure and temperature is a gas which is 1.5 to 2.0 times heavier than air.

- i. **Combustion:** The combustion reaction of LPG increases the volume of products in addition to the generation of heat. LPG requires upto 50 times its own volume of air for complete combustion. Thus it is essential that adequate ventilation is provided when LPG is burnt in enclosed spaces otherwise asphyxiation due to depletion of oxygen apart from the formation of carbon-dioxide can occur.
- ii. **Odour:** LPG has only a very faint smell. Ethyl Mercaptan is normally used as stenching agent for this purpose.
- iii. **Toxicity:** LPG even though slightly toxic, is not poisonous in vapour phase, but can, however, suffocate when in large concentrations due to the fact that it displaces oxygen.

iv. Properties of Propane, Butane & LPG

Sl. No.	Particulars	Propane	Butane	LPG
1.	Chemical Formulae	C3H8	C4H10	60% - Butane, 40% - Propane
2.	Max. Vapour Pressure Saturated in Kg/Cm ²	22.66	6.32	16.87
3.	Gross calorific value in Kcal/kg	11900	11800	11840
4.	Specific gravity (liquid) at 15 deg C Water =1	0.504	0.582	0.543
5.	Specific gravity (vapour) at 15 deg C air=1	1.50	2.01	1.75
6.	Ideal combustion Ratio (Air to Gas)	24 to 1	31 to 1	28 to 1
7.	Flammability limits (Upper)	9.60%	8.60%	9.1%
8.	Flammability limits (Lower)	2.15%	1.55%	1.90%
9.	Ignition Temperature (°C)	493-504	482-537	488-502
10.	Volume of gas produced per unit volume of liquid	274	233	250
11.	Volume of air required to burn unit volume of gas	23	30	26
12.	Volume of oxygen required to burn unit volume of gas	4.8	6.25	5.5
13.	Max. flame temperature (°C)	1980	1990	1985
14.	Percent Gas in air for Maximum Flame Temperature	4.4	3.5	3.9

3.14.3 Pre Requirement

When handling or there is potential exposure to LPG, safety glasses and rubber or leather gloves must be worn to protect the body from cold related injuries.

3.14.4 Precautions

When using LPG appliances or equipment, always follow manufacturer's directions and maintain appliances in a clean and undamaged condition. Before operating LPG equipment, be sure connections are tight.

- i. If leaks are present, turn off the equipment and check connections.
- ii. Do not operate until the leak is fixed.
- iii. Be aware that if a leak has occurred, LPG is heavier than air and will settle in low spots such as cellars or drains – so ventilate well.
- iv. Keep vertical cylinders upright, even when empty, to ensure the pressure relief valve can operate effectively. A cylinder lying horizontally and involved in fire is more likely to burst.
- v. Except cylinders designed to operate horizontally they must be stored vertically so safety equipment will work properly.
- vi. LPG cylinders shall be stored outside of buildings or shops.
- vii. Ensure the pressure relief valve is pointed away from the structure supporting the cylinder, in case the relief valve operates and the discharge ignites.

- viii. When using a gas barbecue or other LPG equipment outdoors, be sure the area is clear and free from any ground fuel or litter that may ignite in the event of a fire.
- ix. Protect cylinders from direct sun.
- x. On extremely hot days, if the relief valve operates, cool the cylinder with water.
- xi. Keep cylinders clear of rubbish or brush.
- xii. Any fire around the cylinder will increase the pressure within.
- xiii. Secure portable cylinders.
- xiv. If the relief valve operates, unsecured cylinders could move about rapidly and erratically due to the jetting action.
- xv. Shout and raise alarm / siren in case of unsafe conditions.
- xvi. In case of leakage, stop all operations, close all isolation valves.

3.14.5

Handling & Storage

- i. Stationary installation not exceeding 40 kg of LPG may be installed indoors on any floor. It is recommended to have a minimum floor area of 5 m³ for such installation.
- ii. Stationary installations each not exceeding 40 kg of LPG may be installed indoors on any floor and within the same workspace provided the minimum distance between two such installations is 3 m, the proportion of such installations to floor area is one installation per Sq m and the aggregate quantity of gas of all such installations does not exceed 200 kg.
- iii. Refer IS: 6044 -2001 (Part-2) for capacity higher to above.
- iv. The storage tanks shall not be placed one above other.
- v. Number of storage tanks in one installation shall not exceed six. In case of more than one installation, the safe distance shall be maintained as per Table - 1 of IS: 6044 (Part-2).
- vi. Safe Handling:
 - a) Do not drag, drop or roll cylinders
 - b) The uncontrolled release of a gas under pressure may cause physical harm.
- vii. Conditions for Safe Storage:
 - a) Do not store near sources of ignition or incompatible materials
 - b) Cylinders should be stored upright, on a firm and stable surface.
 - c) Cylinders should be stored in an accessible, well-ventilated area.

3.14.6

First Aid Measures

1.	Swallowed	Due to high volatility of product, this is not likely to occur.
2.	Eyes	<ul style="list-style-type: none"> i. Do not delay– flood eyes gently with clean tepid water (not hot) for at least 15 minutes, or flush eyes for as long as possible with sterile saline solution. ii. Remove contact lenses (if fitted). iii. Seek medical attention.

3.	Skin	<ul style="list-style-type: none"> i. Do not delay – handle patient carefully and immerse in or flush the affected area with tepid water (not hot) for at least 20 minutes. ii. Loosen any clothing that may restrict blood flow but do not remove. iii. Thaw (defrost) out any frozen clothing with tepid water but do not remove. iv. Do not apply any form of direct heat. v. Keep contaminated clothing away from ignition sources as some gas may be given off during thawing. vi. Loosely cover the affected area with a clean, dry dressing. vii. Do not allow smoking or drinking of alcohol as these reduce the blood flow to any affected area.
4.	Inhaled	<ul style="list-style-type: none"> i. Allow fresh air to victim. ii. Excessive exposure may cause unconsciousness or even death, due to asphyxiation (refers to vapour not liquid). If breathing has stopped, or irregular, apply artificial respiration. iii. Seek medical attention.

3.14.7

Fire Fighting Measures

1.	Fire/ Explosion Hazard	<ul style="list-style-type: none"> i. Evacuate area, if required and remove ignition sources. ii. Cut-off gas supply, if it is safe to do so – do not endanger life. iii. Use Dry Chemical Powder only to extinguish the fire. iv. Drench and cool the LPG tank or cylinder with water spray from a safe distance. v. Wait for Emergency Services at a safe distance. <p>Note: If ignition has occurred and water is not available or can't be sprayed on the tank or cylinder safely, the metal may weaken from the heat and explode. The potential affected area should be evacuated immediately, and emergency services notified from a safe location.</p>
2.	Combustion products	<ul style="list-style-type: none"> i. Carbon dioxide, water vapour, traces of carbon monoxide and nitrogen oxides ii. Fumes, smoke, carbon monoxide and aldehydes can be formed during incomplete combustion. <p>Note: Fire fighters may need self-contained breathing apparatus.</p>
3.	Advice to Firefighters	<ul style="list-style-type: none"> i. Temperatures in a fire may cause the tank or cylinder(s) pressure relief devices to open and release gas, or eventually rupture. ii. Cool the tank or cylinder(s) exposed to fire by applying water spray from a protected location.

Note:

1. Fire fighting/ protection facilities shall be as per Oil Industry Safety Directorate (OISD) norms/ American Petroleum Institute (API)/ National Fire Protection Association (NFPA)/ Institute of Petroleum (IP).
2. Water Sprinkler system shall be provided in vulnerable areas like storage tanks, column & hot pumps. Also semi-fixed foam system shall be provided in storage tank area
3. In order to detect leakages in advance hydrocarbon detectors shall be provided in vulnerable areas at all installations including LPG cylinder bank location.

3.14.8

Accidental Release Measures

1.	Personal precautions, Protective equipment and emergency procedures	<ul style="list-style-type: none"> i. Evacuate area, if required and remove ignition sources. ii. Stop flow of gas/ liquid, if it is safe to do so – do not endanger life. iii. Move people from potential affected area, keep up-wind. iv. Notify emergency services. v. Spray water mist to disperse the gas cloud but avoid spraying water directly on leaking container as this may increase leakage. vi. Prevent spillage from spreading or entering underground drains by blocking with wetted cloths, sand or earth.
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3.14.9

Engineering Controls/ Personal Protection

1.	Ignition sources	<ul style="list-style-type: none"> i. Provide suitable ventilation to minimise an explosive environment. ii. Do not bring sources of ignition into a potential hazardous area. iii. Use only intrinsically safe electrical equipment. Do not bring items such as mobile phones, radios, cameras and other non-intrinsically safe electrical equipment into a potential hazardous area iv. Use only appropriate intrinsically safe (certified) tools and equipment in a potential hazardous area. <p>Note: Hazardous area atmosphere zones are not always easy to define or measure, these zone extents may need to be clarified by a competent person.</p>
2.	Ventilation	LPG appliances can be hazardous when used in a poorly ventilated room. Maintain adequate ventilation

3.14.10

Personal Protection: To protect against accidental release of pressurised LPG when there is a possibility of LPG liquid release:

- i. Eyes/ Face: Wear full wrap-around safety glasses or goggles.
- ii. Hands: Wear appropriate thermal insulating gloves.

- iii. Body: Wear reduced static full body cover, cotton or other material with equivalent static and flame resistant properties
- iv. Respiratory: Where an inhalation risk exists, wear self-contained breathing apparatus.

3.14.11

General Safety Requirements

- i. Static Electricity & Lightening Protection:
 - a) Earthing and bonding, telecommunication & instrumentation shall conform to IS: 1913 (Part-1), IS: 2309 & IS: 3043.
 - b) Hand torches if used shall be of flame-proof type.
 - c) All electrical installations within the safety zone shall be of flame-proof type as per IS: 2148.
- ii. Grass & Weed Removal: Readily ignitable material such as weeds, long grass or any combustible materials shall be removed from an area within 3 m from the shell of LPG tank of up to 2,000 ltr. capacity and within 6 m from the shell of larger tanks. For weed killers, chemical having no fire potential hazard shall be used.
- iii. Warning Signs: No smoking or naked flames shall be permitted within the safety zone of the installation. Prominent notices in this regard shall be displayed at access points.
- iv. During working at height, refer clause no. 3.13.3 above.

Reference:

1. IPSS: 1-11-030-17: Safety Standard for Working on Gas Lines in Steel Industry.
2. IPSS: 1-11-002-19: Safety Procedure for Oxygen, Nitrogen & Fuel Gases.
3. Guidelines of IOCL for LPG.
4. MSDS of LPG from Hindustan Petroleum.
5. IS 6044 - 2001 (part-2): Code of Practice for LPG Storage Installations.

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	ENERGY ISOLATION	Doc. No: SG/22 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

To provide a generic guideline for Energy Isolation practices to be observed in Iron & Steel Industries.

Associated Hazards: Electrical Shock, Electrical Flash, Electrical Burn, Fire, Slip/ Trip/ Fall, Hit/ Press/ Cut hazard, Fall of materials from height, Chemical Exposure etc.

2. Scope

This guideline is applicable to all locations of Iron and Steel Industries who adopts energy isolation practices. The Energy Isolation is over and above the existing Work Permit System so in all the cases the existing practice of taking Work Permit shall continue.

3. Procedure

The primary objective of energy isolation is to ensure all energy sources are properly isolated before starting of any maintenance or servicing job on the equipment so that the work shall be done without any injury to personnel or damage to equipment. The example of energy which are positively isolated before work are Electrical, Hydraulic, Pneumatic, Gas Line, Gravitational, Potential Energy, Moving locomotive, EOT crane or any other energy.

To achieve this objective, it is necessary to establish-

- 1) Assurance for the correct isolation through
 - a) Energy Source Identification
 - b) Accreditation/ Authorisation for Isolating Persons
- 2) Assurance that Equipment cannot be energized till person has completed the Job through –
 - a) Personal Locks
 - b) System Locks

Expert's Knowledge is essential for design & implementation of Energy Isolation Lock out Tag out (LOTO) safety procedure and awareness and training of workforce is vital for implementing and sustaining it.

3.1 Isolation Locks

Four types of locks which shall be used for four different purposes and shall be identified through their distinct colour. All isolation locks shall have unique and single key. The Serial No. is to be engraved on the body of the lock.

Personal Locks: A lock attached by Individuals for personal protection after an Isolator is placed in the safe (Isolation) position. The owner's personal details are mentioned on the sticker put on Personal Protection Locks.

- i) **Red Colour Lock** - Self-protection for own Employees.
- ii) **Blue Colour Lock** - Self-protection for Contractor Employees. Contractor's supervisor shall put for himself & on behalf of his workers.

System Locks:

- i) **Black Colour Lock** - Group lock - A lock attached by **the equipment owner who is issuing the working clearance** to a Group Isolation Box and to secure Equipment Lock keys.
- ii) **Yellow Colour Lock** - Equipment Lock - A lock attached by an Isolating Person to an Isolator in the safe position to prevent accidental or inadvertent movement.

For the Equipment Lock and Group Lock the Name of the department and Section shall be mentioned on a sticker put on the locks

3.2 Category of Persons responsible for Energy Isolation

Isolation Planners are those who are responsible for preparing and maintaining the Isolation procedure and Energy Source Identification document.

Isolating Persons are those who perform Isolation and are authorised under Positive Isolation Procedure.

Protected Persons are those who attach their Personal Lock to an Isolator or a Group Isolation Box for doing job on equipment.

3.3 Energy Source identification (ESI)

ESI is a document which shall have the following details about Isolation for each particular type of maintenance jobs-

- i) List of Isolation points,
- ii) Method of Isolation,
- iii) The locking points.

The purpose of this document is

- i) To have an established and approved procedure for all energy Isolation so that no deviation occurs in the method of Isolation and locking points by different persons.
- ii) This document can be referred to by any external agency which is asking for energy Isolation and can be confirmed by them while placing the locks that the correct source has been isolated.

The ESI document should have a proper document number as per Quality Management System of the department and should be reviewed minimum once in a year for any revision.

3.4 Methods of Energy Isolation

There are four methods of Energy Isolation -

- i) Individual Isolator Isolation;
- ii) Isolation for working alone;
- iii) Group Isolation;
- iv) Control Stop Isolation

i) Individual Isolator Isolation:

This procedure is to be used preferably:

- a) When Isolation is to be done at a single place and
- b) The agencies involved are not more than two.
- c) The agencies asking for Isolation may be allowed to enter the area for applying the Personal Locks, without any risk to the plant, machinery, safety of person as well as Equipment and mal-operation.

If any one of the above conditions are not met then Group Isolation method is to be adopted.

ii) Isolation for working alone:

This procedure shall be used only where an Isolating Person wishes to isolate and be the only person (Maximum one more person is allowed) under the isolation. This procedure is permitted only when a single isolator needs to be put off for taking the maintenance job. The person who is taking self Isolation must be Authorised Isolating Person for that particular job and the owner of the Energy source. This isolation procedure should be adopted in those locations where the isolating person is the owner of energy source so that in no case doing the isolation should not affect plant process flow.

iii) Group Isolation:

This is used when number of isolators are to be locked.

- **When only one Group isolation box is used:** This is adopted when numbers of Isolators are to be locked. The Isolating Person ensures all steps of the Isolation procedure are carried out and all Isolators are locked in the safe position with an Equipment Lock. The keys for these locks are then secured in a compartment on a Group Isolation Box/ Portable Group Isolation Box and locked by the Group Lock and the Personal Lock of every Protected Person covered under Isolation. Where the Isolating Person also wants to work as Protected Person, all the rules for the Protected Person shall apply.
- **When more than one Group Isolation boxes are used:** When the situation demands for use of more than one Group isolation box for a particular job (**suppose two Group isolation box A and B**), both the Group isolation boxes should be interlinked. Group isolation Boxes should be interlinked by attaching an **equipment lock on one box (say box-A)** and key of this equipment lock is then secured in a compartment on other **Group isolation Box-B**. The Group isolation Box-B should be locked by Group lock. The advantage of this is that **Group isolation Box-B** can treat

Group isolation Box-A as one isolator and **Box-A** cannot be deactivated until the equipment lock from **Box-B** has been removed.

Work Flow for the Group Isolation:

- a) The executing agency/ agencies which want Isolation shall request the Isolating Agency (Electrical/ Mechanical etc.) as per the existing work permit procedure in the appropriate formats for Isolation and convey the details of the job for which the Isolation is being requested.
- b) The Isolating Agency shall decide whether it needs group Isolation or Individual Isolation based on the above criteria.
- c) If the Permit is being issued to a Contractor then the Contractor's supervisor shall write the name and gate pass number of the persons on the permit. In case the list is long and cannot be accommodated on the work permit then it may be attached with the request for the permit.
- d) At the Equipment level the Equipment Locks shall be placed by the isolating agencies & Equipment lock keys along with Tags to be handed over to the owner agency by the isolating agency.
- e) All the keys shall be put inside the Group Isolation Box and Group Lock shall be placed on the Group Isolation Box by the equipment owner agency. Equipment lock may also be placed on Group isolation Box in case of inter linking. The Group Isolation Box shall carry - a) The list of isolated Equipment, b) The method of Isolation.
- f) After Isolation, the Equipment owner i.e. issuing Agency shall issue the permit in the existing work permit formats and communicate the same to the agency which has requested the Isolation. The working personnel shall place their Personal Lock at the Isolation box before starting the job.
- g) After completion of the job the working agency shall remove the Personal Locks and inform the Executing Agency. The working agency shall also surrender the permit taken for the job to the executing agency. Now the executing agency will raise the power getting request to isolating agency.
- h) When all the jobs related to that particular equipment will be finished and the issuing agency gets information from all executing agencies about the finishing of their jobs, the issuing agency will ensure that all the personal locks are removed from Group isolation box and all the permits on the Equipment are surrendered, then the issuing agency i.e. the equipment owner will remove the black lock. Then the issuing agency will inform the isolating agency for removal of equipment lock from respective isolating points.
- i) After Lifting the Equipment Isolation lock, Isolating Agency shall inform the owner of the equipment/ operation of its availability.

iv) **Control Stop Isolation:**

Control Stop is a method of stopping Equipment (where full isolation of energy is impractical to implement) for the performance of short duration, low risk routine tasks. A separate Control Stop procedure is to be developed.

Where Control Stop can be used: It should meet all of the following criteria:

- a) Routine Task.
- b) Short duration task i.e. < or = 30 Minutes.
- c) Low level of Consequences i.e. Even if isolation fails it should be restricted to minor injury.
- d) Control Stop Procedure should be approved by Chief / Head of Operation and Head/ Sr. Manager Safety.
- e) The Operator and working agency should be trained on Control Stop procedure.

Where Control Stop can NOT be used: Control Stop System shall not be applied to, nor exemptions granted for the following job which are:

- a) Non Routine job.
- b) Involve Electrical work on equipment or near bare conductors.
- c) Involve specialist isolation like High voltage or Combustion.

3.5 Accreditation/ Authorization:

Each Department shall identify the Accredited/ Authorised Persons for every type of job. Only these persons shall be Authorised to do energy isolation for doing the job. These persons shall be defined as Isolating Persons.

3.6 Training:

Training in specific Isolation tasks is the responsibility of the department. Records of person trained shall be kept by the department. Isolation Planners must complete Isolation Training Level-2. Protected Persons must complete Isolation Training Level-1. Isolating Persons must complete Isolation Training Level-1A. It is the department's responsibility to ensure that contractors working in the department are trained Level#1.

3.7 Exemption:

- i. At present the Electrical jobs like, all the jobs below and up to 250 V AC and 220 V DC, Lighting circuit, Electrical maintenance jobs in buildings such as jobs on tube lights, fans, PCs etc. is not covered under this procedure. However, all the existing systems of taking the Work permit shall continue. It is clarified that those electrical equipment which are controlling/ regulating other energy sources shall be included in this procedure irrespective of the voltage level e.g. 24 V DC solenoid valve source which controls the steam valve may be in the scope of positive isolation.
- ii. There is no exemption for other energy sources except for the Electrical energy as mentioned above.

- iii. In case if energy is given to the positively isolated equipment for performance trial/ Testing such as High potential test of Breaker/ Bus-bar/ Cable, spring charging/ discharging of Breaker, Pressure Testing of the Vessel etc., then it shall not be covered under this procedure. Once the job for which energy isolation required is over, Executing Agency who is getting the performance trial/ Testing done through Working Agency shall take separate work permit for performance trial/ testing from the authorized Owner Agency specifically stating that the equipment will be energized for this job and upon receipt of separate Work Permit, the working agency shall follow their own Standard Operating Procedure (SOP). However, the Owner agency shall confirm that working agency has approved SOP by their respective in-charge before handing over the equipment which clearly mentions the trial procedure.

References

1. Tata Steel India Safety Standard: Positive Isolation Procedure (SS/GEN-26)

Annexure: Sample Photographs of Isolation of Different Energies:



Activated Group Isolation Box with Personal Locks of Employee & Contractor and Group Isolation Lock



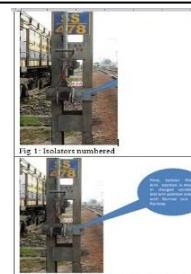
Electrical Energy Isolation Arrangement



Energy Isolation Arrangement for Valves



Rail Track line Energy Isolation Derailer



Overhead Electrified Line (OHE) Isolation



Potential Energy Isolation arrangement for belt conveyor

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	SAFE HANDLING OF LIQUID METAL	Doc. No: SG/23 Rev no : 00 Effective Date: 14.10.2019

1. Objective

This guideline has been prepared to introduce safe methods of handling hot liquid metal in different areas of Iron & Steel industries, for facilitating mitigation of these hazards & prevention of accidents. Handling of hot liquid metal involves many potential hazards namely Fire, Metal through, Explosion, Radiation, Burns, etc.

2. Scope

This guideline is applicable for safe handling of hot liquid metal in different areas of Steel Plants, viz., Blast Furnaces, Steel Melting Shops, Foundries, Pig Casting Machines, Electric Arc Furnaces, etc.

The guideline covers the following aspects related to hot liquid metal handling:

- i) Ladle / Torpedo Ladle preparation
- ii) Inspection and maintenance of ladle cars
- iii) Pouring into ladle at BF
- iv) Transportation of hot liquid metal
- v) Inspection and maintenance of hot liquid metal tracks
- vi) Hot liquid metal pouring at SMS
- vii) Dumping

3. Procedure

3.1. Ladle / Torpedo Ladle Preparation

- i) Before the ladle is placed for pouring the hot liquid metal, it shall be inspected for the following & the activities carried out as mentioned below:
 - a) If metal jams have been removed from the lip/ mouth of the ladle.
 - b) The condition of the lining of the lip / mouth.
 - c) The shell lining condition.
 - d) Cleaning / changing the nozzle.
 - e) Cleaning / changing the slide gate plate/ purging plug.
 - f) Checking the tare weight of the ladle/ torpedo; if more than normal tare weight then de-slagging to be done at pit (de-slagging pit should be filled with dry sand/ dry granulated slag).
 - g) Checking the shell condition; if shell temp. $>300^{\circ}\text{C}$ (mouth & charging pad), gunning with suitable refractory to be done.
- ii) Place the cleaned and prepared ladle, at heating stand for preheating / on transfer car.

3.2 Inspection & Maintenance of Ladle Cars / Torpedo Ladles

- i) Inspect the ladle car for the condition of:
 - a) The chassis.
 - b) The suspension springs.
 - c) Bearing covers and alignment.
 - d) Coupling and coupling handle.
 - e) Any metal jam, etc. spilled on the car.
 - f) Cable and cable reeling drum (if provided).
 - g) Car frame protection lining condition wherever provided.

- ii) Inspection of Torpedo Ladle:
Cover the mouth of the torpedo before starting the inspection. Inspect for the condition of:
 - a) The chassis and staircase.
 - b) The suspension spring.
 - c) Bearing covers and alignment.
 - d) DP and UT test of axle.
 - e) Presence of any metal jam / debris on the torpedo platform.
 - f) Drive system and limit switches.

- iii) Place the inspected and cleaned car near the heating stand. If the inspection/ maintenance time is more than 16 hrs., then place the torpedo under heating station to heat up to 900 °C.

- iv) Place the preheated ladle/ prepared ladle on the car, centering it properly following the signals.

- v) Check the clearance of chassis of the ladle car with the wheels and flash feet after placing the ladle.

- vi) Damaged chassis/ suspension spring, etc. should be rectified.

- vii) All the metal transfer cars should be fitted with warning bells which should ring during movement of the transfer cars.

- viii) Ladle tilting unit of mechanical ladles and ladle handling cranes should be fitted with devices for smooth positive control when tilting and pouring, so as to stop accidental tilting.

- ix) Hand-tilted transport ladles should have an integral locking device to prevent accidental tipping.

- x) Large transport ladles (>500 kg) should have a self-restraining anti-tipping arrangement / device.

3.3 Pouring / Torpedo Ladle Filling at BF

i) General Practices

- a) Place the ladle car below the spout exactly aligned below the chute.
- b) Put a skid below the wheels.

- c) Remove loco to a safe distance (6 m).
- d) Hot Metal/ Teeming ladles to be placed on the stand.
- e) Before pouring is started, it shall be ensured that:
 - Only minimum required nos. of persons shall be present.
 - They all shall use PPEs like face shield, flame retardant suit, anklets, goggles, hand gloves, helmets and safety shoes.
- f) Newly lined torpedo after proper heating to be filled 50% for the first time.
- g) After taking out the metal, it should be kept under cover for soaking.

ii) Specific Practices

- a) Ladles shall be placed on both the lines on both sides of the rocking runner. Track line of torpedo must be marked for proper placement below (marking will be at position of last wheel of torpedo car). Track line should be dry and filled with sand.
- b) Rocking runner shall be checked before pouring. Check proper placement of torpedo by taking metal for few seconds and changing to other side. If proper placement is not there, replacement to be done.
- c) After opening the tap hole, pouring shall be done in one ladle leaving 250 mm empty from the top to avoid spillage during transportation. After filling up to 90% of the torpedo, tilt the runner to other side.
- d) As soon as one ladle is full (250 mm empty from top) rocking runner shall be turned to fill ladle on other side.
- e) Next ladle shall be brought in position on the other side using the pusher car. Before removing the filled torpedo, tilting runner drive must be under control stop.
- f) Remove filled torpedo and place empty torpedo as soon as possible and check proper communication between cast house and traffic crew.
- g) As soon as tapping is completed, ladles with hot liquid metal shall be removed by locos.
- h) Then Hot Metal ladles/ Torpedoes shall be sent to Steel Melting Shop, Pooling Pit Foundry or Pig Casting Machines, as per requirement.

3.4 Transportation

- i) The ladle cars and the ladle shall be inspected again for spillage after pouring.
- ii) Before withdrawal, track position, metal jamming, etc. shall be checked.
- iii) Ladle shall be removed only after clearance from the Furnace In-charge.
- iv) If any ladle/ torpedo is overfilled, it shall be transported with utmost care at a very slow speed of less than 5 kmph and taken to pooling pit, and about 10-15 ton of metal dumped & then again sent to Steel Melting Shop.
- v) Level Crossing Gate and Signaling System shall be provided at every railroad crossing. Also, Loco Shunting Staff shall come down at every rail-

road crossing and caution people before allowing the train to pass. Park the torpedo before fouling mark to avoid side collision.

- vi) Loco shall move at slow speed and shall not apply sudden brakes to prevent spillage and splashing of hot metal.
- vii) Ladle shall not be transported in tilted condition.
- viii) It shall be ensured that persons are not in the vicinity of the track during movement of ladles.
- ix) Stopper-operating mechanisms on bottom-pouring ladles should be secured prior to transport so as to ensure that they do not operate accidentally while in motion.

3.5 Inspection and Maintenance of Hot Metal Tracks

- i) Hot metal transport tracks shall be regularly inspected for any undulations and prompt action to remove undulations shall be ensured.
- ii) Track alignment shall be checked periodically and any sinking shall be immediately attended.
- iii) Tracks shall be inspected regularly for any scrap and other materials lying in the area.
- iv) De-weeding shall be done to ensure the safety of the persons moving along with rolling stock.
- v) All the dry weeds along the track shall be removed to avoid fire due to metal splashing during transportation of hot metal.
- vi) Accumulation of water on the tracks or near the tracks shall not be allowed.
- vii) It shall be ensured that there is no gas or water lines in the work area, which can cause explosion if a spill occurs.

3.6 Liquid Metal Pouring at SMS

Hot Metal tapped from Blast Furnaces, and transported as described earlier is poured as per the following details:

i) Ladle to Mixer

- a) Ladles are brought to the Mixers bay and loco removed.
- b) After the ladle is filled, the Crane Operator lowers and engages the hooks in ladle.
- c) The Crane Operator lifts the ladles full of hot metal continuously giving siren / alarm so that people working in the area move away.
- d) Hot Metal/ ladle car ladles to be placed on the stand, wherever it's required.
- e) Ladle is brought near the Mixer platform where the crust is broken using lancing or punching as per requirement.
- f) Metal from the ladle is poured very slowly and continuously into the Mixer, carefully avoiding jerks and sharp movement so that there is no spillage of hot metal.
- g) Ladle is fully drained off as per signals of the Mixer Operator.

- h) Falling out of any crust pieces (during pouring) is avoided. This is watched by the Mixer Operator who stops the pouring whenever the crust is about to fall.
- i) Straighten and lower the ladle.
- j) Place empty ladle back on the ladle car.
- k) Repeat the process with other ladles.

ii) Mixer to Hot Metal Ladle

- a) Ladle shall be inspected for the condition of refractory lining.
- b) All the ladles shall be placed below the spout of the Mixer one by one.
- c) Ladle shall be aligned/ placed below the spout perfectly by the Loco Operator following signals of the Pourer.
- d) Mixer shall be tilted by the Pulpit Operator and metal poured into the ladle as per requirement.
- e) After completion of pouring, the ladles shall be drawn and brought to the Converters.

iii) Torpedo Ladle to Metal Transfer Car

- a) Place the torpedo at the desired pit at Steel Melting Shop following light signal.
- b) Plug in the torpedo drive connection for pouring.
- c) After complete evacuation of hot metal, plug out the drive connection.
- d) Ensure that the torpedo should not be in tilted condition.
- e) Remove the torpedo from SMS and send for filling or maintenance.

iv) Hot Metal Ladle to Furnace (Twin Hearth)

- a) The furnace bottom is to be inspected when repair is being done.
- b) It is to be prepared with dry raw dolomite.
- c) It shall be ensured that scraps, lime, etc. free from moisture are charged.
- d) As soon as the furnace is ready to receive metal, doors are lowered and closed.
- e) Spout (prepared and inspected) is lifted and fixed into the door with the help of hot metal crane.
- f) Hot metal crane then lifts ladle and pours into the spout as per the signals of the Furnace Charge Man/ Melter.
- g) Place back empty ladle on the car.
- h) Repeat this process with other ladles till the furnace has received the required quantity of metal.

v) Hot Metal / Mixer Ladle to Converter

- a) Ladle, after filling the required quantity of hot metal, is brought to Converter bay on the self propelled Ladle Car/ Hot Metal Transfer Car.
- b) It is lifted with the help of hot metal/ charging crane.

- c) Converter vessel after emptying and slag coating is charged with heavy and light scrap.
- d) It is tilted again to receive hot metal and hot metal ladle is positioned with respect to converter by charging crane.
- e) Ladle is then tilted gradually and metal is poured slowly into the converter taking care that no splashing takes place.
- f) Ladle is then made upright, taken back and placed on the ladle car.
- g) Converter vessel is brought to upright position to start the process.
- h) During charging, operating platform in front of converter shall be cleared of personnel.
- i) Track-pit shall be provided for emergency handling of ladle metal through.
- j) Stoppage of converter skirt & hood leakage to be ensured during hot metal charging for preventing explosion hazards.

vi) Converter to Steel Ladle

- a) Inspected and preheated ladle is placed on transfer car and placed below the Converter for tapping.
- b) After the blow is over, first slag is tapped in the slag pot. Ensure that slag pot is dry.
- c) Ladle car is then moved back to bring ladle below the spout of the Converter vessel, after removing the slag pot.
- d) Vessel is tilted to other side and liquid steel is slowly tapped into the ladle till the slag appears.
- e) The metal car is then brought to slag and ladle preparation bay.
- f) Slag pot is then taken out with the help of crane and the car with metal ladle goes to Argon Rinsing Station.
- g) Safe practices to be ensured while manual addition of aluminium bars. Moist bars may lead to explosion hazards during Converter tapping operations.

vii) Movement of Steel Ladle to Continuous Casting Machine through Secondary Refining Units

- a) After Secondary Refining, the ladle is moved forward on car towards the caster side/ lifting pit of CCS.
- b) EOT crane is brought above it from side movement.
- c) The hook is lowered and ladle is engaged as per the signals of the Charge Man/ Operator. Ensure that area must be free from moisture.
- d) Ladle is then lifted slowly and very carefully to CCS pouring platform (on ladle turret loading arm).
- e) It is then placed on the other side by lifting the arm and rotating the turret for pouring and casting.

- f) After pouring and casting, turret arm is lifted and rotated to charging side for removal of empty ladle by crane. After that, it is returned to pit side of SMS / Ladle Preparation Bay (after dumping) by Ladle Transfer Car.
- g) Shop floor below the ladle movement and turret loading area shall be cleared of any personnel, during operation.

viii) Twin Hearth Furnace to Steel Ladle

- a) Proper preheating and inspection of ladles shall be done before tapping.
- b) Ladle shall be inspected for shell condition and skull-free condition of refractory lining.
- c) Rigidity of slide gate mechanism shall be ensured.
- d) Ladle shall be placed at tapping stand.
- e) Graphite powder shall be placed at bottom of ladle exactly over the nozzle.
- f) Dried out coke to be added at bottom of ladle before tapping.
- g) Oxygen ppm (particle per million) of the heat shall be optimum.
- h) Required quantity of Ferro Alloys to be added during tapping with help of crane.
- i) Aluminium bars can be added manually.
- j) Continue tapping till molten steel gets exhausted at furnace.
- k) In case of high oxygen ppm, the flow of reactive slag into ladle is to be avoided by using suitable means.
- l) After filling up, ladle shall be covered with heat shield cover.
- m) Ladle shall be lifted by traverse hanger hook with the help of crane.

ix) Teeming Operation

- a) The ladle shall be positioned to the required teeming platform through crane.
- b) HPP (High Pressure Pump) cylinder shall be fixed to ladle for opening slide gate.
- c) Ideally on opening the slide gate, nozzle filling compound should fall down.
- d) Ladle nozzle shall be placed at the centre of mould for uniform flow.
- e) During teeming, add aluminium shots as de-oxidiser.
- f) Slide gate shall be closed after the mould is full.
- g) Crane along with ladle shall be moved to subsequent moulds till the teeming is complete.

x) Blast Furnace Ladle to Foundry Ladle

- a) BF ladle shall be lifted by crane by engaging traverse in BF ladle properly.
- b) BF ladle shall be slowly tilted to transfer the hot metal into foundry ladle.

- c) Foundry ladle filled with hot metal kept on Hot Metal Transfer Car shall be driven slowly towards pouring bay.
- d) Ladle shall be lifted slowly by crane by engaging traverse in foundry ladle properly.
- e) Centering the foundry ladle on the pouring basin of Ingot moulds / Bottom plates, ladle shall be opened.
- f) No rolling of crane on the tracks shall be permitted.
- g) After pouring and filling the Ingot moulds/ Bottom plates, foundry ladle shall be tilted with the help of auxiliary hoist of crane and total residual slag/ metal shall be dumped into slag pots slowly.
- h) Foundry ladle shall then be kept horizontally before the lancing stand for lancing the nozzle of the ladle properly.

xi) Ladle pouring at PCM

- a) Ladles are brought to PCM line (track) at the approach of shunting winch.
- b) PCM operator positions the ladle with shunting winch to PCM runner.
- c) With the help of vertical winch hook, ladle is slowly and continuously lifted from the bottom.
- d) After ladle is poured and emptied fully, it will be positioned into chassis and then pushed out of machine through the shunting winch.

3.7 Safety Precautions for handling liquid metal in Converter / Concast /Twin Hearth & Teeming

- i) Before ladle is lifted by the hanger hook, the hook and the crane shall be checked for its rigidity by lifting loaded ladle to smaller height and holding momentarily and checking the breaking effect of both downward and upward movement before it is further transported.
- ii) Person working in pit side should not come beneath the raised load.
- iii) Other activities, viz., cleaning, lancing, relining and de-bricking shall be momentarily stopped during heat movement in the area.
- iv) At pit side, persons shall maintain safe distance at the time of tapping and teeming operations.
- v) All workmen involved in teeming, shall wear all necessary PPEs in proper manner, viz., safety helmets, safety shoes, smelter glasses, face shields flame retardant suits, hand gloves, anklets, etc.
- vi) During movement of crane, sound alarm shall be used to caution persons working below.
- vii) Ensure proper coordination between different agencies at pit side.
- viii) Refractory encasing and/or plate heat shield shall be provided for protection of all structures and other facilities in the vicinity of ladle movement for protection against liquid metal radiation.

3.8. Hot Metal Ladle cleaning and dumping at Ladle Repair Shop (LRS)

- i) Ladles from SMS, PCM and Foundry shall be brought to LRS for cleaning and inspection.
- ii) With the help of LRS crane, punching and hooking shall be done.
- iii) All scraps and slag shall be dumped in the skull pot / slag pot.
- iv) Ladle structure and refractories shall be inspected.
- v) If repair is needed, it shall be repaired before ladle is sent to Blast Furnaces for placement and metal filling.

3.9. General Safety Points for all the jobs related to handling of liquid metal

- i) Generally while pouring hot liquid metal, it should be ensured that no water or oil is spread or stagnant down below the ladle, as chances of explosion exist if there is spillage of hot liquid metal.
- ii) The crane shall be load tested and inspected periodically.
- iii) Load test date and SWL bearing capacity, board shall be displayed prominently over the crane.
- iv) The ladle hook arm and wire rope shall be periodically inspected and tested for rigidity.
- v) Crane shall be made free from loose materials and inflammable materials.
- vi) Crane shall be provided with cut-off limit switches for all movement and maintained in operable condition.
- vii) Crane rails should be periodically inspected.
- viii) Sufficient clearance is needed by the side of railway track. There should not be any obstruction over the tracks.
- ix) Structures shall be periodically inspected and tested.
- x) All lifting equipment, tools and tackles are to be checked periodically.
- xi) At the time of handling and transferring liquid metal, concerned person shall be well trained in signaling operation to guide the Crane Operator.
- xii) Ladles, cranes and locos when handling liquid metal, shall be driven at safe speed.
- xiii) Ladle trunion diameter shall be periodically checked for timely replacement.
- xiv) Locking devices on casting and transport ladles should be engaged prior to filling, to prevent accidental spillage; they should only be released just before tipping the ladles.
- xv) Signage and emergency escape route shall be shown.
- xvi) Unauthorized entry of personnel to be restricted around area of work.
- xvii) Danger Boards shall be displayed at conspicuous locations in the hazardous areas, to draw the attention of the persons entering the area, about the potential danger.

- xviii) All passageways and other areas where molten metals are handled shall be kept clear of obstructions and tripping hazards.
- xix) Protective clothing including apron, gloves, shoes, eye protection, etc. shall be used by persons working in hot metal handling area.

References:

1. IPSS: 1-11-009-15 'Code of Practice for Safe Handling of Liquid Metal'.
2. International Labour Organization (Sectoral Activities Programme: Code of practice on Safety and Health in the Iron and Steel Industry).

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	TRANSPORTATION IN STEEL INDUSTRY	Doc. No: SG/24 Rev no. : 00 Effective Date : 14.10.2019

1.0 Objective

This Safety guideline outlines the minimum acceptable mandatory requirements to develop and maintain Safe method of Transportation of materials by Heavy vehicles such as Truck, Trailer, Dumper, etc.

2.0 Scope

The scope of work covers all steel plants in Iron and Steel sector.

3.0 Procedure

3.1 Definitions

Heavy Motor Vehicle: Any goods carriage the gross vehicle weight of which or a tractor or a road roller the tare weight of either of which exceeds 12 Ton.

Projected Materials: Any over dimensional consignment which are of extra ordinary dimensions and tonnage.

Side Projection: Any load which is project more than 150 mm over the sides of the trailer, and must not be more than 2.5 meters in total width.

Rear Projection: Any load projected more than 1.2 meters over the rear side of the trailer. If measured from the centre of the trailer axle or axle group, a load must be Not more than 3.7 meters, and not longer than the length of the load in front of the axle, or axle group.

Height Projection: The height of the materials should not exceed above the height of the Vehicle cabin.

3.2 Risk Assessment

Concerned person should identify the risks associated with the activities and possible danger involved and what is causing those dangers. For example, could someone be hit by a moving vehicle? Could someone fall from a vehicle, e.g. while getting in or out, or during loading or unloading? Or be hit by an object falling from a vehicle? Could a vehicle tip over?

3.3 Identification of Associated Hazard

Here some associated hazards are identified which can cause danger during transportation:

SNo	Materials	Mode of Transportation	Types of Vehicle used for transportation through Road	Associated Hazards
1	Raw Materials			
1.1	Iron Ore	Road, Rail, Conveyor	Dumper, Truck, Trailer, Container	Falling of material, Spillage, Dust, Toppling, Dashing, Collision, Break Down

SNo	Materials	Mode of Transportation	Types of Vehicle used for transportation through Road	Associated Hazards
1.2	Coke, Coal	Road, Rail, Conveyor	Dumper, Truck, Tipper Trailer	Spillage, Dust, Toppling, Dashing, Collision, Break Down
1.3	Lime	Road, Rail, Conveyor	Dumper, Truck, Tanker	
1.4	Sinter	Conveyor		
1.5	Flue Dust	Road	Dumper, Truck	
1.6	Hot Metal	Road, Rail	Camag Car, Hot Metal Ladle Vehicle	
2.0 Finished Product				
2.1	Slab	Road	Trailer	Falling of Materials, Toppling, Dashing, Collision, Break Down
2.2	Billet	Road	Trailer	
2.3	Coils	Road	Trailer	
2.4	Sheet	Road, Rail	Trailer	
2.5	Bar	Road, Rail	Trailer	
2.6	Wire	Road, Rail	Trailer	
2.7	Rod	Road, Rail	Trailer	
3.0 Miscellaneous				
3.1	Supply Material	Road	Dumper, Truck	Falling of Materials, Toppling, Dashing, Collision, Break Down
3.2	Refractory Material	Road	Dumper, Truck	
3.3	Sand	Road	Dumper, Truck	Spillage of Materials, Toppling, Dashing, Collision, Break Down
3.4	Bricks	Road	Dumper, Truck	Falling of Materials, Toppling, Dashing, Collision, Break Down
3.5	Slag	Road, Rail	Dumper, Truck	
3.6	Granulated Slag	Road, Rail	Dumper, Truck	Spillage of Materials, Toppling, Dashing, Collision, Break Down
3.7	Scrap Uneven	Road	Dumper, Truck, Trailer	
3.8	Scrap Mill	Road	Dumper, Truck	
3.9	Descale of Tundish	Road	Dumper, Truck, Trailer	
3.10	Pig Iron Scrap	Road	Dumper, Truck	
3.11	Biodegradable Scrap	Road	Dumper, Truck	
3.12	Coal Tar	Road	Dumper, Truck	Spillage of Materials, Toppling, Dashing, Collision, Break Down, Fire
4.0	Chemical & Gases	Road, Pipe lines	Tanker, Truck, Container	
5.0	Petroleum Product	Road, Rail, Pipe Lines	Tanker, Container	

3.4 **Responsibility**

- i) Line Management.
- ii) Transporters/ Contractor/ Suppliers/ Vendors/ Customers/ User department.

3.5 **Responsibility of Management**

3.5.1 Develop and ensure implementation of Transportation Safety Standards.

- i) To ensure that this standard is made available to and understood by all transporters/ Contractor/ Suppliers/ Vendors/ Customers/ User Department.
- ii) To ensure that Transporters/ Contractor/ Suppliers/ vendors/ customers/ User Department are appropriately trained to transport materials.
- iii) Investigate thoroughly all motor vehicle incidents and collisions.
- iv) Recognize and reward excellence in motor vehicle operations and in safe transportation skills.
- v) Audit of loading, unloading, transportation of material and audit of fitness of vehicles as per check list on an established frequency.
- vi) All concerned party should be informed about the hazards prevailing while transportation of material in general and specific.

3.4.2 **Responsibility of Transporters/Contractor/Suppliers/Vendors/Customers**

- i) Adhere to mandatory requirements of road safety standards and other Government's Road Safety Rules and Regulations and guidelines given in Central Motor Vehicles Rules (CMVR), 1989.
- ii) Comply with driving laws and regulations both inside and outside works guided by Authorities.
- iii) Ensure adequate and appropriate defensive driving safety training has been received and successfully completed.
- iv) Report all incidents and collisions to concerned line managers of department or Safety Office and keep record.

3.4.3 **Responsibility of Driver/ Operator**

- i) To adhere all rules & regulations, and Safe work procedures whilst operating the vehicles and mobile machinery.
- ii) To conduct daily inspection of vehicles & mobile machinery once in a shift as per checklist made available by line management.
- iii) To ensure all loads are tied and securely transported.
- iv) To ensure all unattended vehicles and mobile machineries have the handbrake or emergency brake applied & Scotch block provided under the wheel to avoid roll down.
- v) Driver carrying hazardous material must be carrying trem card/ MSDS.
- vi) To inform and request to line management/ contractor for repair of any fault or deviation observed.

- vii) To inform all incidents and near miss to line management / Contractor.
- viii) All drivers & Operators must observe the Safety of other road user also.

3.6 Regulatory Requirements

- 3.6.1 All Transporters/ Contractor/ Suppliers/ vendors/ customers must follow all government laws and regulation concerning driving, including
 - i) Alcohol/ illegal drug prohibitions.
 - ii) Having a valid vehicle pass, driver's license or permit to operate the vehicle being driven.
 - iii) Obeying all traffic signage and regulations.
 - iv) No loose clothing and improper Personal protecting Equipment (PPEs).

3.6.2 Painting of vehicle registration number

Registration number of motor vehicles must be marked as per the guidelines of CMVR, 1989.

3.6.3 Motor Vehicle records

The Factory/ Department/ Division must keep a record of heavy vehicles of Transporters/ Contractors/ Suppliers/ Vendors/ Customers operating under the specific department.

3.6.4 Driver Training

Drivers must undergo defensive driving training as appropriate to their levels of use. Line managers must organize training at regular intervals for their heavy vehicle's driver operating under their department.

3.6.5 Safe Driving audit:

Each Department/ Division/ other locations may establish and ensure a Transportation audit schedule. It must be carried out at loading, unloading, parking, and during movement of the vehicles inside as well as outside the plant. All collisions or incidents shall be reported to management promptly (e.g., within 24 hours).

3.7 Human

3.7.1 General Safety Requirement for Heavy Vehicle Drivers

3.7.1.1 Following are some safety requirements for Heavy Vehicle Drivers:

- i) Do not allow any person to stand at foot rest or sit on the loaded material of the vehicle.
- ii) Do not allow any body to get ON and OFF during running of vehicle.
- iii) At all Railway level crossing follow the principle of STOP LOOK and PROCEED.

- iv) Never overload the vehicle beyond its carrying capacity.
- v) Before coming out or going inside Factory, stand in queue.
- vi) Before starting vehicle, ensure that the material loaded on the vehicle is properly secured.
- vii) Never drive vehicle beyond speed limit (Please know the specific speed limit before entering inside plant).
- viii) Give prior signal at least 30 meters before taking turn at right or left side.
- ix) Keep a safe distance of 2 seconds to the vehicle ahead.
- x) Never sit or take rest under the vehicle or within the vicinity of 10 feet of the vehicle or at any parking place area.
- xi) While taking a turn, speed should be below 10 km/hr.
- xii) When turning to the left, drive as close as to the left-hand side of the road from which the turn is being made and of the road which is being taken.
- xiii) When turning to the right draw as near as may be to the centre of the road and arrive as near as may be at the left hand side of the road which is being taken.
- xiv) Use seat belt while driving vehicle and all the vehicles must be fitted with seat belt for all the Crew members, if allowed.

3.7.1.2 General Safety requirement for Fork Lift Operation

- i) Fork lift operation will be restricted only for in plant operation.
- ii) Fork lift will not allow moving on road inside works with load.
- iii) Fork lift will be operated by only authorized trained & licensed personnel.
- iv) Use of seat belt is mandatory while operating Fork lift.
- v) Speed of the Fork lift should not be more than 5 KM/ hr.
- vi) Keep arms and legs inside the Fork lift while operating.
- vii) Fork lift will be used to handle only stable loads.
- viii) Be careful while negotiating sharp turns with load.
- ix) Load should be placed on fork in such a way that it should not block your view.
- x) No person will be allowed to sit on fork lift other than operator.
- xi) While operating fork lift with load, Centre the load on the forks and as close
- xii) to the mast as possible to minimize the potential for the forklift tipping or load falling.
- xiii) Overloading a Fork lift makes it hard to control and could make it tip over.
- xiv) Place the load at the lowest position for travelling.
- xv) Don't place extra weight on the rear of a counterbalanced forklift to allow an overload.



3.7.2 Safety precaution during parking of vehicle

3.7.2.1 Every vehicle needs to be parked at parking or any other place. Driver must know that where to park the vehicle. Following precautions before parking the vehicle to be observed.

- i) Do Not park the vehicle where there is “No Parking” board displayed. Park at designated parking place or at safer place and not on the road.
- ii) Do not park the vehicle in such a way that it is obstructing the movement of other vehicle or narrowing the width of road.
- iii) Keep the parking light ON.
- iv) Before parking please ensure that no one is at the rear side of the vehicle.
- v) After parking apply the hand brake.
- vi) Place scotch block under the wheel at both side of wheel.

3.7.2.2 Safety at Railway level crossing for all

- i) Stop your vehicle before crossing all railway level crossings.
- ii) First look left, then right and again left before crossing Rail.
- iii) At Road junction, allow the loco to cross the level crossing first.
- iv) Do not park your vehicle near/ on railway tracks.
- v) Do not enter into level crossing while the drop gates are lowering down.
- vi) Stop your vehicle before STOP line when the drop gate is being closed/closed.
- vii) Do not cross railway tracks at any other places than specified.

3.7.3 Rules for Using Mobile Phone while driving

- i) Do NOT use mobile phones while driving, with or without accessories like hands free, wireless, headset and Bluetooth etc. as it causes distraction while driving which in turn can cause accidents.
- ii) In case of emergency, one should park the vehicle at safe place and then attend the call.

3.7.4 Defensive driving method

Defensive driving is the practice of safe driving techniques. These techniques are used regardless of the actions of others or of adverse conditions created by the environment or vehicle condition. Safe driving techniques call for the driver to be prepared for a variety of potentially dangerous and often life threatening driving situations. The following things must be ensured apart from the learning of the defensive driving method.

- i) Ensure the checklists that have been appended with this standard.
- ii) Keep the space on either side of your vehicle free.
- iii) Do not drive parallel to other vehicle except while overtaking.
- iv) Always Stop, Look and Listen at railroad crossings unmanned before proceeding.
- v) If the vehicle develops mechanical or tire trouble and begins to slowdown, drive it to the side of the road as far as possible from traffic.
- vi) Activate the vehicles hazard-warning lights.
- vii) Switch-off the ignition of immobilized crashed vehicles to reduce risk of fire.
- viii) Wear High Visibility Jacket while attending the breakdown.
- ix) Place a hazard-warning triangle (with Reflector) to the both side of the road, 50 meters from the scene.
- x) Barricade the vehicle with red tapes.
- xi) Avoid working on the traffic side of your vehicle.
- xii) Remove all the barriers and clean the oils from the road before moving ahead.

3.8 Physical

3.8.1 Vehicle Maintenance

Vehicle servicing must be performed at least according to the manufacturer's requirements and at the appropriate time, mileage, and driving condition intervals specified in the vehicle's operator's manual. Record must be available with the driver.

3.8.2 Vehicle fitness

All vehicle must be fit enough to transport the specific load. Vehicle must be selected as per requirement of materials to be transported. All Vehicles must comply the mandatory requirement of Transport Authority as per attached check list.

Checklist of Heavy Vehicles (Dumper, Truck, Trailer etc.)

SN	Criteria	OK	Not	NA	Remarks
1	Steering Bush Play (No Play)				
2	Steering wheel play (20-30 mm)				
3	Rear view mirror (Physical condition)				
4	Three Piece Mirror (left Side)				
5	Horn (Physical condition)				
6	Cabin door (Physical condition)				
7	Body condition (Standard physical condition)				
8	Material Body (physical condition)				
9	Seat Belt (Retractable Type)				
10	Reversing Buzzer (audible) connected with Reverse Gear				
11	Side Indicator with Audible Buzzer				
12	Wiper Blade assembly Should be in working condition				
13	Front wind Glass (Clear without scratch mark)				
14	Spring Pin bolt, Clamp (Looseness to be checked)				
15	Tire condition (Physical condition with visible tread)				
16	Self Start (Within 5 – 8 Sec)				
17	Head Light (Focus should be equal of the light)				
18	Emission check (< 65 HSU)				
19	Brake & Parking Light (Should be visible from 30 m)				
20	Oil Leakage				
21	Number Plate (Should be clear & as per MV Act)				
22	Foot rest (Physical Condition)				
23	Side & Rear side material body cover hinge & locking pin				
24	Hand / Parking Brake				
25	Main Wheel Brake				
26	Fail Safe Brake				
27	Trailer Brake				
28	Brake Air Line (Physical condition)				

3.8.3 General requirement to ensure road worthiness of vehicles

- i) Vehicle must be fit enough to transport the specific load. Vehicle fitness certificate must be issued by a competent person.
- ii) Retreaded tyres should not be used in front wheel.
- iii) Rear view mirror & three piece mirror should be fitted for clear visibility.

- iv) Horn sound should be audible from at least 30 meter distance. Intensity of sound should not be more than 90 db. Pressure horn should not be used in vehicle.
- v) Vehicle's cabin, cabin door, cabin door handle, material body etc. should be physically in good & working condition. Vehicles having bulged body should not be used for transporting the materials.
- vi) Vehicle's number plate, parking light, side indicator, brake light etc. should be cleaned at regular interval for clear visibility. Light reflecting radium tape to be pasted on periphery of the vehicle.

3.9 System

3.9.1 Safety during transportation of Materials

3.9.1.1 Transportation of hazardous materials

Transportation of hazardous materials/ dangerous goods must be done in accordance with applicable laws and regulations. Dangerous or hazardous goods specified in column 3 Table 1 to rule 137 of CMVR, 1989 must be transported as per guideline given in sec 129 to sec 137 of CMVR, 1989.

3.9.1.2 Safety during transportation of CR/ HR Coils

Associated Hazards

- i) Poor site layouts
- ii) Fall of coils from Vehicle
- iii) Height Restriction
- iv) Overturning
- v) Collisions
- vi) Striking people and equipment
- vii) Vehicle roll down

Loading/ Unloading of CR/ HR coils

Do's

- i) Wear personnel protective equipment (PPEs).
- ii) Wear High Visibility Jacket for better visibility to other crew member.
- iii) No person will be on trailer during loading/ unloading of material.
- iv) All sticker pasting, painting of the coil will be done on ground by keeping at safe distance.
- v) For positioning the coil at centre of the bed, signal will be given from ground.
- vi) Put scotch block under the wheel to prevent rolling down of vehicle.
- vii) Vehicle will be allowed to go only after ensuring that material is properly secured and tightened.
- viii) Materials to be loaded as per trailer capacity.
- ix) Use proper De-shackles, Pins, Chains and Links.

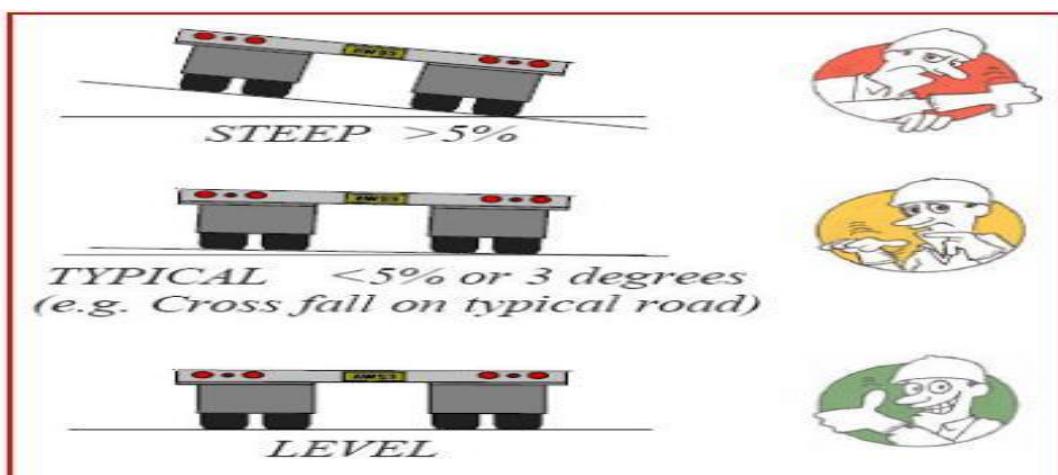
- x) Each Coil to be tied to trailer bed individually with two chains at an angle of 45 degree.
- xi) Three chains to be used for each coils.
- xii) Rubber pads to be provided for edge protection.
- xiii) Drivers should sit at drivers rest point during loading of coil.
- xiv) Never overload the trailer beyond Safe work load.

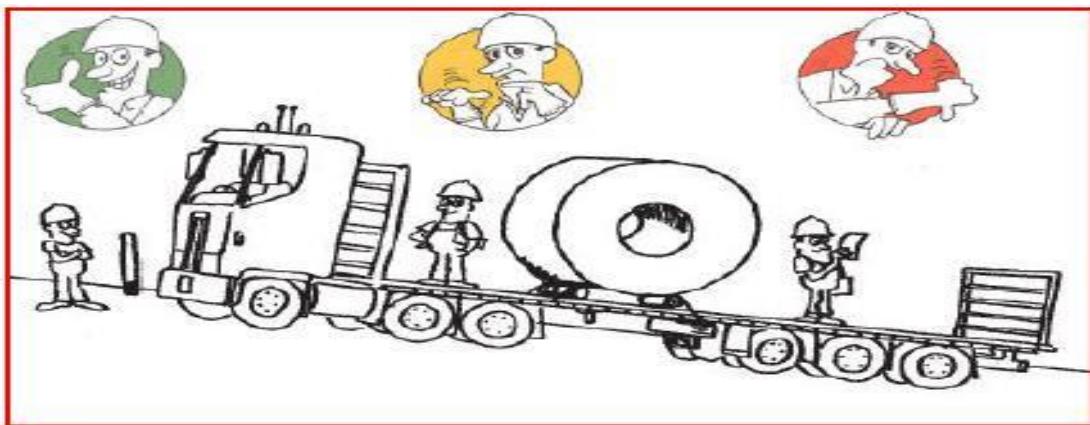
Don'ts

- i) Do not cook food at in the trailer at loading/ unloading point.
- ii) Do not lash the coil with the hook of the bed.
- iii) Do not allow crew member and others in loose clothing.
- iv) No person will move under the hanging material.
- v) Do not sleep/ take rest in front of or below or side of the vehicles.
- vi) Do not park at unauthorized parking place.
- vii) Do not move here & there after placing the trailer at loading point.

Loading/ Unloading point design/ condition

- i) Wherever possible, loading areas should be selected and designed to be flat/ level. Where vehicle alignment is critical from safety point of view (e.g. when using twin hoist cranes), alignment lines must be clearly marked and the Safe Working Procedure must incorporate this requirement.
- ii) The loading/ unloading area design must be subjected to a full risk assessment. The loading/ unloading risk assessment must consider the following attributes of the loading point:
 - a) **Side slope/ Long slope:** When loading areas are not flat/ level, load stability may be compromised depending on the nature of the load. This is particularly relevant prior to load restraint being applied, or when removing load restraint prior to unloading.





- b) **Road Camber:** This can have a similar effect to side slope, and needs to be considered particularly if moving loads without full load restraint.
- c) **Surface condition:** Potholes, ruts and drains can have a destabilizing effect on forklifts (and any load being carried) as well as being slip/trip hazards for pedestrians.
- d) **Flagmen:** Trained, competent Flag men may be used to guide and direct reversing vehicles. Where Flagmen are deployed, there must be clear rules on signals and safe positioning to avoid potential for trapping. He should always be visible to operator.
- e) **Segregation of vehicles / pedestrians / other traffic.:** As an alternative to Flagmen, the loading area should be segregated to prevent pedestrian access during reversing. Use of robust barriers to protect plant/equipment may be necessary.

3.9.2 Safety during transportation of Wire coil / Wire rod

Associated Hazards

- i) Poor site layouts
- ii) Fall of coils from Vehicle
- iii) Opening of coil
- iv) Height Restriction
- v) Overturning
- vi) Collisions
- vii) Striking people and equipment
- viii) Vehicle roll down

Loading/ Unloading of Wire coils

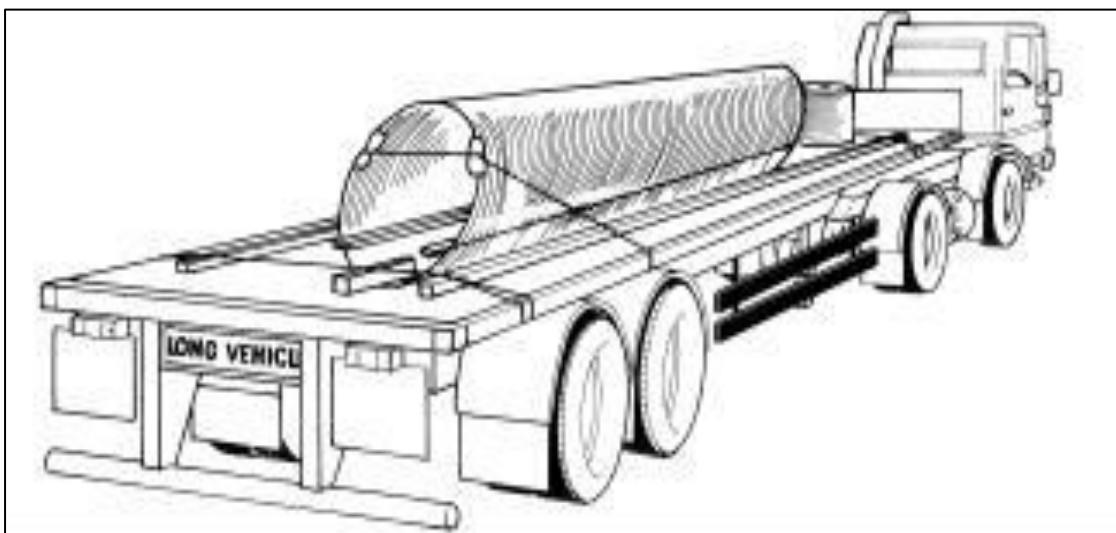
Do's

- i) Wear personnel protective equipments
- ii) Wear High Visibility Jacket for better visibility to other crew member No person will be on trailer during loading/ unloading of material.
- iii) All sticker pasting, painting of the coil will be done on ground by keeping at safe distance for positioning the coil at centre of the bed, signal will be given from ground.
- iv) Put scotch block under the wheel to avoid rolling down of vehicle.

- v) Vehicle will be allowed to go only after ensuring that material is properly secured and tightened materials to be loaded as per trailer capacity.
- vi) Use proper De-shackles, Pins, Chains and Links.
- vii) Coils to be tied to trailer bed with chains as shown in figure.

Don'ts

- i) Do not cook food at in the trailer at loading/ unloading point.
- ii) Do not allow crew member and others in loose clothing.
- iii) No person will move under the hanging material.
- iv) Do not sleep/ take rest in front of or below or side the vehicles.
- v) Do not park at unauthorized parking place.
- vi) Do not move here & there after placing the trailer at loading point.
- vii) Do not transport wire rod without providing red flag on both side of rear part.



3.9.3 Transportation of Pipes

Specific requirement for safe transportation of pipes:

- i) Pipes up to 200 mm dia shall be unitized before transporting. These are normally available at 6 m length. There shall be 6 straps in a length of 6.0 m. The largest dimension of the bundle shall not exceed 800 mm. These bundles shall be transported on trucks having full height side and back 'dala'. The posts of the dala shall be laterally fastened at the top ([Sketch no.1](#)).
- ii) Pipes more than 200 mm dia shall be transported on trailer bed, without being unitized.
 - a) For 6.0 m long pipes, there shall be 2-chain lashings and 2 wooden Dunnages.
 - b) For 12.0 m long pipes, there shall be 3-chain lashings and 3 wooden Dunnages.
- iii) Flat bed trailer shall be used for transporting pipes over long distance. Semi flat bed trailer can be used for local transportation. Semi flat bed trailers shall

have 3 nos. of wooden logs in addition to the log for dunnage to make up level (Sketch no. 2).

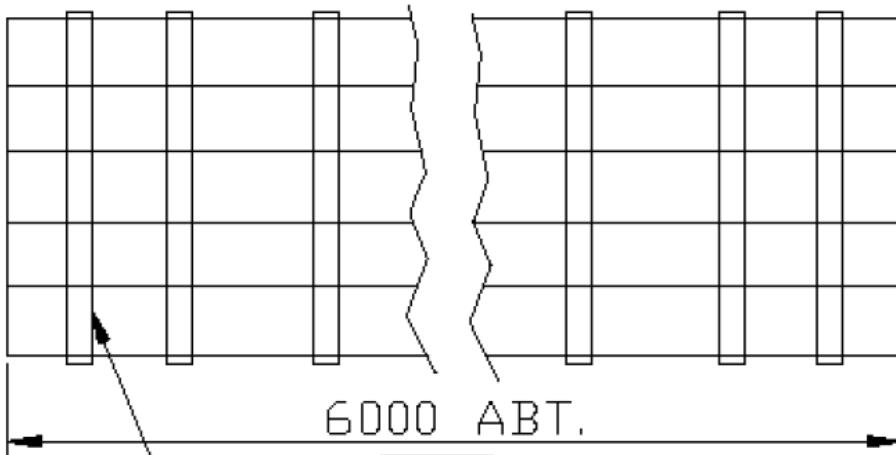
- iv) Two types of wooden dunnage may be used on a trailer bed.
 - a) Grooved Dunnage: (Sketch no. 3a and 3b).
 - b) Flat Dunnage with side choker blocks: (Sketch no. 4a and 4b).
- v) Pipes of 1,300 mm or greater diameter will be transported over steel saddles with seating arrangement as shown in sketch no. 5.
- vi) Proper platform with ladder shall be used for working on the trailer bed, for placing dunnage for the pipe, for lashing and for rigging work for loading and unloading.
- vii) Chain lashing of minimum 12 mm links or web lashing of equivalent strength shall be used. With chain lashings, necessary fixtures like bracket, D-Shackles, turn buckles shall be provided. The link chain shall be tightened with turn buckle and web lashing with standard ratchet.
- viii) The trailer shall be fitted with head boards to prevent injury to the driver by sliding of pipes in case of sudden braking.
- ix) Height of stacking on trailer bed: No. of tiers of pipes loaded on trailer shall not be more than the no. of pipes in the bottom row. In no case the carrying capacity of the trailer shall be exceeded. Any projection of pipe beyond trailer bed shall not be allowed. Single pipe having width and/or length more than the trailer bed shall be treated as an oversized consignment and arrangement for transportation shall be made accordingly.
- x) Loading and unloading of pipes shall be done using C- hooks and slings of adequate length. The C- hooks shall be anchored at the end of the pipes.
- xi) The arrangement of loading, depending on diameter of the pipe is given in **table: 1**.

Category	Diameter(mm)	Arrangement of loading																					
a.	$D \leq 200$	To be unitized and transported on truck with full height dala.																					
b.	$200 < D \leq 1200$	Transport on trailer bed with number of lashings as specified. Based on available width of trailer bed between number of posts as 2400mm ,following configuration may be followed: <table border="1" data-bbox="656 1494 1320 1784"> <thead> <tr> <th>Diameter of pipe</th><th>No. of Horizontal Rows</th><th>Max. No. of tier</th></tr> </thead> <tbody> <tr> <td>250</td><td>9</td><td>9</td></tr> <tr> <td>500</td><td>4</td><td>4</td></tr> <tr> <td>700</td><td>3</td><td>3</td></tr> <tr> <td>900</td><td>2</td><td>2</td></tr> <tr> <td>1000</td><td>2</td><td>2</td></tr> <tr> <td>1200</td><td>2</td><td>2</td></tr> </tbody> </table>	Diameter of pipe	No. of Horizontal Rows	Max. No. of tier	250	9	9	500	4	4	700	3	3	900	2	2	1000	2	2	1200	2	2
Diameter of pipe	No. of Horizontal Rows	Max. No. of tier																					
250	9	9																					
500	4	4																					
700	3	3																					
900	2	2																					
1000	2	2																					
1200	2	2																					
c.	$D > 1200$	Transport one pipe on steel saddle as given in (<u>sketch no 5</u>).																					

CHECKLIST

Points	Yes	No	NA
1. Are the pipes upto 200mm diameter unitized before transporting? Is the largest dimension of the bundle exceeding 800mm? Are the bundles being transported on trucks having full height side and back 'dala'? Are the posts of the dala laterally fastened at the top as shown in(sketch no.1)?			
2. Are 2 chain lashings and 2 wooden dunnages used for transporting pipes with dia more than 200mm and 6.0 m in length on trailer bed?			
3. Are 3 chain lashings and 3 wooden dunnages used for transporting pipes with dia more than 200mm and 12.0 m in length on trailer bed?			
4. Is proper platform with ladder being used for working on the trailer bed, for placing dunnage for the pipe, for lashing and for rigging work for loading and unloading?			
5. Is the chain lashing of minimum 12mm φ links or web lashing of equivalent strength being used?			
6. Are chain lashings provided with necessary fixtures like bracket, D-Shackles, turn buckles ?			
7. Is the link chain tightened with turn buckle and web lashing with standard ratchet?			
8. Is the trailer fitted with head board?			
9. Is the no. of tiers of pipes loaded on trailer not more than the no. of pipes in the bottom row?			
10. Is it ensured that the carrying capacity of the trailer is not exceeded?			

ANNEXURE-I



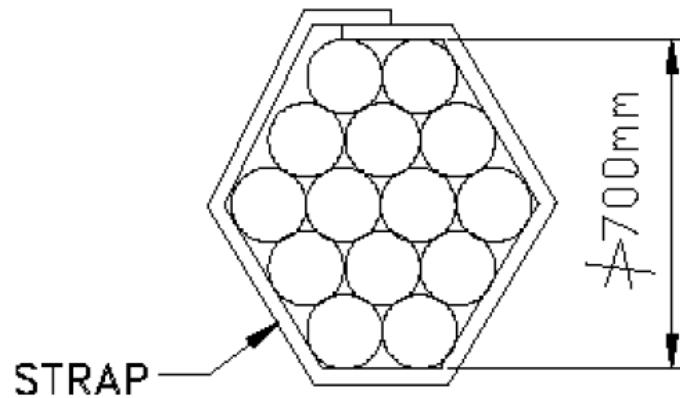
SIGNODE OR SIMILAR MAKE
32mm WIDE STEEL STRAP

TOTAL 6 – BANDS

2 – BANDS AT ONE END

2 – BANDS AT THE OTHER END

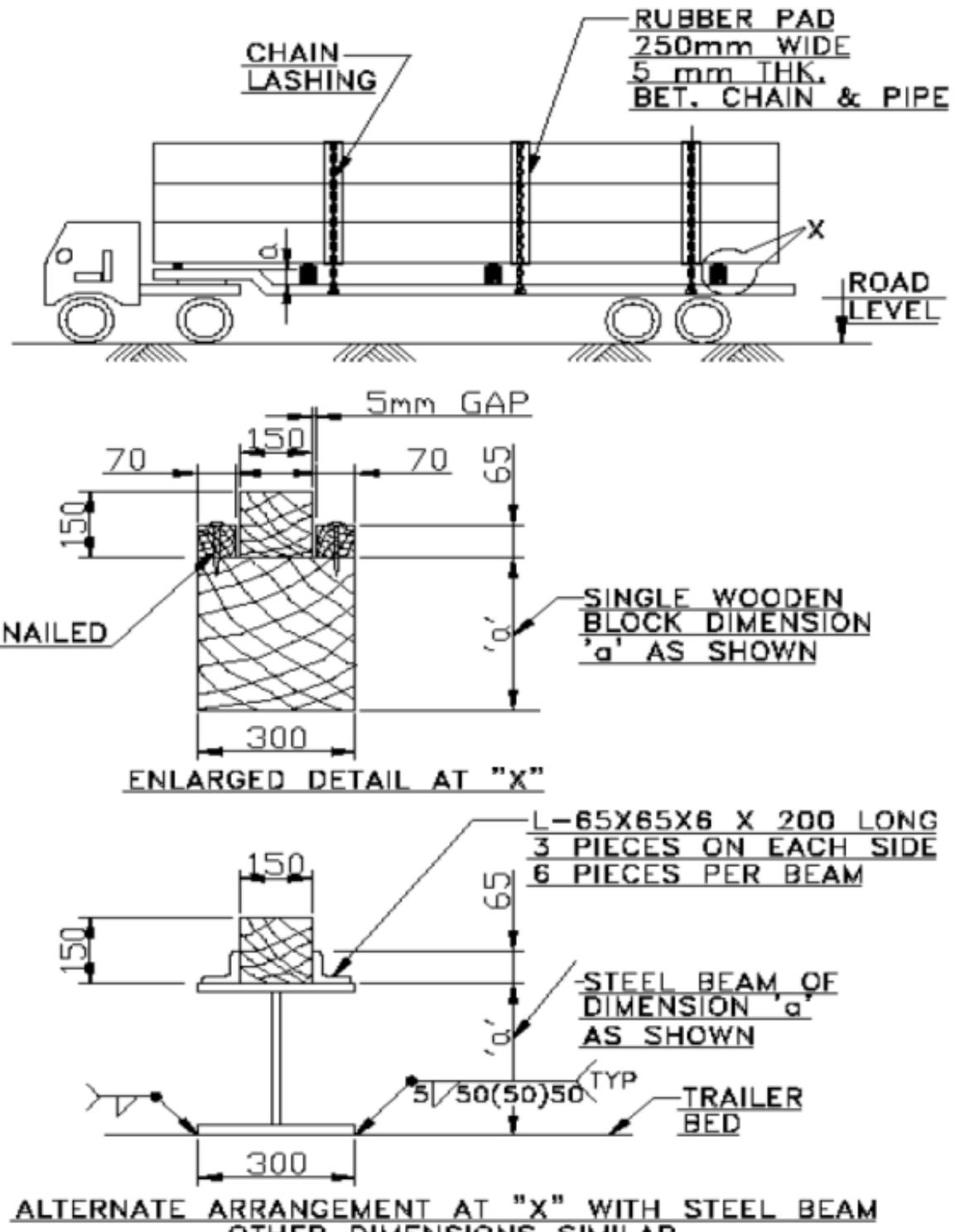
2 – BANDS IN THE MIDDLE



TYPICAL
CROSS SECTION

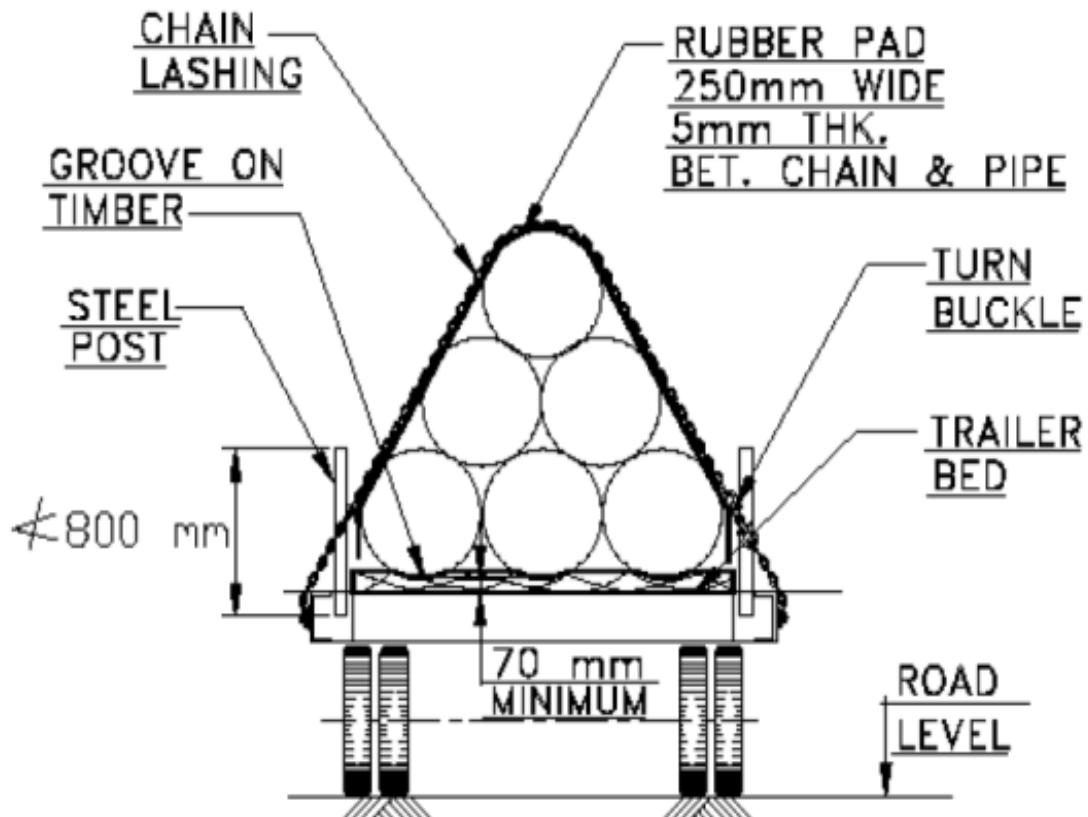
SKETCH NO. 01

ANNEXURE-II



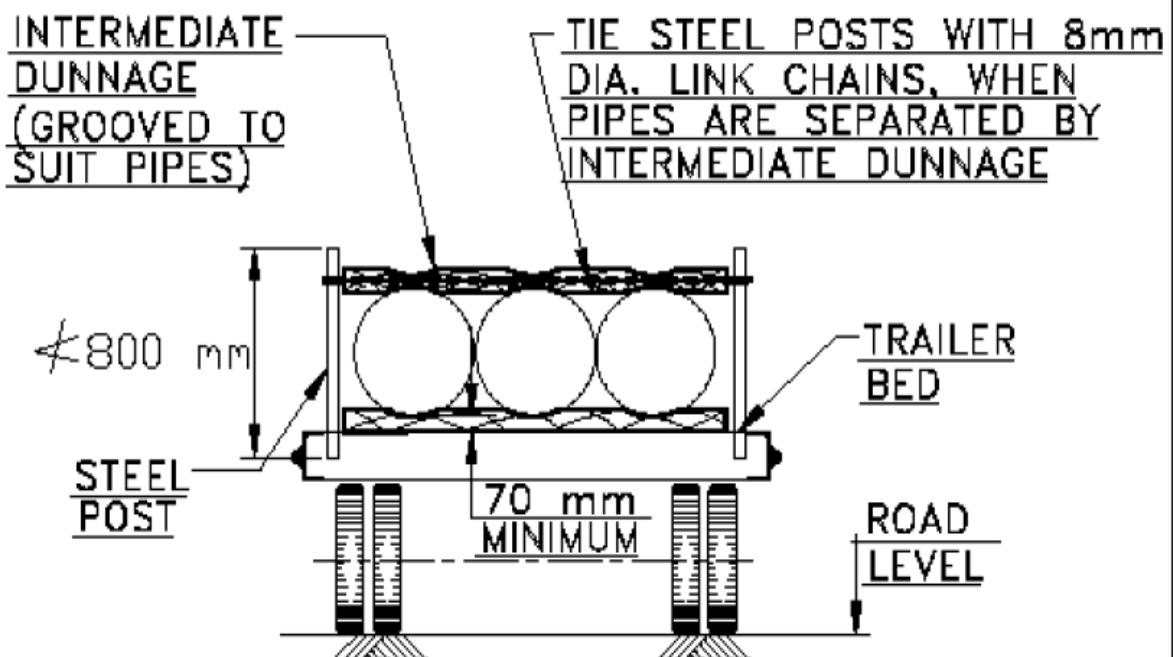
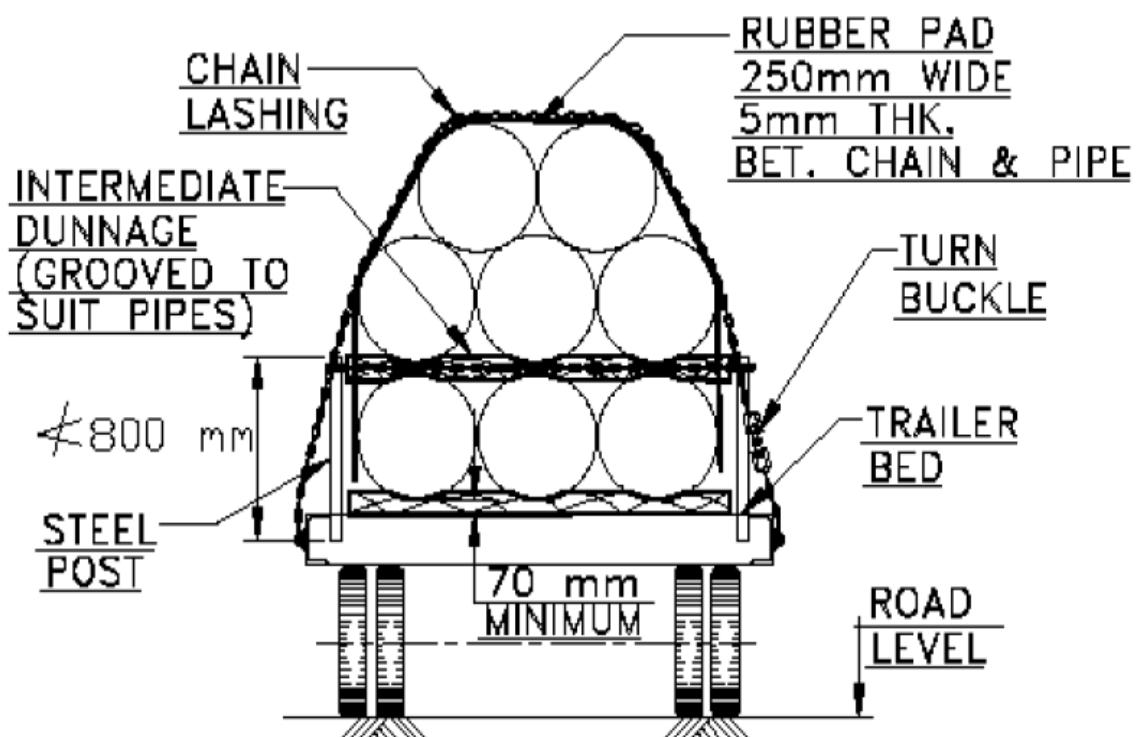
SKETCH NO. 02

ANNEXURE-III



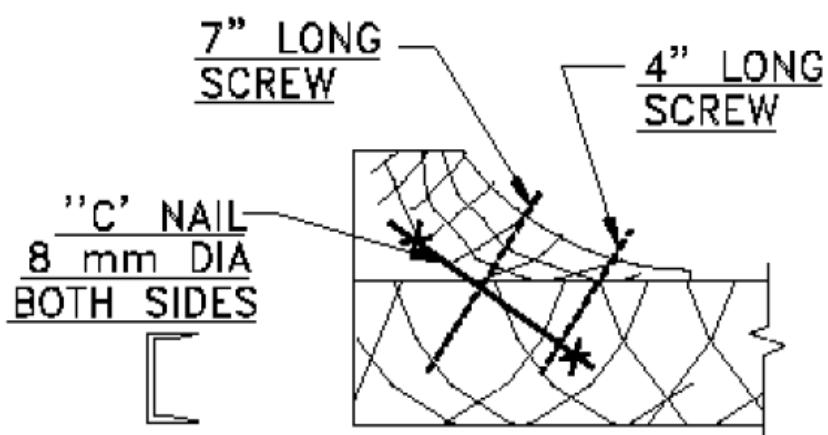
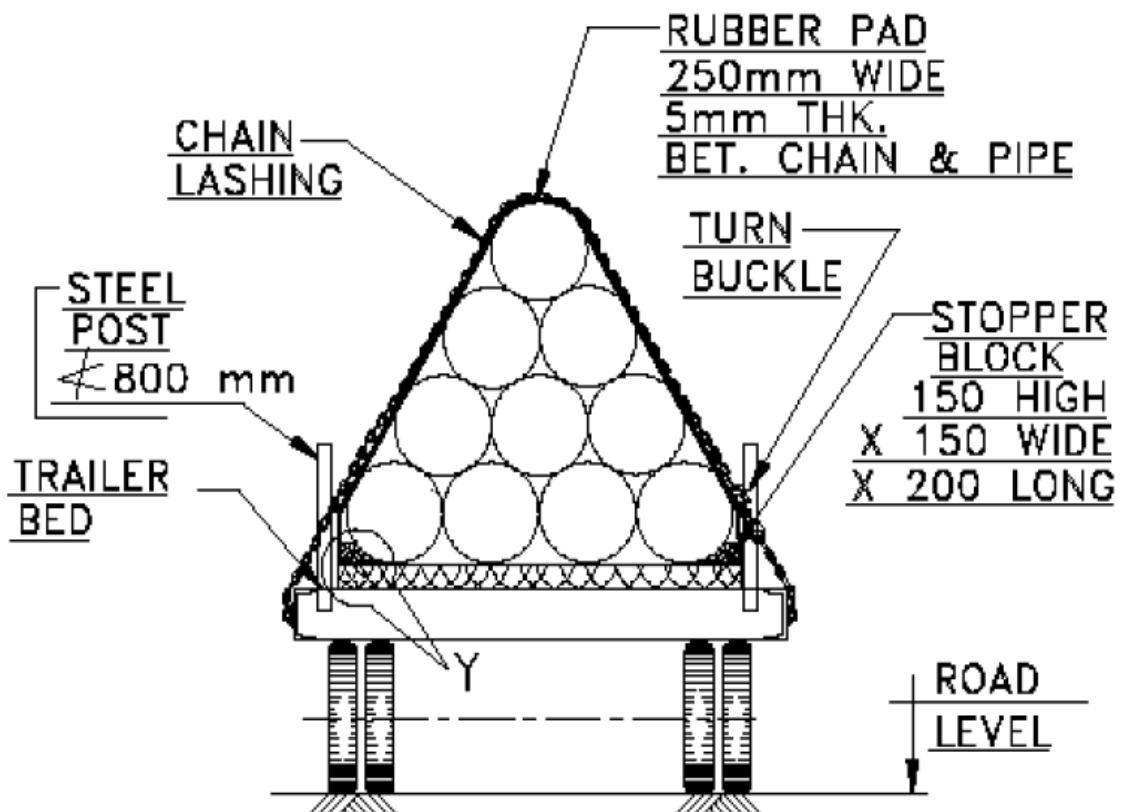
SKETCH NO. 3a

ANNEXURE-IV



SKETCH NO. 3b

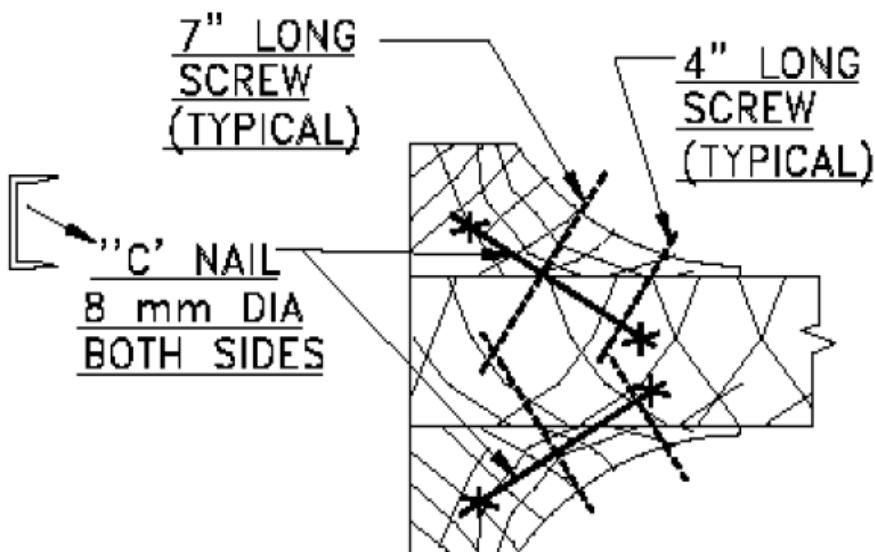
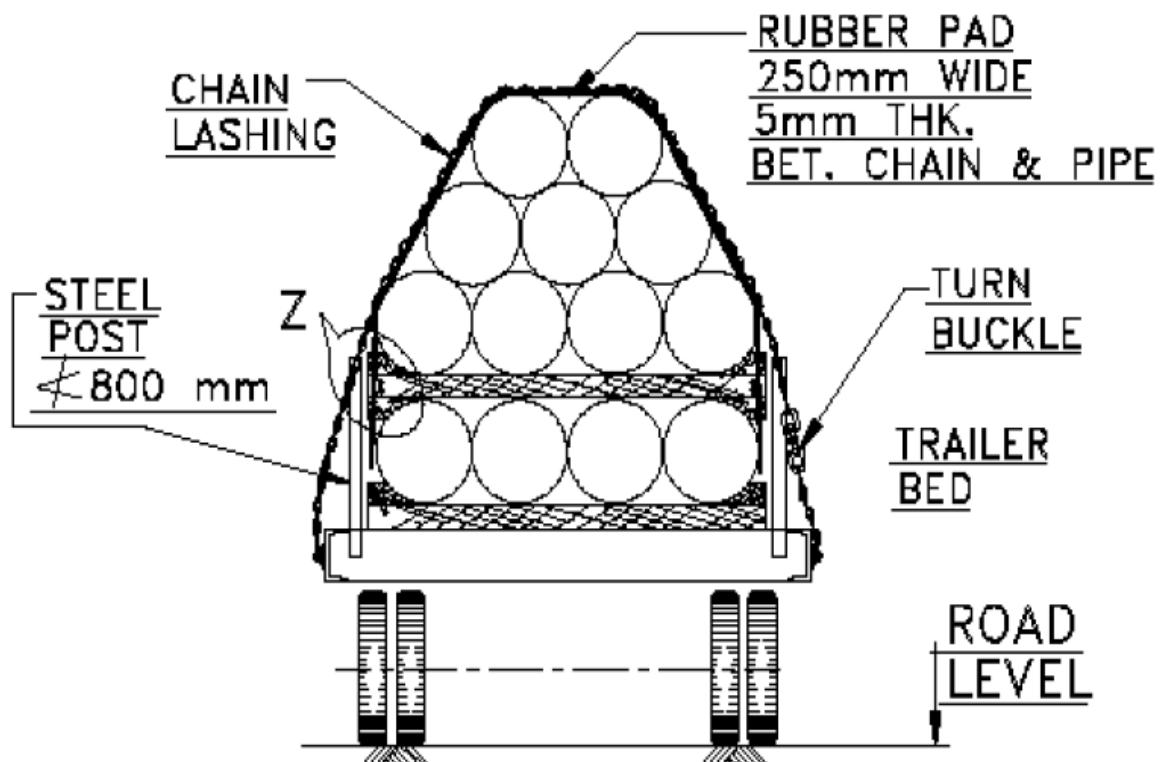
ANNEXURE-V



ENLARGED DETAIL AT "Y"

SKETCH NO. 4a

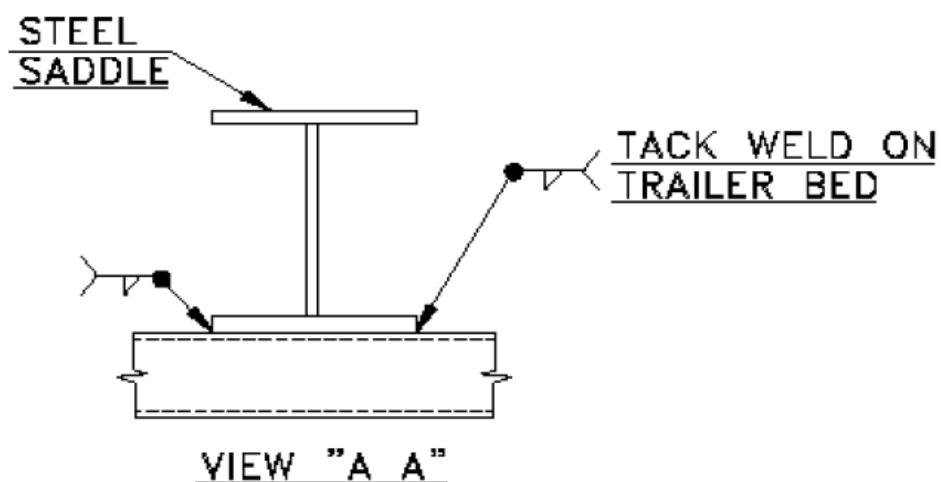
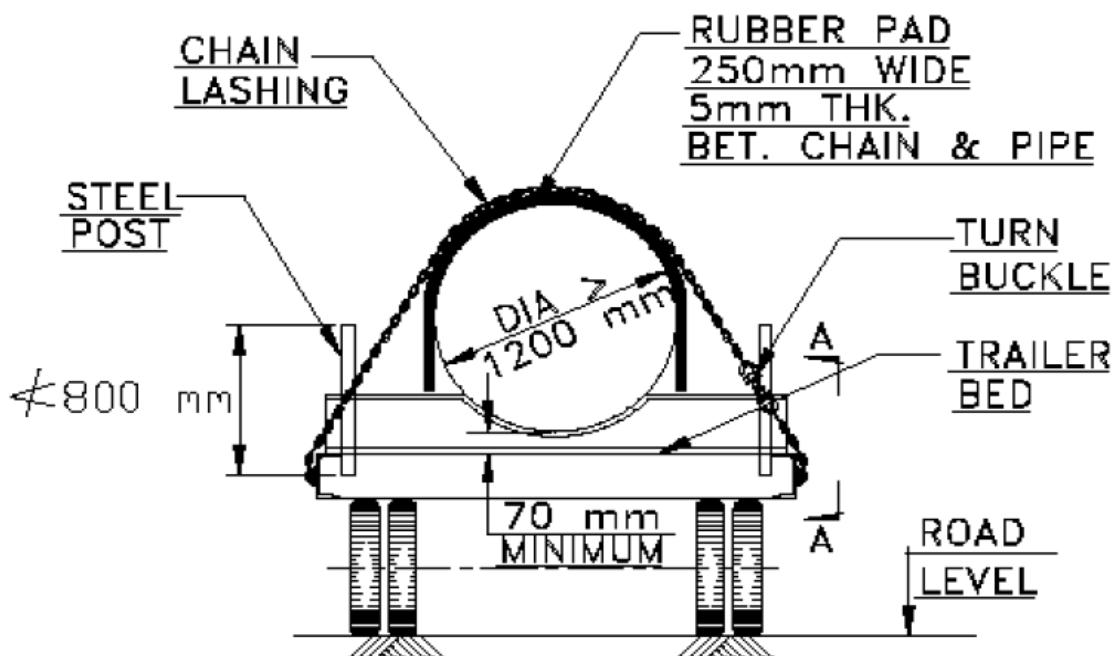
ANNEXURE-VI



ENLARGED DETAIL AT "Z"

SKETCH NO. 4b

ANNEXURE-VII



SKETCH NO. 5

3.9.4 Transportation of freight materials (Granulated Slag, Coal, Coke, Flue dust, Scrap etc.)

Loading and unloading areas should be:

- i) Clear of other traffic, pedestrians and people not involved in loading or unloading.
- ii) Clear of overhead cables, pipes, or other dangerous obstructions.
- iii) Level to maintain stability, vehicles should be parked on firm level ground; fenced or provided with other edge protection where there is a danger of people falling.
- iv) If necessary, protected against bad weather, e.g. strong winds can be very dangerous during loading.
- v) Loads should be spread as evenly as possible, during both loading and unloading. Uneven loads can make the vehicle or trailer unstable. Loads should be secured or arranged so that they do not slide around.
- vi) All such materials must be transported with cover on it. In no case materials should fall on road.
- vii) For transporting materials like flue dust which is hot in nature, special arrangement should be made by line management / process owner to stop spillage of materials.



3.9.5 Transportation of Projected material:

- i) Check and ensure that material has been properly tied with chain and shackle.
- ii) Fitness of vehicle must be checked and ensured that vehicle is fit to transport such material.
- iii) Measure, the dimension of loaded material, projected outside dala body at all or any sides (Rear, sideward, above the driver's cabin).
- iv) Driver must know the dimension of projected material.
- v) Centre of Gravity of the material must lie in the centre of vehicle to maintain the balance.
- vi) Route survey to be done from start to destination and must be ensured that through selected route there is adequate side & height clearance and material can be transported.

- vii) A Flag man must move at least 30 feet ahead of vehicle to escort the vehicle to destination and caution the Oncoming traffic (Red/ Green flag in day time and Red/ Green torch in night time).
- viii) While transporting in night time, red bulb in working condition must be fitted at both sides and rear of the outermost projected material. While in day time, red flag of appropriate size must be fastened up at outermost part of all projected material at both side and rear side.
- ix) Flag man must wear personnel protective equipments (PPEs).
- x) Flag man must wear high visibility jacket for better visibility to other crew member.
- xi) Use red/ green light battery-operated torch for signalling.

3.9.6 Transportation of Hot metal/ hot slag:

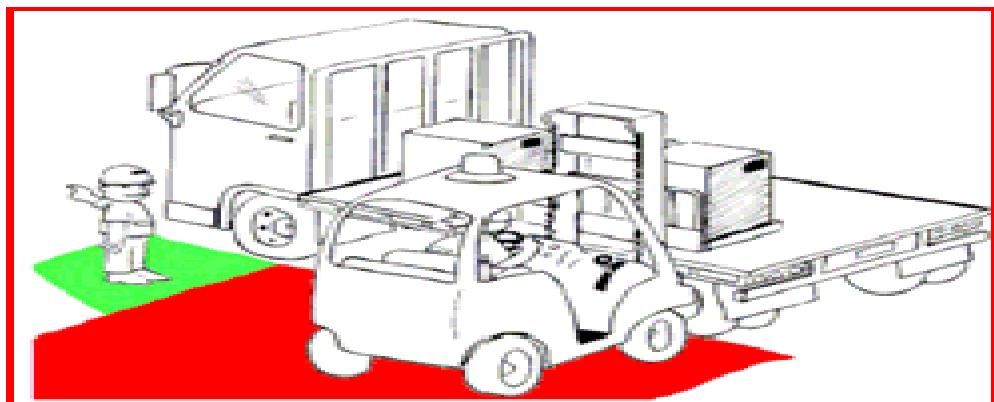
- i) Check and ensure that ladle has been properly placed on its foundation.
- ii) Check and ensure the material has been covered properly & there is no chance of heat emission.
- iii) Check for any spillage of materials from the ladle. Material should not spill out of ladle.
- iv) Movement of vehicle should be clear from other traffic.
- v) Flagman must accompany the vehicle to warn the other road users.
- vi) Provision of siren must be there which should be audible from safe distance. Siren must be in operation while vehicle will move on road.
- vii) In case of breakdown of vehicle, immediate action should be taken to remove the vehicle at safe place.
- viii) Vehicle should not be stopped under any gas pipelines or cable bridge.
- ix) Both operator & Flagman must be trained for safe operation of vehicle & can take appropriate action in case of emergency.

3.9.7 Exclusion zones:

Effective exclusion zones must be implemented at every loading point where mechanical handling equipment is used. This applies whether the loading point is inside or outside a building.

The principles that must be applied are:

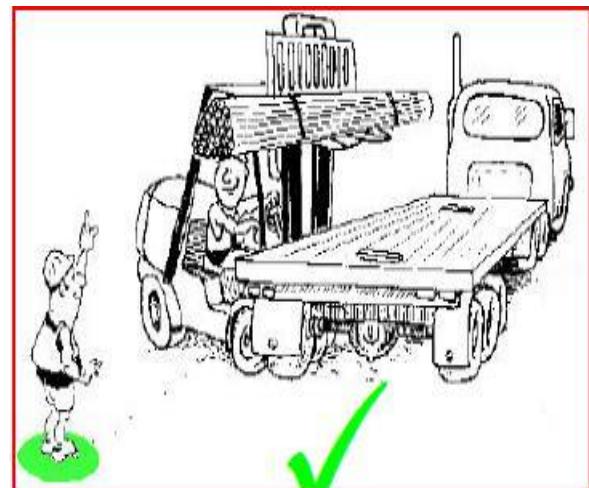
Unsafe “Red” zones must be clearly identified. These are the areas that no



one can enter during loading/unloading. The size /nature/ position of the zone will vary from product to product and situation to situation, but should be large enough to ensure that should something go wrong during the activity, personnel Safe “Green” Zones must be clearly identified. These are the areas where people should be during loading / unloading.

Note that it is the principles that must be applied – the actual implementation will vary and the identification of exclusion zones (e.g. painting, barriers etc.) is not prescriptive.

All relevant personnel should be trained in the principles and implementation of exclusion zones. This training must make clear that it is the crane driver/ forklift/ mobile plant driver in charge of loading who is responsible for enforcing the exclusion zone.



3.9.8 Falling off Trucks

Work on the bed of a vehicle or trailer must be avoided wherever possible. Where a task cannot be completed without accessing the vehicle, appropriate measures must be implemented to prevent falls or mitigate the consequences of falls.

3.9.9 Suspended Loads

The requirement to touch suspended loads must be avoided wherever possible. Suspended loads must not be taken over people, or be so close to them that they could be crushed or trapped by a swinging or falling load. When loads are being moved by overhead crane, where possible establish flight paths that avoid travelling over walkways or key equipment.



3.9.10 Load Limits

Be aware of the load limits of varying equipment when operating different machines throughout the day. Depending on the equipment set-up and size the load limits can change drastically. When lifting objects with a machine make sure loads are secure with the proper rigging attachments, and always inspect to ensure they are in good working condition. As with most equipment operations, confirm all workers are at a safe distance when lifting and moving loads. Load related notification may be referred as released by government of India as attached in **Annexure - VIII**.

Annexure - VIII: Revised Safe Axle Load for Transport Vehicles:

No. RT11028/11/2017-MVL

Annexure- "B"

Government of India

Ministry of Road Transport & Highways
(Transport Division)

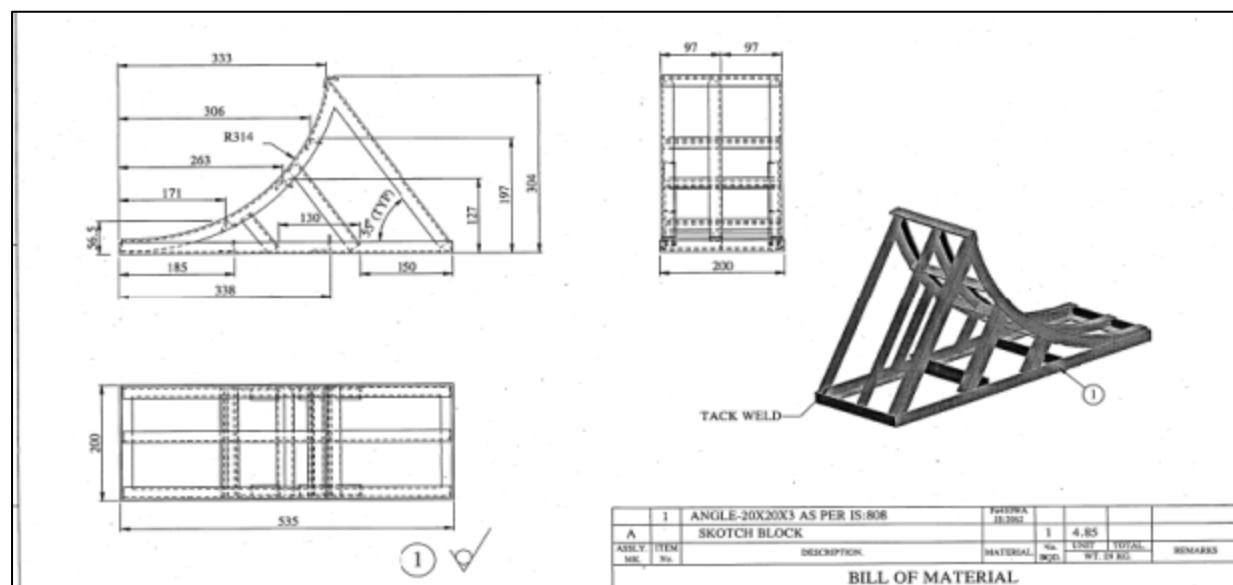
Transport Bhawan, 1, Parliament Street, New Delhi - 110001

Revised Safe Axle Load limits for Transport Vehicles										
Sr No	Type of Vehicle	Axle Combination on Tractor	Axle Combination on Trailer	No of Axles	Single Axles	Tandem Axle	Dual Axles	Tridem Axle	Permissible GVW	Remarks
1	Two Axle Rigid Truck	Two tyres on front axle and four tyres on rear axle	-	2	1	0	1	0	19	
2	Three Axle Rigid Truck	Two tyres on front axle and eight tyres on rear tandem (two) axle	-	3	1	1	0	0	28.5	
3	Four Axle Rigid Truck	Two tyres each on two axles and eight tyres on one tandem (two) axle	-	4	2	1	0	0	36	
4	Five Axle Rigid Truck	Two tyres each on three axles and eight tyres on one tandem (two) axle	-	5	3	1	0	0	43.5	
5	Five Axle Rigid Truck	Two tyres each on two axles, four tyres on one axle and eight tyres on one tandem (two) axle	-	5	2	1	1	0	47.5	
6	Six Axle Rigid Truck	Two tyres each on four axles and eight tyres on one tandem (two) axle	-	6	4	1	0	0	49	To be capped at 49 tonnes.
7	Tractor - semi articulated trailers	Two tyres on front axle and four tyres on rear axle	Four tyres on single axle	3	1	0	2	0	30.5	

8	Tractor - semi articulated trailers	Two tyres on front axle and four tyres on rear axle	Eight tyres on tandem (two) axle	4	1	1	1	0	40	
9	Tractor - semi articulated trailers	Two tyres on front axle and four tyres on rear axle	Twelve tyres on a tridem (three) axle	5	1	0	1	1	46	
10	Tractor - semi articulated trailers	Two tyres on front axle and eight tyres on rear tandem (two) axle	Four tyres on single axle	4	1	1	1	0	40	
11	Tractor - semi articulated trailers	Two tyres on front axle and eight tyres on rear tandem (two) axle	Eight tyres on tandem (two) axle	5	1	2	0	0	49.5	
12	Tractor - semi articulated trailers	Two tyres on front axle and eight tyres on rear tandem (two) axle	Twelve tyres on a tridem (three) axle	6	1	1	0	1	55	To be capped at 55 tonnes
13	Tractor Trailer	Two tyres on front axle and four tyres on rear axle	Eight tyres on two axles	4	1	0	3	0	42	
14	Tractor Trailer	Two tyres on front axle and eight tyres on rear tandem (two) axle	Eight tyres on two axles	5	1	1	2	0	51.5	
15	Tractor Trailer	Two tyres on front axle and four tyres on rear axle	Four tyres on single axle & Eight tyres on tandem (two) axle	5	1	1	2	0	51.5	
16	Tractor Trailer	Two tyres on front axle and eight tyres on rear tandem (two) axle	Four tyres on single axle & Eight tyres on tandem (two) axle	6	1	2	1	0	55	To be capped at 55 tonnes

11.12 Scotch block:

It is important to have adequate scotch block against the wheel once driver is coming out of vehicle. It is advised to have minimum one pair of wheel to be placed against the wheel nearer to driver. However, while using two pair of wheel chock it should be used to diagonally opposite wheels. Standard dimension of wheel Chock/Scotch block is mentioned in drawing for reference.



3.9.11 Unloading

All safety precautions related to loading apply equally to unloading points and activities. Loads must be inspected prior to the removal of any load restraint. This is to ensure, so far as possible, that the load is stable and will not slip/fall when load restraint equipment is removed.

3.10 Safety Precautions during Movement of Mobile Crane and Other Cranes

Do's while operating Hydra/ Ace crane

- i) Use of Mobile cranes at construction sites to be restricted, so that there is no movement of persons around the Mobile cranes. Area around Mobile cranes operations should be identified and barricaded to prevent unauthorized person in the hazardous zone.
- ii) Mobile cranes are not allowed to move on road with load.
- iii) The operator should have only one helper to move ahead of Mobile crane at a distance of 3.0 m ahead of boom length on road at right side to guide the operator. While two helpers are allowed at Construction site only.
- iv) The helpers should wear fluorescent jacket. The Helpers should be provided with whistle at ground to caution the surroundings & his own presence to the operator.
- v) The operator should have a valid HMV driving license.
- vi) The operator and Helper shall be well trained.
- vii) Extended guard on front & rear wheel and Bumper must be provided.
- viii) Guy ropes of required length on both sides of object shall be provided for lowing and lifting of material only.
- ix) Clear access while movement of the equipment to be ensured.
- x) Extra reflective mirrors in operator's cabin to overcome the difficulties pertaining to the left side view shall be provided.
- xi) Automatic reverse horn should be provided.
- xii) The operator should stop the movement of the crane if the helper's signal is not visible.
- xiii) Always keep the loading area as level as possible.
- xiv) The terrain should be reasonably hard. The undulation of path across the direction of travel ways should be less than 10 degrees.
- xv) The Centre of Gravity of the load shall always be within the wheel load.
- xvi) Before lifting load, check if connecting string / tackle are properly hooked and are strong enough to take the load.
- xvii) Before using Mobile cranes, proximity hazards and obstructions to the movement should be identified and corrected.
- xviii) Apply parking brake and scotch block when the machine is parked.
- xix) Lift loads as far as possible with crane in unscrewed position.
- xx) Helper to ensure avoidance of man movement within the vicinity of crane.
- xxi) Tyre pressure to be checked on daily basis.
- xxii) Keep the load to the minimum height.
- xxiii) Length of slings should not be too long to avoid swinging.

xxiv) Avoid going over extremely rough tracks consisting of pot holes or sudden dumps. If at all such path is to be negotiated, minimum speed and lowest gear should be used

Don'ts while operating Mobile cranes/ Ace crane

- i) Engagement of two Mobile cranes to lift single object should not be done.
- ii) Overloading of the machine should not be done.
- iii) Do not start the crane unless all routine pre-operation is done.
- iv) Do not drive the crane too close to the edge of ditch or excavated pit.
- v) Do not coast down a gradient in neutral gear.
- vi) Do not leave the crane seat with the load raised and never leave the crane unattended while engine is running.
- vii) Mobile phone and radios should not be used by the operator and helper while crane is in operation.
- viii) No other person should be in driver's cabin during operation.
- ix) No oblique pulling on boom.

3.10.1 Some important points for loading cranes (e.g. Ace Crane) on trailer

- i) Examine the trailer for tyre condition, general health, road worthiness and conformance to all safety requirements.
- ii) Examine the under frame of the trailer to ensure that it can take the load of the crane at the edges. For transporting crane the loading will be mostly on the edges of the trailer.
- iii) Width of the trailer bed should be such that when the centre line of the track chain is parallel to the length of the trailer, most of the track chain will be within the width of the trailer.
- iv) The trailer should be parked on the level ground at the time of the loading. Necessary wedges should be put on the wheel to prevent movement during loading.
- v) No one should be on the trailer bed while loading the crane on the trailer.
- vi) The loading crane and lifting arrangement should be checked as per the relevant safety standards.
- vii) All fastening between the trailer and the crane like D-Shackles, chains, hooks etc. should be checked beforehand.
- viii) The counter weight, boom etc. of the crane being loaded should be removed before hand.
- ix) The cabin should be locked with the base to prevent any rotation.
- x) After the crane is loaded on the trailer, necessary cleats and stoppers of adequate strength shall be welded on all four sides to prevent any movement of the crane during transit. The cleats shall be welded without any movement of the trailer.

- xi) Necessary lashing, chain etc. shall be used to hold the load in desired condition. These should be of adequate strength to prevent toppling on transit.
- xii) All other jobs related to this shall be done as per the requirement of relevant safety standards.

3.11 VEHICLE INCIDENT / COLLISION REPORT:

Sl.	Criteria	Details
1	Registration Number of vehicle	
2	Type of vehicle	
3	Vehicle pass number	
4	Safety Number	
5	Department under which vehicle is operating	
6	Name of the driver/employee to whom vehicle is assigned	
7	P.No./ Gate Pass number	
8	Brief description of collision /incidents	
9	Damage report of company property	
10	If the operator injured then details of injury by first Aid Station	
11	Doctor's report if any	
12	Damage report of vehicle	
13	Is the vehicle collided with other vehicle?	
14	If Yes , Details of the other vehicle in the same format	
15	Weather conditions at time of collision/incident	
16	Were seat belts worn?	
17	Was the accident alcohol related?	
18	Was speeding involved?	
19	Road conditions	
20	Last time the vehicle operator received driver training:	

Reference:

1. Central Motor Vehicles Rules, 1989 & Road transport and Safety Bill 2015.
2. IPSS: 1-11-023-15 'Safety Standard for Transportation in Steel Industry'.
3. Tata Steel Standard -SS/GEN-29, Version-04 and SS/Gen-52

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	LOCO OPERATION	Doc. No: SG/25 Rev no. : 00 Effective Date : 14.10.2019

1. Objective

This Safety Guideline has been prepared with a view to provide guidance for operating Locos for train movement or Loco movement safely inside the plant premises.

Hazards: Hit / Run over.

2. Scope

This guideline is applicable for all Iron & Steel industries.

3. Procedure

3.1 General Safety Precautions

Following precautions shall be taken during operation of a loco:

- i) Use PPEs i.e. safety boots, helmets etc. as per requirement.
- ii) Check for the presence of firm railings, stairs and couplers of the locomotive.
- iii) Check that the locomotive floor is clean. If it is oily, wipe with cotton or spray saw dust on it for absorption.
- iv) Ensure that the brakes, lights and horn are working properly.
- v) Ensure that 2-4 scotch blocks are available on the loco and that the Shunting Porter (S/P) places scotch blocks under the wheels of the wagon, next to the loco, to prevent rolling of wagons and accidents.
- vi) Ensure availability of the fire extinguishers inside the cabin. Periodic inspection to be done and date of checking should be displayed.
- vii) At least three of the crew (1 loco operator & two shunting porters) must be present in the locomotive at all times.
- viii) Maintain speed of train about 5-7 kmph & sudden braking must be avoided.
- ix) Loco to stop before level crossing, S/P will get down, caution the road traffic and signal the loco operator to move the loco. Auto drop gate to be provided where road traffic is more.
- x) Operator must ensure that the S/P is in front of the train with signal flag/ signal lamp / Walkie-Talkie (**Annexure -I**) and is following the signals & keeps a sharp lookout for overhead traveling cranes.
- xi) Never start, or couple with, a loco or train suddenly. After getting clearance/ signal, first blow a long horn as a warning and then gradually start the motion.

- xii) Shunting Porter will check that points are set properly in the desired direction of movement. Permissible gap in tongue rail on hand points is 5 mm max & for motorized points, it is 3 mm max.
- xiii) Move loco carefully in fire/ spark prone areas like BF, SMS and any other identified unit.
- xiv) While driving, observe control panel and other equipment of the loco to ensure safety and to avoid accidents/ delays.
- xv) Be well conversant with the wagon handling capacity of loco.
- xvi) If the loco fails on a gradient, immediately stop by braking and put adequate scotch blocks for blocking the wheels of loco and train (Block at least 4 wagons).
- xvii) Handle walkie-talkie with care as sometimes it is the only mode of communication.
- xviii) Mobiles not to be used during movement of loco.
- xix) When approaching any point keep a sharp look out for another train coming from its loop line and moving in the same direction to avoid side collision.
- xx) In case of fire, use the fire extinguisher available on the loco. If not adequate, inform fire services giving your exact location.
- xxi) Never allow unauthorised persons on the locomotive.
- xxii) S/P to wear retro – reflective Jackets for easy identification.
- xxiii) Retro-reflective strips to be provided in loco body.
- xxiv) S/P should not move between couplers.
- xxv) S/P to be given the “On the job training”.
- xxvi) Brakes of Loco and 5 to 7 wagons are to be kept connected to form a unit to prevent accidental rolling of the rake on slope.
- xxvii) Shop floor must be cleaned and free from oily substances.
- xxviii) One S/P on front side, second S/P at rear side of locomotive to be present during operation.
- xxix) In case of Track Maintenance:
 - a) Take written permission of CA (Competent Authority) from respective departments to block the rail track within their battery limit.
 - b) Permit to Work on rail track memo to be given to shop in-charge who in-turn intimate concerned personnel.
 - c) Written block memo for the track to be given to Y/M (Yard Master).
 - d) Display red flag/ banner flag 30 – 50 mtrs away on both ends of working areas of the track.

3.2 Pre-Start Checks for Loco Operator

- i) Loco operator should check the loco as per the checklist of Standard

Operating Procedures (SOP) (to be developed by the user).

- ii) Visually check the presence and fitness of various critical loco parts mentioned below before boarding the loco.
- iii) At the loco end, check Buffers with their holding bolts, Train brake hose pipes (Both air and vacuum), valve, Universal couplings with washer, dummy carriers, Centre buffering coupler (with all its components), railings and footsteps.
- iv) At the sides of the loco check Brake cylinder, its holding bolts, brake linkage, brake adjusting screw, brake shoe, axle box cover, Equalizer bar, saddle, coil springs, side bearer, condensate drainage valve, safety valve on the main air reservoir, traction motor cable holding clamps, side bearer, Bogie hose and its valve, J-Filter, C-2 valve, Gear Box cover with its bolts.

3.3 Starting of Engine

- i) Operation shall be checked as per (SOP) of respective units (to be developed by the user) and abnormalities, if any to be documented and reported.

3.4 Forward Movement of Loco

(Hauling Capacity of Locos given at the end)

- i) Ensure both sides of the loco (Operator and Attendant) are clear and blow a long horn.
- ii) Set the reverser in the direction of movement, push the brake lever to release the brake and after the brake piston goes into the cylinder (Brake pressure zero), set the throttle to a higher notch. (In GE loco the engine picks up speed as the throttle is opened but in WDS-6 loco the engine takes 10 – 20 seconds to start picking up speed).
- iii) When making the first movement in the shift, after the loco comes into motion, check the brakes by putting the throttle to zero and pulling the brake lever.

3.5 Coupling of Wagons

- i) Stop the loco a little away from the wagon/ loco and let the S/P go and set the coupler of the wagon.
- ii) After getting signal from the S/P, slowly inch the loco forward till the loco gently comes into contact with the wagon/ loco.
- iii) Check by pulling a little, after getting signal from the S/P, that coupling is complete.
- iv) Direct the S/P to remove the Scotch block before proceeding.
- v) Coupling Handle to be covered.

3.6 Decoupling Of Wagons

- i) Stop the loco and make sure that the full train has come to a standstill within the fouling marks of the siding.

- ii) Shunting Porter should ensure that scotch blocks are placed tightly under the wheels of the wagon to be decoupled on the downward side on a gradient (If gradient is not known, he should block wheels from both sides).
- iii) After getting signal from S/P, move loco backward slightly to bring the couplers together and then stop so that couplings are separated.
- iv) Move the loco away slightly and then stop to see that the detached train is stable.
- v) After making sure that no rolling of the decoupled wagons takes place, proceed for the next program.

3.7 **Safety Precautions for 3.5 & 3.6**

- i) Both the S/P to be positioned at the Stop where coupling/ decoupling is to be done.
- ii) One S/P will communicate with the loco operator and other S/P will do the coupling/ decoupling or either S/P is required to go to the other side of the wagon depending on the position of Loco Operator's cabin or line curve or any other obstacle.
- iii) S/P will go under the coupler but not between the coupler with all PPEs.
- iv) S/P will ensure placement of scotch block on both sides of detached Wagon wheels at both ends for ensuring stability of detached wagons and to prevent accidental rolling towards lower gradient.
- v) S/P will ensure removal of scotch block after coupling with Loco is done.

3.8 **Movement on Level Crossings, Busy Area or Curved Track**

- i) Ensure S/P in front of the loco/ train with communication device and a signaling flag.
- ii) Keep speed of the loco around 5 kmph by bringing throttle to lower notch or by braking.
- iii) Blow horn to alert the staff in the vicinity of the tracks.
- iv) Stop the loco/ train 8 – 10 feet from the level crossing and direct S/P to walk up to the road.
- v) After the S/P has cautioned the road traffic by Red Flag/ Red Light and when the level crossing is clear, slowly move forward, blowing horn.
- vi) Direct the S/P to get on the loco / wagon after the level crossing is cleared by the loco / first wagon.
- vii) In busy areas ensure presence of the S/P in front of the loco, move slowly and cautiously blowing horn to warn the staff working in the vicinity of the tracks.
- viii) On a curved track ensure S/P in front of Loco / Train with communication device, move forward slowly (Below 5 kmph), blow horn continuously till end of curve and keep a sharp lookout for any obstacle on the track or train coming on the same track from the other direction.

3.9 Movements Inside the Shops

- i) Stop loco/ train just outside covered shed and visually check clearance of the track. Inform the Shop I/c. Set clearance from upper side for empty loco and inform this to loco operator.
- ii) After getting signal from the S/P, proceed with speed below 5 kmph & blowing horn. Watch out for overhead cranes.
- iii) Blow horn while entering inside the shop.
- iv) In pushing mode S/P will lead the wagons by walking inside the shop.
- v) Ensure the red light blinker at the last wagon for making it conspicuous and distinctly visible.

3.10 Unloading of Hopper Wagons over Bunkers

- i) Ensure that signal given by S/P through flag or signal lamp is visible (In case of walkie-talkie, this is not needed).
- ii) As per direction of the RM Charge man/ Operative, the S/P must place the wagon over the specific bunker in such a way that the doors to be opened are just above the bunker.
- iii) Precautions to be taken for movement of S/P while going to open gates of the wagons over the platform.
- iv) Door closing of the wagons to be done at the empty side of bunker to prevent falling of materials in track area & also hitting persons working in close vicinity.

3.11 Stopping and Parking the Loco:

- i) Stop the loco at a safe, illuminated area clearing the adjacent track or road.
- ii) Put the switches/ levers as follows:
 - a) Engine control switch - IDLE
 - b) Reverser - NEUTRAL (Central position)
 - c) Throttle - IDLE (Zero notch)
 - d) Loco brake - Applied
 - e) Light switches/ Aux Breaker - OFF
- iii) Press the Engine Stop switch till the engine stops completely.

References:

- i) IPSS: 1-11-033-17 "Safety Standard in Loco Operation in Steel Industry".

ANNEXURE - I**SIGNALS FOR SHUNTING**

A	Day time-Signal Flags	a. Red Flag b. Green Flag
	If Shunting Porter shows	
B	a. Green Flag	Loco to move towards signaling S/P
	b. Red Flag	Loco to stop
	c. Wave both flags (Red & Green) Slowly, above shoulder height	Slow coupling (Loco moving towards signaling Shunting Porter)
	d. Wave Green Flag towards SLO (Below waist level)	Loco to move away from signaling S/P
C	Night Time-Signal Lamp	a. Red Glass
		b. Green Glass
		c. Plain Glass (Yellow Flame)
	If Shunting Porter shows	
	a. Red Light	Loco to stop
	b. Green Light	Loco to move towards signaling S/P
	c. Yellow Light (Slowly move up and down)	Loco to move slowly away from signaling S/P
	d. Green Light	Move slowly towards signaling S/P
	e. Yellow Light (Steady)	Move away from signaling S/P
D	THREE LIGHT SIGNALS IN RRI SYSTEM AT OBBP & HMC AREA:	
	NOTE: Follow the signal on the left side of the track.	
	ON TURN OUT	
	a. Both lower lights glowing	Stop
	b. Upper light and one lower light (tilt is to the left)	Proceed (Left)
	c. Upper light and one lower light (tilt is to the right)	Proceed (Right)
	ON STRAIGHT TRACK	
	a. Both lower lights glowing	Stop
	b. Upper light and one of the lower light	Proceed
D	SIGNALING WHILE CONNECTING TRAIN BRAKES	
	a. Signaling for dropping vacuum for Train brake	S/P will give downward pressing movement with palm of right hand
	b. Signaling for developing/ raising Vacuum for train brake	S/P will give upward pushing movement with palm of right hand.

<u>Wagon handling capacity of locos</u>				
SN	Location & Type of Track	GE 80 T	GE 90 T	WDS – 6
1	Level Track	10	10	36
2	Level track with sharp curves – reduced speed	10	10	30
3	Marshalling Yard - Straight track, 1:400 gradient	7	7	25
4	RM sidings – Level but jammed up to rail top	-	-	25
5	BF High line 1:80 gradient	-	-	7
6	SMS High line 1: 90 gradient	5 or 6 Charging bogies by 90 T Loco		
7	SGP Pouring Line 1: 150 gradient	-	-	10
8	M/Yd to Railway Siding:400 to 1:250 gradient	-	-	20
9	BF / SMS Dumping (MRD) 1:200 gradient	5	6	10

NOTE:

- Each of the wagon i.e. (BOX, BOBS, FLAT, BOI and GONDOLA wagons) is assumed to have:

Tare Weight	= 25 T
Carrying Capacity	= 60 T
Gross Weight	= 85 T
- For Charging Bogies, Tare Weight = 10T

Carrying Capacity	= 20T
Net Weight	= 30T
- Reduce the above capacities by 20 % on wet tracks or tracks covered by grass.
- Increase the above capacities by 30 % when hauling Hard Coke. Bulk density of Hard Coke is less than 1 while that of other commodities like I/Ore, L/Stone etc. is around 2.5 or more. Since the Hard Coke carried in each wagon is less, the loco can haul more wagons.





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