COMPENDIUM OF SAFETY PROTOCOLS FOR CONTAINMENT OF OXYGEN LEAKAGE IN HOSPITALS

3rd May, 2021

KERALA STATE EMERGENCY OPERATIONS CENTRE (KSEOC)

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1. SCOPE AND APPLICABILITY

This document is prepared with regard to the emergency situation which the State of Kerala is facing due to the COVID19 pandemic. The oxygen leakage incident in Dr. Zakir Hussain Hospital in Nashik, Maharashtra on 21-4-2021 was an eye opener to the whole country. Considering this, KSEOC has prepared a compendium of fundamentals for the safe handling of emergencies due to oxygen leakages.

2. INTRODUCTION

This work was facilitated by a number of "guidance documents," among which the most prominent were:

- Liquid Oxygen, Air Products and Chemicals, Inc
- The Chemical Accidents (Emergency Planning Preparedness And Response) Rules, 1996, Ministry of Environment and Forest, 1st August 1996

Oxygen is the second largest component of the atmosphere, comprising 20.8% by volume. Liquid oxygen is pale blue and extremely cold. Although non-flammable, oxygen is a strong oxidizer. Oxygen is necessary to support life. Oxygen, by itself is not combustible. It acts as a catalyst to fire which could lead to an explosion as oxygen heavily increases combustibility rate. Thus, arresting the leakage of oxygen while making sure that there are no sources of ignition around the place of leak can aid in preventing fire and thus, minimize casualties.

Oxygen is transported in liquid form so that there is less risk of a fire hazard, but an explosion risk is still present. The rules for transporting liquid oxygen are the same as that of cryogenic liquids. Oxygen will react with nearly all organic materials and metals, usually forming an oxide. Equipment used in oxygen service must meet stringent cleaning requirements, and systems must be constructed of materials that have high ignition temperatures and that are nonreactive with oxygen under the service conditions. Liquid oxygen is a cryogenic liquid. Cryogenic liquids are liquefied gases that have a normal boiling point below –130°F (–90°C). Liquid oxygen has a boiling point of –297°F (–183°C). Vessels used in liquid oxygen service are designed for the pressure and temperatures involved. Piping

arrangements should follow similar design and conform to national standards and codes.

3. PHYSICAL AND CHEMICAL PROPERTIES OF LIQUID OXYGEN

Molecular Formula	O_2
Molecular Weight	31.999
Boiling Point @ 1 atm	–297.4°F (–183.0°C)
Freezing Point @ 1 atm	–361.9°F (–218.8°C)
Critical Temperature	–181.8°F (–118.4°C)
Critical Pressure	729.1 psia (49.6 atm)
Density, Liquid @ BP, 1 atm	71.23 lb/scf (1141 kg/m3)
Density, Gas @ 68°F (20°C), 1 atm	0.0831 lb/scf (1.33 kg/m3)
Specific Gravity, Gas (air=1) @ 68°F (20°C), 1 atm	1.11
Specific Gravity, Liquid (water=1) @ 68°F (20°C), 1 atm	1.14
Specific Volume @ 68°F (20°C), 1 atm	12.08 scf/lb (0.754 m3/Kg)
Latent Heat of Vaporization at BP	91.7 Btu/lb (213 KJ/Kg)
Expansion Ratio, Liquid to Gas, BP to 68°F (20°C)	1 to 860
Solubility in Water @ 77°F (25°C), 1 atm	3.16% by volume

4. HEALTH IMPACTS

Normally, air contains 21% oxygen, and oxygen is essentially nontoxic. No health effects have been observed in people exposed to concentrations up to 50% at a pressure of 1 atmosphere for 24 hours or longer. The inhalation of 80% oxygen at a pressure of 1 atmosphere for more than 12 hours can cause irritation of the respiratory tract, progressive decrease in vital capacity, coughing, nasal stuffiness, sore throat and chest pain, followed by tracheobronchitis and later by pulmonary congestion and/or edema. Inhalation of pure oxygen at atmospheric pressure or less can cause pulmonary irritation and edema after 24 hours. Respiratory symptoms can occur in two to six hours at pressures above 1 atmosphere. One of the earliest responses of the lung is accumulation of water in its interstitial spaces and within the pulmonary cells. This can cause reduced lung function, which is the earliest measurable sign of toxicity. Other symptoms include fever and irritation of the sinus and eye.

5. STORAGE FACILITIES

Liquid oxygen is stored, shipped, and handled in several types of containers, depending upon the quantity required by the user. The types of containers in use include the cryogenic liquid cylinder and cryogenic storage tank. Storage quantities vary from a few liters to many thousands of gallons. Since heat leak is always present, vaporization takes place continuously. Rates of vaporization vary, depending on the design of the container and the volume of stored product. Containers are designed and manufactured according to the applicable codes and specifications for the temperatures and pressures involved.

Types of storages

Compressed gas cylinders: Are high-pressure, non-reactive, seamless tempered steel containers for compressed gas used for medical, therapeutic or diagnostic purposes. They are insulated, vacuum-jacketed pressure vessels. They are equipped with pressure relief valves and rupture disks to protect the cylinders from pressure buildup.

Cryogenic storage tanks: Customer installations generally include a tank, vaporizer and pressure control manifold. Tanks may be spherical or cylindrical in shape and are mounted in fixed locations as stationary vessels or on railcar or truck chassis for easy transportation. A cryogenic tank consists of an internal tank, an external tank, pipelines, insulation, ladder, platform and valves. Safety and measuring instruments are installed in the tank.

6. TRANSPORTATION

Tankers should be periodically inspected and they must be maintained with proper care and caution and the insulation of the container of the tanker must be checked regularly. The tank trucks should carry / contain the **TREM card (**Transport Emergency Card)**, MSDS** (Material Safety Data Sheet) and other legal documents for safety needs. The driver should be competent enough to handle emergencies associated with the truck. The Safety Relief Valve (SRV) in the truck should be periodically tested. All other tanker accessories including pressure and temperature gauges should be in good condition and must be calibrated at regular intervals.

7. SAFETY CONSIDERATIONS

The hazards associated with **liquid oxygen** are

- Exposure to cold temperature of the cryogenic liquid that can cause severe burns.
- Oxygen enrichment of the surrounding atmosphere; and the possibility of a combustion reaction if the oxygen is permitted to contact a non-compatible material.
- Cause many materials of construction to lose their strength and become brittle enough to shatter.
- It is important to note that fire chemistry starts to change when the concentration of oxygen increases. Materials easily ignited in air not only become more susceptible to ignition but also burn with added violence / strength / vigor in the presence of Oxygen.
- Elevated oxygen levels can be reached very quickly and all personnel must be aware of the hazard.
- Any clothing that has been splashed or soaked with liquid oxygen or exposed to high oxygen concentrations should be removed immediately and aired for at least an hour. Personnel should stay in a well-ventilated area and avoid any source of ignition until their clothing is completely free of any excess oxygen. Clothing saturated with oxygen is readily ignitable and will burn vigorously.
- Do not permit smoking or open flames in any areas where liquid oxygen is stored or handled.
- Do not permit liquid oxygen or oxygen-enriched air to come in contact with organic materials or flammable or combustible substances of any kind. Some of the organic materials that can react violently with oxygen when ignited by a spark or even a mechanical shock are oil, grease, asphalt, kerosene, cloth, tar, and dirt that may contain oil or grease. Sanitizers (especially alcohol based), surgical spirit, etc. can also add fuel to fire in a hospital setting where the atmosphere is Oxygen rich.
- If liquid oxygen spills on asphalt or other surfaces contaminated with combustibles, do not walk on or roll equipment over the area of the spill. Keep sources of ignition away for 30 minutes after all frost or fog has disappeared.
- Systems used in oxygen service must meet stringent cleaning requirements to eliminate any incompatible contaminants

Storage

- Store and use liquid containers with adequate ventilation. Do not store containers in a

confined area or in an area unprotected from the extremes of weather.

- Cryogenic containers are equipped with pressure relief devices designed to control the internal pressure. Under normal conditions these containers will periodically vent product. Do not plug, remove or tamper with any pressure relief device.
- Oxygen must be separated from flammables and combustibles by at least 20 feet or a half-hour fire wall. Post "No Smoking" and "No Open Flames" signs.

Handling

- Cryogenic containers must be stored, handled and transported in the upright position. When moving, never tip, slide or roll containers on their side. Use a suitable hand truck for moving smaller containers. Move larger containers by pushing, not pulling. Avoid mechanical and thermal shocks.
- Never allow any unprotected part of the body to come in contact with uninsulated pipes or equipment containing cryogenic product. The extreme cold will cause flesh to stick fast and potentially tear on withdrawal.
- Use only oxygen-compatible materials and lubricants.
- If there is any difficulty in operating the container valve or container connections, discontinue use and contact the vendor. Do not remove or interchange connections. Use only the properly assigned connections
- Use only transfer lines and equipment designed for use with cryogenic liquids. Some elastomers and metals, such as carbon steel, may become brittle at extremely low temperatures and may easily fracture. These materials must be avoided in cryogenic service.
- It is recommended that all vents be piped to the exterior of the building.
- When liquid oxygen is held in any closed vessel or space, there must be an appropriate pressure relief device because of the very large pressure increase that can occur as the liquid oxygen vaporizes. Liquid oxygen must also be handled with all the precautions required for safety with any cryogenic fluids. Keep out of reach of children.

Personal Protective Equipment (PPE)

- Medical Oxygen handling personnel must be thoroughly familiar with properties and safety considerations before being allowed to handle liquid oxygen and its associated

equipment. The eyes are the most susceptible to the extreme cold of the liquid and vapors of liquid oxygen.

- The recommended PPE is a full-face shield over safety goggles; clean, loose-fitting thermal-insulated or leather gloves; long-sleeved shirts; and pants without cuffs. Wear this PPE when handling or using liquid oxygen, or whenever the possibility of exposure due to a spill exists.
- In addition, safety shoes are recommended for those involved with the handling of containers. In emergency situations, self-contained breathing apparatus (SCBA) must be used.
- Clothing that is fire resistant in air may be readily ignitable in oxygen-enriched atmospheres.
- Only trained and certified emergency responders should respond to emergency situations.

First Aid

- For skin contact with liquid oxygen, remove any clothing that may restrict circulation to the frozen area. Do not rub frozen parts, as tissue damage may result. As soon as practical, place the affected area in a warm water bath with a temperature not exceeding 105°F (40°C). Never use dry heat. Call a physician as soon as possible.
- Frozen tissue is painless and appears waxy with a possible yellow color. It will become swollen, painful, and prone to infection when thawed. If the frozen part of the body has been thawed, cover the area with a dry sterile dressing with a large bulky protective covering, pending medical care.
- In case of massive exposure, remove clothing while showering the victim with warm water. Call a physician immediately.
- If the eyes are exposed to the extreme cold of the liquid or vapors, immediately warm the frostbite area with warm water not exceeding 105°F (40°C) and seek medical attention.

Fire Fighting

- Since oxygen is nonflammable but supports combustion, fire-fighting actions require shutting off the source of oxygen, if possible, then fighting the fire according to the material involved.

- Do not direct water streams toward venting oxygen. The water will freeze and plug the pressure-relief vent, which may result in container failure.
- Oxygen vigorously accelerates combustion. Materials that would not normally burn in air could combust vigorously in atmospheres having high concentrations of oxygen.

Emergency Actions:

- If possible, shut off source of escaping oxygen. Evacuate area. Prevent liquid oxygen from entering sewer, basements and work-pits.
- Do not absorb in sawdust or any other combustible material. Keep the bulk tank, PCC (Portable Cryogenic Container) or tanker cool by spraying with water if exposed to a fire. If tanker has overturned, do not attempt to upright or move it.

Accidental Release Measures

- *Personal Precautions*-Clothing saturated by cold gas should be removed immediately. Clothes and other materials, will burn fiercely in presence of high concentrations of oxygen.
- *Environmental Precautions*-Oxygen itself does not pose a hazard to the environment. However, because of extreme cold of the liquid, damage to ecology can occur in the immediate environs of the spill. Beware of oxygen-enriched atmospheres coming into contact with readily combustible materials.
- *Small Spills*- Shut off the source of escaping oxygen. Ventilate the area
- *Large Spills*- Evacuate the area. Shut off the source of the spill if this can be done without risk. Restrict access to the area until completion of the cleanup procedure. Ventilate the area using forced draught if necessary.

Exposure Controls/Personal Protection

- *Occupational Exposure Hazards*-Avoid exposure to oxygen-enriched atmospheres, as this could result in clothing becoming saturated by oxygen. On ignition the clothing could burn fiercely resulting in serious burns.
- *Engineering Control Measures*-Engineering control measures are preferred to reduce exposure to oxygen-enriched atmospheres. General methods include forced draught ventilation, separate from other exhaust ventilation systems.

Personal Protection-Safety goggles or glasses, plus face shield, loose-fitting insulated

gloves and safety shoes, or boots. Skin Wear loose-fitting overalls preferably without pockets

Conditions to avoid- Oxygen-enriched atmospheres will react with all of the elements, excepting the rare gases, especially at elevated temperatures. These reactions could sometimes be violent, as those when high concentrations of oxygen come into contact with highly combustible materials such as oil and grease.

Incompatible Materials- At the temperature of liquid oxygen, ordinary carbon steels and most alloy steels, lose their ductility and are therefore considered to be unsatisfactory. Metals and alloys that have satisfactory ductility include austenitic stainless steel (i.e. types 204 and 216), and nickel chromium alloys, nickel, Monel 400, copper, brasses, bronze and aluminum alloys.

Disposal Methods

- Small amounts may be allowed to evaporate into the atmosphere. In case of large spills consult an expert and allow evaporation. Large amounts should only be handled by gas supplier.
- Disposal of Packaging: The disposal of containers must only be handled by the gas supplier.

8. HANDLING OF OXYGEN CYLINDERS

They are usually found in hospitals and must be handled with care**.**

- It is observed that oxygen cylinders are transported by rolling them on the ground. This procedure is wrong and compressed gas cylinders should always stay upright.
- Oxygen cylinders should be chained to prevent it from falling in storage areas.
- All gas cylinders must have caps over their valves. The valves should be capped (even if the cylinder is empty) when the cylinders are not in use to protect it from damage which might cause leakage. The valve is the most fragile part of a cylinder.
- Empty cylinders should be kept separated from filled ones.
- Cylinders must always be kept away from combustible materials.
- Cylinders should be stored in well ventilated areas.
- Smoking should be strictly prohibited near cylinder storage areas and ‘No-Smoking’ signs should be clearly placed.

- Cylinders should be transported with care as a broken valve will result in the cylinder shooting away like a rocket, which might cause injuries or even death. Trolley should be used for maneuvering.
- Proper Handling of Compressed Gas Cylinders must be known to all hospital personnel. Regular trainings are to be imparted to hospital staff.

9. OXYGEN STORAGE TANKS IN HOSPITALS

- Oxygen Storage Tanks should be installed away from public places such as hotels/residential areas/ other ignition sources, etc. where there is the presence of naked flames, which might lead to an explosion in case of a gas leak.
- There should be safe barricading for oxygen storage plants as prescribed by the SMPV (U) rules [Static and Mobile Pressure Vessels (Unfired) rules].
- There should be no unauthorized entries into the plant premises and smoking should be prohibited in its vicinity.
- The necessary hydro-testing to be done as prescribed legally and certificates to be available at site.
- Use of Pressure Vessels of a capacity beyond one kilolitre should be with appropriate license issued by the authority competent (PESO).

10. MAJOR STAKEHOLDERS FOR MANAGING OCCURRENCE OF OXYGEN LEAKAGE

1. KSDMA
2. DDMA
3. Fire Force
4. Police
5. Health Department
6. Directorate of Electrical Inspectorate
7. Factories and Boilers Department
8. PESO
9. Local Volunteers Groups
10. NGOs

- The person in charge of the site should be competent.
- There should be periodic inspections of the storage tanks.
- The strength of the storage tank should be certified by the appropriate authority

(PESO – The Petroleum and Explosives Safety Organization). The details of finished and upcoming tests and checks should be clearly stored along with the operator training details.

- Valves should be opened using the correct tools and not a pipe wrench as it will damage the components of the valve and might cause leakage in the long run.
- The recommendations of NFPA (National Fire Protection Association) must be followed which recommends the switch for oxygen lines to be five feet or more above the ground.
- Proper color code for oxygen supply lines should be followed and color coding policy is to be displayed at site.

11. MEDICAL OXYGEN- BASIC DO'S AND DON'TS

Do's* **(*** Indicative only; Medical advice to be followed)	**Don'ts**
Target SpO2: 92-94%	Don't use HFNC with high Oxygen flow
Target PaO2: Around 60mmHg	Don't allow leak from NIV mask
Never exceed oxygen flow (liters per minute – lpm) of - 14 lpm on NRBM 6 lpm on nasal prongs 8 lpm on simple mask	Don't keep central oxygen pipeline connected when ventilator is not in use
Titrate use of IPAP to achieve Tidal Volume of 6-7 ml/kg only	Don't keep flow meter connected when not in use
Use only EPAP/CPAP for better oxygenation	Don't keep ventilator ON when not in use
Encourage awake proning for all. Lateral position is favored for those who do not tolerate prone position, in obese and pregnant patients.	Don't use leaky or faulty flow meters
Use Oxygen concentrator (with different capacity and dual flow meter)	Don't keep humidifier bottle full of water in flow meter

12. FORMATION OF CRISIS GROUPS

As per the Chemical accidents (Emergency planning, Preparedness and Response) Rules, 1996, Ministry of Environment and Forest

State Crisis groups	***District Crisis group***	***Local Crisis group***
Schedule 6 [See rule 6(2)] i. Chief Secretary Chairperson ii. Secretary (Labour) Member Secretary iii. Secretary (Environment) Member iv. Secretary (Health) Member v. Secretary (Industries) Member vi. Secretary (Public Health Engg.) Member vii. Chairman, State Pollution Control Board viii 4-Experts (Industrial Safety & Health) Member- to be nominated by the State Government viii. Secretary/Commissioner (Transport), Member ix. Director (Industrial Safety)/Chief, Member x. Inspector of Factories, Member xi. Fire Chief, Member xii. Commissioner of Police, Member xiii. One Representative from the Industry, Member- to be nominated by the State Govt.	Schedule 7[See rule 8] i. District Collector Chairperson ii. Inspector of Factories Member Secy. iii. District Energy Officer, Member iv. Chief Fire Officer, Member v. District Information Officer, Member vi. Controller of Explosives, Member vii. Chief, Civil Defence, Member viii. One Representative of Trade Unions, Member to be nominated by the District Collector ix. Deputy Superintendent of Police, Member x. District Health Officer/Chief Medical Officer, Member xi. Commissioner, Municipal Corporations, Member xii. Representative of the Department of Public Health Engineering, Member xiii. 4 Experts (Industrial Safety & Health), Member- to be nominated by the District Collector xiv. Commissioner (Transport), Member xv. One Representative of Industry, Member to be nominated by the District Collector xvi. Chair-person/Member-Secretary of Local Crisis Groups	Schedule 8[See rule 8)] i. Sub-divisional Magistrate / District Chair person Emergency Authority ii. Inspector of Factories Member Secy. iii. Industries in the District/ Member-Industrial area/ industrial pocket iv. Transporters of Hazardous Chemicals(2 Numbers), Member v. Fire Officer, Member vi. Station House Officer (Police), Member vii. Block Development Officer viii. One Representative of Civil Defence ix. Primary Health Officer x. Editor of local Newspaper xi. Community leader/Sarpanch/ Village xii. Pradhan nominated by Chair-person xiii. One Representative of Non-Government xiv. Organization to be nominated by the Chair-person xv. Two Doctors eminent in the Local area, to be nominated by Chair-person xvi. Two Social Workers to be nominated by the Chair-person

13. RESPONSE STRATEGY

The moment liquid oxygen leaks into open air it vaporizes or becomes a dense mist. So, it cannot be contained effectively in case of a leak and the only solution is to eliminate the risk of fire and to arrest the leak by finding its source. In case of an accident which results in oxygen leak, the following information is critical:

1. The primary objective is to stop the leak at the source.

2. For attempting to close the leak, firefighters need to approach the container. The following Personal Protective Equipment (PPE) must be used:

- Pyro protected full body coverall/fire suits
- Self-contained breathing apparatus (SCBA)
- Cryogenic gloves
- Safety shoes
- In addition, a tools box with spark proof tools, to arrest the leak

Protection equipments are essential because when there is an accident, the atmosphere around the container becomes oxygen-rich due to leakage. To stop it, the valve through which leakage is occurring needs to be isolated. The atmosphere around the valve will have almost 75% oxygen, and firefighters can't stay in such environment for a long time.

3. The container should be cooled and it should not be allowed to heat up. This is because of the fact that majority of the liquid oxygen will still be inside the container.

4. All sources of ignition from the surrounding area should be eliminated. Due to the huge amount of oxygen leak, a fire can easily lead to an explosion.

5. There should be adequate ventilation around the container so that the leaked oxygen doesn't get accumulated anywhere (such as in drainages) because this might cause an explosion later.

6. Firefighters must stay up-wind from the container when working on it so that the leaked oxygen poses comparatively less threat to them.

7. In case of fire, water spray or water fog should be used to extinguish the fire and cool down the container. Water jets should not be used under any circumstances. Water spray and

water fog helps in reducing the excess oxygen level in the atmosphere and thus, decrease the risk of explosion.

8. If there is only leakage of oxygen and no fire, water spray and water fog must be used only to decrease the oxygen level in the atmosphere. It should not be sprayed directly on the container.

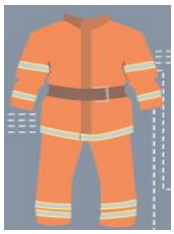
9. If the gas leak cannot be arrested, the area in danger must be evacuated.

10. All traffic moment in the area must be stopped to decrease the risk of a fire and explosion.

11. Electricity to the area must be disconnected to reduce the risk of a spark and thus, an explosion.

12. Leakage Arrester Kits are used in case of breakage of main valves.

PPE Policy

SCBA	Fire Suit	Safety Shoes	Cryogenic Gloves
			

In addition to these PPE's a **spark proof tool** box also should be available for arresting the leak.

14. REFERENCES

- Liquid oxygen, Safetygram 6, Air Products
- The Occupational Safety, Health and Working Conditions Code, 2020, the Gazette of India, September 29, 2020
- Occupational Health and Safety Act, 1993, Hazardous Chemical Substances Regulations 1995, Department of Labour, Government of India
- PESO Advisory No: G/KL/05/2021 Dated 23/04/2021
- MSDS, Liquid Oxygen, Praxair
- The Chemical Accidents (Emergency Planning Preparedness And Response) Rules, 1996, Ministry of Environment and Forest, 1st August 1996
- Documents shown in the Annexures.

15. ABRREVATIONS

CPAP	-	Continuous Positive Airway Pressure
DDMA	-	District Disaster Management Authority
EPAP	-	Expiratory Positive Airway Pressure
HFNC	-	High-Flow Nasal Cannula
Hg	-	Hemoglobin
IPAP	-	Inspiratory Positive Airway Pressure
KSDMA	-	Kerala State Disaster Management Authority
NIV	-	Non- Invasive Ventilation
NRBM	-	Non-rebreather mask
PCC	-	Portable Cryogenic Container
PESO	-	Petroleum and Explosives Safety Organization
PPE	-	Personal Protection Equipment
SCBA	-	Self-Contained Breathing Apparatus
SpO2	-	Saturation of Peripheral Oxygen
PaO2	-	Partial Pressure of Oxygen
TREM card	-	Transport Emergency Card
MSDS	-	Material Safety Data Sheet
SRV	-	Safety Relief Valve
PCC	-	Portable Cryogenic Container

16. ANNEXURES

ANNEXURE I

EMERGENCY RESPONSE PLAN FOR HOSPITAL

Name of the hospital:

No. of Oxygen beds in the hospital

Mode of Oxygen production in hospital: Natural Oxygen Plant/ Liquid Oxygen

Mode of Oxygen storage in hospital: Liquid Oxygen storage/ Bulk cylinder storage

No. of Bulk Oxygen cylinders used simultaneously in the hospital:

Total Storage capacity of Oxygen in hospitals:

Contact Number of Medical Superintendent:

Contact Number of Deputy Superintendent:

Contact Number of Agency supplying Bulk Cylinder:

Contact No. of Agency supplying Liquid Oxygen:

Contact No. of Central Supply Oxygen Room Staffs:

Scenario 1 – Leakage from Cryogenic Liquid Oxygen tank

- The leakage usually occurs during refilling of Oxygen. The staffs of refilling agencies shall be trained to control the leakage using non-sparking equipment.
- Flow meter check could be done daily for leakage or valve complaint.

1	Inform the Medical Superintendent	By Hospital staff in Central Supply Oxygen Room
2	Inform Fire and Rescue Department 101, Police 100, PRO, Deputy Superintendent	By Medical Superintendent
3	Change the valve of Oxygen supply from Liquid Oxygen to Bulk Cylinder Oxygen to ensure continuous supply of Oxygen.	By Central Supply Oxygen Room staffs
4	Using a SCBA and PPE kit for fire, the leakage from the cryogenic tankers could be checked.	Fire Fighters

5	Inform the bulk cylinder refilling agency and ask to provide additional supply of oxygen on war foot basis Contact No. of Agency ……	By Medical Superintendent
6	Shift the patients to other hospitals or other wards if needed or procure additional bulk Oxygen cylinders from nearby hospitals Referral Hospital No. ……...	By Medical Superintendent

Scenario 2 – Leakage in Central Supply Oxygen Room

1	Inform the Medical Superintendent	By Hospital staff in Central Supply Oxygen Room
2	Inform Fire and Rescue Department 101, Police 100, PRO, Deputy Superintendent	By Medical Superintendent
3	Arrange Type B cylinders as per the number of patients who need Oxygen supply in the hospital	By Deputy Superintendent
	Shift the bulk cylinders from Central Supply Oxygen Room to patient's bed side for patient support	By Deputy Superintendent
4	Inform the bulk cylinder refilling agency and ask to provide additional supply of oxygen on war foot basis Contact No. of Agency ……	By Medical Superintendent
5	Shift the patients to other hospitals if needed or procure additional bulk Oxygen cylinders from nearby hospitals Referral Hospital No. ……...	By Medical Superintendent

Scenario 3- Leakage or fire in Natural Oxygen Plant

1	Inform the Medical Superintendent	By Hospital staff who witness/ check/ monitor the leakage
2	Inform Fire and Rescue Department 101, Police 100, PRO, Deputy Superintendent	By Medical Superintendent
3	Inform the staffs in Central Supply Oxygen Room to change the valve and provide Oxygen from Automatic Gas Manifold (Centralized supply) to the hospital areas necessary	By Deputy Superintendent
4	Change the supply to additional areas by Bulk cylinders which were covered earlier by Natural Oxygen Plant	By staffs in Central Supply oxygen room
5	Turn off the supply of Oxygen from Natural Oxygen Plant until the production is restored	By Natural Oxygen Supply room
6	Inform the bulk cylinder refilling agency and ask to provide additional supply of oxygen on war foot basis Contact No. of Agency ……	By Medical Superintendent

ANNEXURE II

SECTIONS DEALING WITH CONTROL OF LEAKAGE OF HAZARDOUS SUBSTANCES IN THE HAZARDOUS CHEMICAL SUBSTANCES REGULATIONS, 1995

Sec 3(1) (k):

An employer shall, before any employee is exposed or may be exposed, after consultation with the health and safety committee established for that section of the workplace, ensure that the employee is adequately and comprehensively informed and trained, as well as thereafter informed and trained at intervals as may be recommended by that health and safety committee, with regard to procedures to be followed in the event of spillages, leakages or any similar emergency situation which could take place by accident.

Sec 4(a):

Every person who is or may be exposed shall obey a lawful instruction given by or on behalf of the employer or a self-employed person, regarding:

a. the prevention of an HCS (Hazardous Chemical Substance) from being released;

Sec 9A:

1) Subject to section 10(3) of the Act, every person who manufactures, imports, sells or supplies any hazardous chemical substance for use at work, shall, as far as is reasonably practicable, provide the person receiving such substance, free of charge, with a material safety data sheet in the form of Annexure 1, containing all the information as contemplated in either ISO 1 1014 or ANSIZ400.1.1993 with regard to-

a) Product and company identification;

b) Composition/information on ingredients;

c) Hazards identification;

d) First-aid measures;

e) Fire-fighting measures;

f) Accidental release measures;

g) Handling and storage;

h) Exposure control/personal protection;

i) Physical and chemical properties;

j) Stability and reactivity;

k) Toxicological information;

l) Ecological information;

m) Disposal considerations;

n) Transport information;

o) Regulatory information; and

p) Other information

Sec 14: Labeling, packaging, transportation and storage

An employer shall, in order to avoid the spread of contamination of an HCS, take steps, as far as is reasonably practicable, to ensure:

a) That the HCS in storage or distributed are property identified, classified and handled in accordance with SABS 072 and SABS 0228;

b) That a container or a vehicle in which an HCS is transported is clearly identified, classified and packed in accordance with SABS 0228 and SABS 0229; and

c) That any container into which an HCS is decanted is clearly labeled with regard to the contents thereof.

Laws relating to control of hazardous substances in India

I. **Factories Act, 1948**
II. Section 41B states about compulsory disclosure of information by the occupier.
III. Section 41C states about the specific responsibility of the occupier in relation to hazardous processes.
IV. Section 41E deals with Emergency standards.
V. Section 41F states about the Permissible limits of exposure of chemical and toxic substances.
VI. Hazardous Waste (Management and Handling) Rules, 1989

Under Rule 4, a person generating hazardous wastes in quantities exceeding specified limits is required to take all steps for proper handling and disposal of such wastes.

Rule 5 prescribes the permit system administered by the State Pollution Control Board for the handling and disposal of hazardous wastes. No person without the Board's authorization may collect, receive, treat, transport, store or disposal of hazardous wastes. No person without the board's authorization may collect receive, treat, transport, store or dispose off hazardous wastes.

Rule 7 requires the packaging labelling and transport of hazardous wastes.

VII. Hazardous Chemicals (Manufacture, Storage and Import) Rules, 1989

Under Rule 3, the Central and State Pollution Control Boards are required to enforce governmental directives and procedures, and the district collector or other designated authority is required to prepare " off-site emergency plans" to contain major chemical accidents.

VIII. Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996

It was issued to strengthen the administrative response to hazardous substance accidents. These Rules supplement the Hazardous Chemical Rules of 1989. The Rules require the Centre and the States to constitute "crisis groups" at the national, State, district and local levels to deal with chemical accidents.

IX. Hazardous Micro-organisms Rules,1989

These Rules came into force in October 1993. They regulate the manufacture, use, import, export and storage of hazardous micro-organisms and genetically engineered cells/organisms.

Harmful and Other Wastes (Management and Transboundary Movement) Rules, 2016

They were set up under the Environment (Protection) Act, 1989, which gives the Central Government the capacity to "acknowledge all such measures as it might consider essential or convenient for the purpose of protecting and improving the quality of the environment and counteracting, controlling and abating ecological pollution". These standards were endorsed after the Bhopal Gas Tragedy Case to counteract further such cases.

Section 4 provides for the process that needs to be followed by various people for proper management of Hazardous Waste

Section 16 states the proper procedure for treatment, storing and removal facility of hazardous and other waste

International laws concerning control of hazardous substances

I. Control of Substances Hazardous to Health Regulations 2002

It is a United Kingdom Statutory Instrument which states general requirements imposed on employers to protect employees and other persons from the hazards of substances used at work by risk assessment, control of exposure, health surveillance and incident planning.

II. DSEAR – Dangerous Substances and Explosive Atmospheres Regulations, 2002

Relevant Victorian Legislation:

III. The Occupational Health and Safety Act 2004

Sec.21 (2)(b) : Make arrangements to ensure, so far as is practicable, safety and absence of risks in connection with the use, handling, storage and transport of substances.

Sec. 21 (2) (e): Provide such information, instruction, training and supervision to employees as are necessary to enable the employees to work safely and without risks to health.

Sec. 22 (1) (b): Monitor workplace conditions.

Sec. 35 (1) (f): Consult the health and safety representative/s and workers on workplace changes in substances used that may affect health and safety.

IV. **The Occupational Health and Safety Regulations 2007**

Under the regulations, Chapter 4 covers Hazardous Substances and Materials

V. Toxic Substance Control Act (TSCA)

The Toxic Substances Control Act of 1976 is a United States Law that mandates the EPA to protect the public from "unreasonable risk of injury to health or the environment" by regulating the manufacture and sale of chemicals

VI. **The Emergency Planning and Community Right-to-Know Act (EPCRA), 1986 |United States**

VII. **Hazardous substances act 15 of 1973| South Africa**

VIII. **Hazardous Substances and New Organisms Act 1996 |New Zealand**

ANNEXURE III

PETROLEUM AND EXPLOSIVES SAFETY ORGANISATION (PESO)

Office of the Deputy Chief Controller of Explosives

3rd Floor, Kendriya Bhavan, Kakkanad, Ernakulam, Kerala

Tele: 27540359, 27547863 Fax: 27547803

Email: dyccekochi@explosives.gov.in

PESO Advisory No: G/KL/05/2021 Dated 23/04/2021

Advisory

The following Advisory is issued to all the Bulk Oxygen facilities in the state of Kerala for user operational and maintenance procedures, in order to establish high standards of reliability and safety in the interests of employers, employees and the general public. This is issued on the basis of the accident at the Liquid Medical Oxygen storage premises at M/s Zakir Hussain Hospital, Nashik on 21.04.2021.

Storage safety

• The location should comply with SMPV (U) RULES 2016

• Avoid installing liquid storage vessel in indoor environment or near drains or pits.

• The control equipment should be protected from the weather and the area fenced.

• Oxygen storage should be separated from vacuum and medical air compressor plant to avoid possible oil contamination.

Periodic Inspection and Maintenance

•The site should be inspected regularly to ensure that it is maintained in a proper condition and that safety distances are respected.

•A comprehensive installation dossier shall be held on site. This dossier shall include:

• Process and instrumentation diagram(s)

• Tank dossier

• Operating instructions

• Written SOP

• Maintenance program

Tank Installation

•An annual external visual inspection should be carried out by a Competent Person approved by PESO in accordance with the SMPV (U) Rules 2016 to confirm the satisfactory condition of the outer containment jacket and associated exposed pipe work, valves, controls and auxiliary equipment.

•Periodic examination of the tank support structure should be carried out where appropriate.

•When a tank is taken out of service for modification or maintenance the accessible areas of the tank including the outer jacket, vessel, pipe work, valves, controls and auxiliary equipment should be examined by a Competent Person prior to recommissioning.

• Periodic monitoring should be carried out of either the insulation space vacuum or the composition of the purge gas in the insulation space, to identify the existence of any inner tank leaks and to confirm the purge is still effective.

•The supply of purge gas to large non-vacuum insulated tanks should be checked periodically to ensure an effective purge is being maintained.

•When soil conditions are uncertain, a regular monitoring of the stability of the tank foundations should be carried out

Inner Vessel

The vessel should be revalidated periodically as per SMPV (U) RULES 2016 while in service for

a further defined period. Revalidation should be based on a documentation assessment and an assessment of the vessel condition.

The documentation assessment should include consideration of the original design code and amendments which may have occurred in the intervening period, the history of the vessel in service, experience with similar vessels elsewhere and any change in operating conditions.

The assessment of the vessel condition should be based on a Written Scheme agreed by the operator and a Competent Person. This will be influenced by the documentation assessment, the established periods between revalidation, foreseeable modes of failure, particular features of the vessel design and contents, the possible detrimental effects of warming the inner vessel and, contamination.

The specific revalidation requirements for the vessel and the required frequency shall be defined and confirmed in writing for inclusion in the tank dossier by the Competent Person, taking into account the documentation assessment and the assessment of the vessel condition.

Pressure Relief Devices

Requirements for relief device inspection and testing as outlined in SMPV (U) RULES 2016 shall be strictly followed.

Regular visual inspection of the devices shall be carried out during normal operation.

Bursting disc elements may deteriorate due to aggressive environments resulting in their relief pressure rating being reduced. It may therefore be necessary to replace disc elements in such environments on a planned basis.

Emergency Isolation Valve(s)

Emergency isolation valves should be periodically tested in accordance with a prescribed procedure to check correct functional operation.

Ancillary Equipment

Ancillary equipment (other than previously detailed) shall be maintained so as to be safe.

De-commissioning

When a tank is to be taken out of service, consideration should be given to making a detailed examination of the inner vessel to assess its condition and, in addition, provide data for revalidation of similar tanks.

Liquid Transfer Area

A road tanker, when in position for filling from or discharging to the installation, shall be in the open air and not be in a walled enclosure from which the escape of liquid or heavy vapor is restricted. Tankers should have easy access to and from the installation at all times. Kerbs or barriers shall be provided to prevent damage to any part of the installation by the tanker or other vehicles.

Training of Personnel

All personnel directly involved in the commissioning, operation and maintenance of liquid oxygen storage systems shall be fully informed regarding the hazards associated with oxygen and oxygen enrichment and be properly trained, as applicable, to operate or maintain the equipment.

Training shall be arranged to cover those aspects and potential hazards that the particular operator is likely to encounter.

Training shall cover, but not necessarily be confined to, the following subjects:

• Potential hazards of oxygen

• Site safety regulations

• Emergency procedures

• Use of firefighting equipment

• Use of protective clothing/apparatus including breathing sets where applicable

• First aid treatment for cryogenic burns.

In addition, individuals shall receive specific training in the activities for which they are employed.

It is recommended that the training be carried out under a formalized system and that records be kept of the training given and where possible, some indication of the results obtained, in order to show where further training is required.

The training programme should make provision for refresher courses on a periodic basis and for changes of site personnel.

Permit to Work

Before maintenance is carried out on the installation, a written Permit to Work for the particular type of work (cold work, hot work, entry of vessel, electrical work, etc.) shall be issued by an authorized person to the individual(s) carrying out the work.

Entry into Vessels

Before entering any tank, vessel or interspace during maintenance or decommissioning, it is essential that the equipment is safe for the work to be carried out. The following precautions, which are not necessarily all those required, shall be observed and included as conditions for the issue of the Permit to Work:

• Complete emptying and purging of the vessel contents

• Confirmation that the inner vessel is approximately at ambient temperature before entry is permitted

• Analysis of the atmosphere in the vessel and/or interspace at several selected points with a suitable gas detector (probes may be necessary) to ensure that the oxygen content is in the range 20 to 21%. It may be necessary to measure this regularly or continuously and to install forced ventilation while work is in progress

• Complete isolation of the interspace purge lines and of process lines from other equipment, which may still be in service, by physical disconnection of a section of pipeline. Blanking discs may be used but they must be of appropriate material and thickness for the gas pressure in the

pipe

• Presence of standby person(s) outside the tank adjacent to the access manhole to monitor the work in progress and provide assistance in the event of an emergency

• Use of appropriate safety equipment such as harnesses, protective clothing, fire extinguishers, etc.

• Availability of rescue equipment (harnesses, self-contained breathing apparatus, winches, radio links, etc.).

Emergency Procedures

Emergency procedures shall be prepared by the site operator to include action to be taken in the event of spillage of liquid oxygen. Local emergency services shall be party to the preparation of the emergency procedures. Works employees likely to be affected shall know the actions required to minimize the adverse effects of a spillage. Consideration shall be given to the carrying out of practical exercises.

The following are guidelines, which should be used for formulating emergency procedures:

• Raise the alarm

• Summon help and emergency services

• Isolate the source of oxygen, if appropriate and where safely possible

• Evacuate all persons from the danger area and seal it off

• Alert the public to possible dangers from vapor clouds in the immediate vicinity and evacuate when necessary.

After the liquid spillage has been isolated, oxygen enrichment checks should be carried out in any enclosed areas where the vapor cloud may have entered. This includes basements, pits and confined spaces.

HAZARDS FROM OXYGEN ENRICHMENT

Fire Hazards from Oxygen Enrichment

•Oxygen reacts with most elements. The initiation, speed, vigor and extent of these reactions depend in particular upon:

• The concentration, temperature and pressure of the reactants

• Ignition energy and mode of ignition.

Reaction Mechanism

The mechanism of these reactions is complicated and depends, among other things, upon the nature of the substances concerned, their physical state, geometric configuration, concentration and manner of ignition. This, too, influences the speed of reaction, which can vary from slow combustion to an explosion.

Combustibility of Materials

Oxygen enrichment of the atmosphere, even by a few percent, considerably increases the risk of fire. Materials, which do not burn in air, including fireproofing materials, may burn vigorously or even spontaneously in enriched air.

Combustion Characteristics

Oxygen enrichment alters considerably the characteristics of combustion.

Materials, which would normally be regarded as harmless, ignite more easily and sparks can cause fire. The resulting flames are much hotter and are propagated at much greater speed.

Hydrocarbon Oils and Grease

Oil and grease are particularly hazardous in the presence of oxygen as they ignite spontaneously and burn with explosive violence. They should NEVER be used to lubricate oxygen or enriched air equipment. Special lubricants, with which oxygen can be used under certain conditions, are

available.

Smoking

Burning accidents, which occur, are normally triggered by the lighting of a cigarette. Therefore, it is impossible to over-emphasize the danger of smoking in oxygen-enriched atmospheres or where oxygen enrichment can occur. In such areas smoking shall be forbidden.

Kindly acknowledge the receipt of this mail

Dr. R. Venugopal IPESS

Deputy Chief Controller of Explosives,

Petroleum & Explosives Safety Organization (PESO) &

Nodal Officer (Oxygen monitoring)

Government of India,

Ernakulam, Kerala.

To

All Medical Oxygen Manufacturing, Bulk storage & Filling Plants, Hospitals

Kerala.

Copy to: 1. The Health Secretary, Government of Kerala

2. The Director of Health Services

3. The General Manager, KMSCL, Thiruvananthapuram

ANNEXURE IV

THE OCCUPATIONAL SAFETY, HEALTH AND WORKING CONDITIONS CODE, 2020

CHAPTER 1 - PRELIMINARY

Section 1(3) defines that this act shall not apply to the offices of the Central Government, offices of the State Government and any ship of war of any nationality.

CHAPTER 3 - DUTIES OF EMPLOYER AND EMPLOYEES, ETC.

Section 6 defines the duties of employer. It includes:

a) Ensuring that the workplace is free from hazards likely to cause injuries or occupational diseases.
b) Complying with all the rules, regulations and by-laws of this code.
c) Providing annual health examination free of cost.
d) Providing a safe working environment as far as possible.
e) Ensuring proper disposal of hazardous, toxic and e-waste.
f) Issuing letter of appointment to all employees.
g) Ensuring no charge is levied on the employees for the maintenance of safety standards.
h) Being responsible for the safety and health of employees of factory, mine, dock work, building or other construction work or plantation, on the work premises with or without the knowledge of the employer.

Section 7 defines that the owner and agent of every mine shall be responsible for making the financial provisions for ensuring the safety of the workers in a mine and shall be held liable jointly and severally for non-compliance.

Section 8 defines that every person who designs, manufactures, imports or supplies any article for use in any establishment should verify its design and safety through due diligence or testing, and make sure that the information is available to those who use it.

Section 9 defines the duties of architects, project engineers and designers in ensuring the health and safety of all the workers involved in any part of the project. They are also required eliminate

any designs which would involve the use of dangerous structures or other processes or materials that might pose a risk to the health and safety of the workers and avoid those designs which might prove to be hazardous during maintenance.

Section 10-12 defines the duty of the employer to send notice of any

- accident
- dangerous occurrences
- spread of certain diseases

among employees to the appropriate authorities prescribed by the Government within the specified time period.

Section 13 lists the duties of the EMPLOYEES. They include:

a) Taking reasonable care of himself/herself and others.
b) Complying with the safety and health requirement standards.
c) Co-operating with employer in meeting the statutory obligations under this code.
d) Report any unsafe or unhealthy situation as soon as possible to his/her employer.
e) Not misusing anything provided for the safety and health of the workers.
f) Not to willfully do anything that might cause injury to himself/herself or others.
g) Performing duties prescribed by the Government.

Section 14 defines the rights of the EMPLOYEES. He/she has the right to obtain information relating to their health and safety and has the right of representing himself/herself to the employer directly or through a member of the Safety Committee. If there is reasonable apprehension of serious personal injury, he/she may bring it to the notice of the employer.

CHAPTER 5 - HEALTH, SAFETY AND WORKING CONDITIONS

Section 23 deals with responsibility of employer for maintaining health, safety and working conditions according to the prescriptions of the Central Government.

CHAPTER 11 - SPECIAL PROVISIONS FOR CONTRACT LABOUR AND INTER-STATE MIGRANT WORKER, ETC.

PART 1 - CONTRACT LABOUR

Section 53- states that welfare facilities specified under Section 23 and 24 should be provided by the employer to contractual workers.

PART 2 - INTER STATE MIGRANT WORKERS

Section 60- provides the provisions for ensuring suitable working conditions for inter-state migrant workers and in case of fatal accident or serious bodily injury to any such worker, to report to the specified authorities of both the States and also the next of kin of the worker and to extend all benefits which are available them by law.

PART 3 - AUDIO VISUAL WORKERS

Section 66(4) provides for healthy working conditions, safety, and wages and other benefits.

PART 4 - MINES

Section 70- states that no person below eighteen years of age shall be allowed to work in any mine and apprentices and other trainees, not below sixteen years of age may be allowed to work, but only under proper supervision of the manager.

Section 72- states that the Central Government may prescribe vocational training and rescue and recovery services for persons employed in a mine.

PART 5 - BEEDI AND CIGAR WORKERS

Section 74(4) - states that the authority, in deciding whether to grant or refuse a license, should take into consideration the welfare of the labor in the locality, the interest of the public generally and such other matters as may be prescribed by the Government.

PART 6 - BUILDING OR OTHER CONSTRUCTION WORKERS

Section 78- states that the employer must not hire a person who is deaf, or has a defective vision, or has a tendency to giddiness, to work in construction which is likely to involve the risk of any accident to that worker or to others.

PART 7 - FACTORIES

Section 82 states that the Government make the provisions relating to any factory in which manufacturing process or operation is carried on which exposes employees to a serious risk of bodily injury, poisoning or disease, for—

(a) Specifying the manufacturing process or operation and declaring it to be dangerous;
(b) Prohibiting or restricting the employment of pregnant women in the manufacturing process or operation;
(c) The periodical medical examination before and/or during the employment.
(d) Welfare amenities, sanitary facilities, protective equipment and clothing, and any other necessary requirements.

Section 84 states that the occupier of every factory involving a hazardous process shall disclose in the manner prescribed by the State Government all information regarding the dangers and he shall, at the time of registering the factory involving a hazardous process, lay down a detailed policy with respect to the health and safety of the workers employed.

Section 85 states that every occupier of a factory involving any hazardous process shall maintain accurate and up-to-date health records of the workers in the factory who are exposed to any chemical, toxic or any other harmful substances and appoint qualified personal for supervision.

Section 89 states that when the workers employed in any factory engaged in a hazardous process have reasonable apprehension that there is a likelihood of imminent danger, they may bring the same to the notice of the employer. It shall be the employer's duty to take remedial action.

PART 8 – PLANTATION

Section 92 states that every employer must make provisions for housing accommodation for his employees and provide educational facilities for the children of the workers employed in the plantation where the children between the ages of six to twelve of the workers exceed twenty-five in number. Health and recreational facilities must also be provided and he is responsible for maintaining welfare facilities.

Section 93 states that the workers' safety must be provided for and should provide periodic

medical examination to them. Every employer of a plantation shall provide washing, bathing and clock room facilities and protective clothing and equipment to those who handle insecticides, pesticides, etc.

CHAPTER 12 - OFFENSES AND PENALTIES

Section 94 states that if there is any contravention of the provisions of this Code, the employer shall be liable to penalty which shall not be less than two lakhs rupees but which may extend up to three lakh rupees, and if the contravention is continued after conviction, with further penalty which may extend to two thousand rupees for each day till such contravention continues.

ANNEXURE V

GUIDELINES FOR RATIONAL USE OF OXYGEN FOR MANAGEMENT OF COVID-19

आरती आहूजा भा.प्र.से.
अपर सचिव
Arti Ahuja, IAS
Additional Secretary
Tel. : 011-23061066, 23063809
E-mail : ash-mohfw@nic.in

सत्यमेव जयते

भारत सरकार
स्वास्थ्य एवं परिवार कल्याण मंत्रालय
निर्माण भवन, नई दिल्ली-110011
Government of India
Ministry of Health and Family Welfare
Nirman Bhavan, New Delhi - 110011

D. O. No. 1830290/Immunization/2020
Dated the 25th September, 2020

Subject: Guidelines for rational use of Oxygen for management of COVID-19

Dear Sir / madam,

As you are aware that medical oxygen is one of the mainstays for management of "Moderate" and "Severe" COVID-19 cases. COVID-19 pandemic has led to a need of ensuring adequate supply of oxygen and also the protocols for its rational use.

Keeping above facts in mind, Ministry of Health and Family Welfare has developed new *'Guidelines for rational use of Oxygen for management of COVID-19'* which are enclosed.

You are requested to instruct all the concerned state and district level officials to strictly follow these Guidelines for creation of Non-ICU oxygen supported beds & ICU beds and for calculation of oxygen requirement for each and every health facilities providing COVID-19 treatment accordingly.

With warm regards,

Yours sincerely

Encl: as above

(Arti Ahuja)

To: - Additional Chief Secretary / Principal Secretary / Secretary (Health) - All States/UTs

Copy to:
1. Mission Director (NHM) – All States/UTs
2. State Nodal Officer, Oxygen – All States/UTs

GUIDELINES FOR RATIONAL USE OF OXYGEN FOR MANAGEMENT OF COVID-19

These guidelines are being issued based on the recommendations of The Empowered Group 1 (EG – 1) chaired by Dr. V.K. Paul, Member, NITI Aayog, the Joint Monitoring Group (JMG) headed by Director General of Health Services (DGHS) MoHFW and the inputs provided by Prof. (Dr.) Randeep Guleria, Director, AIIMS, New Delhi and Prof. (Dr.) Balram Bhargav, DG ICMR cum Secretary, Department of Health Research.

1. It is assumed that out of the 100 confirmed cases of Covid-19;
   a. 80 cases will be Asymptomatic / Pre-Symptomatic or with "**Mild**" disease requiring home isolation or admission to Covid Care Center (CCC).
   b. Out of remaining 20 cases:
      i. 17 cases will be of "**Moderate**" disease requiring hospitalization for 7 days on Non-ICU Oxygen Supported Beds. States / UTs would require to have oxygen storage capacity for all 17 Beds. However, for the purpose of calculation of Daily Oxygen consumption requirement, 50% of these Beds (i.e. 8.5) would be considered for computation purpose.
      ii. 3 will be "**Severe**" cases requiring ICU Beds for 18 days in ratio of 20% for Invasive Ventilation, 40% for Non-Invasive Ventilation (NIV) / High Flow Nasal Cannula (HFNC) and remaining 40% for oxygen therapy by Non-Re Breathing Mask (NRBM) etc. For the purpose of calculation of Daily Oxygen consumption requirement at each health facility, all the Beds (i.e. 3) would be considered for computation purpose.

2. For Moderate cases (SpO2 level *between* 94%-90%), the indicative oxygen flow rate is 2-4 Liters/minute by nasal prongs; 6-10 Liters/minute by facemask and 10-15 Liters/minutes by Non-Rebreathing Mask (NRBM).
3. For Severe cases (SpO2 level less than 90%), the indicative oxygen flow rate is 10 Liters/minute by Invasive Mechanical Ventilation; 25-60 Liters/minute by Non-Invasive Ventilation and 10-15 Liters/minutes by NRBM.

Page 1 of 3

4. For rational use of oxygen for COVID 19 management and for monitoring of oxygen consumption, the following action points are suggested to be implemented by the States / UTs :-

i. Oxygen is a life-saving essential drug. The target **Oxygen saturation rate should be 94%-95%** for the hospitalized COVID 19 patient. Once this rate is achieved, flow of oxygen may not be increased as it may not provide any additional benefit to the patient.

ii. Oxygen consumption should be regularly monitored at each hospital/health facility level.

iii. **Oxygen Monitoring Committee** may be formed in every hospital which may consist of Additional Medical Superintendent, Head of Anesthesia, Head of Respiratory Medicine (Head of Internal Medicine in case Respiratory Medicine department does not exist) and Nursing Superintendent.

iv. The Oxygen Monitoring Committee may be mandated to supervise inventory planning, oxygen consumptions, regular repair and maintenance of gas pipelines, gas plant, and wall mounted gas outlets etc.

v. A team of one Nurse and one OT Technician may be designated as **Oxygen Monitoring Team** for each shift at each hospital/health facility level.
   a. The team must inspect the gas pipeline, wall mounted gas outlets, as well as gas cylinders to detect and promptly address leakages, if any. Nurse in the team will check the oxygen mask on a regular basis.
   b. Ensure closure of valves during 'no-use' at all times.

vi. HFNC device should be used only in ICU setting under supervision of a respiratory physician/physician. Patient should be put on HFNC only after approval of the senior most respiratory physician/physician.

vii. Patients who are on oxygen therapy may be reviewed during daily rounds to evaluate their oxygen requirements as well as oxygen saturation rates.

viii. Regular training of OT Technicians and Nurse should be undertaken on proper oxygen administration and monitoring.

ix. District Magistrate (DM) assisted by the Chief Medical Officer (CMO) of the district must also monitor the consumption including the rational use of oxygen in all facilities of the district on a weekly basis.

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ANNEXURE VI

GUIDELINES ON SAFE STORAGE, TRANSPORTATION AND HANDLING OF LIQUID OXYGEN FOR MEDICAL USE

संजीव कुमार, भा.प्र.से.
सदस्य सचिव
SANJEEVA KUMAR, IAS
Member Secretary

सत्यमेव जयते

भारत सरकार
गृह मंत्रालय
राष्ट्रीय आपदा प्रबंधन प्राधिकरण
Government of India
Ministry of Home Affairs
National Disaster Management Authority

D. O.5-95/2020/Mitigation

Dated: 23rd April 2021.

Sub-: Guidelines on Safe Storage, Transportation and Handling of Liquid Oxygen for Medical Use

Dear Colleague,

As you are aware that on 21 April 2021 a preventable accident resulting in leakage of oxygen from the installed 13 Kilolitre Oxygen Tank occurred at Dr Zakir Husain Hospital at Nasik, Maharashtra, leading to drop in pressure in the piped oxygen supply which resultant in death of 22 patients.

2. Rapid rise in COVID-19 cases and resultant rapid demand of medical oxygen is posing high pressure on its transportation, storage infrastructure and handling at COVID-19 hospitals. Towards ensuring seamless, accident free optimal supply of medical oxygen National Disaster Management Authority has issued numerous advisories which are relevant for "Hazardous Chemicals: Safe Manufacture, Transportation and Handling", from time to time. A few of them are listed as under: -

I. Guidelines on Chemical Disasters 2007.
II. Guidelines on Management of Chemical (Terrorism) Disasters 2009.
III. Strengthening of Safety and Security for Transportation of POL Tankers 2010.
IV. Guidelines on Hospital Safety 2016.
V. Medical Preparedness and Mass Casualty Management 2007

3. In addition to that , The Manufacture, Storage and Import of Hazardous Chemical Rules, 1957; Environment Protection Act, 1986; The Petroleum Act 1934, The Explosives Act 1884, The Static and Mobile Pressure Vessel (Unfired) Rules 1981, The Gas Cylinder Rules, 2004 and various rules framed by states, provide the statutory requirements.

4. However despite all the existing Guidelines and SoP's incidences/ accidents as quoted above do happen which are actually preventable. In view of There is a need to revisit the existing information on Storage, Transportation and handling of Medical Oxygen Supply. In order to minimize the risk and to encourage smooth functioning broad "Guidelines on Safe Storage, Transportation and Handling of Liquid Oxygen for Medical Use" are enclosed as Appendix (A).

5. State Governments should ensure that these guidelines are disseminated to all the hospitals in the state for compliance. SDMA/DDMA/AAPADMITRAS to be roped in for dissemination of these guidelines on ground level with the aim to prevent a repeat of the such accident in future.

Regards,

Yours sincerely

(Sanjeeva Kumar)

Encl: As above

Chief Secretaries of States / Administrators of UTs
(As per the list attached)

Appendix-A

Guidelines on Safe Storage, Transportation and Handling of Liquid Oxygen for Medical Use

I. **End Use Medical Equipment for Liquid Oxygen**

- **Oxygen cylinders** - These are primarily used in hospitals where Medical Gas pipeline (MGps) has not been laid, however many hospitals use cylinders connected in series to supply oxygen to the wards through a manifold. The Jumbo cylinders are used in critical areas like operation Theatres, ICUs, HDUs, etc. Smaller cylinders (B Type) are used for stretchers, ambulances, general wards, etc. The use of oxygen cylinders requires three times the inventory of cylinders consumed in a hospital in a day (one set of cylinders in use, one set as backup and one set in refilling station). It is labour intensive, logistically challenging, unsafe, unhygienic (chances of carrying infection from hospital) and expensive method' However this is the most easily adaptable method in short term and emergency situations.

- **Oxygen Concentrators** - An oxygen concentrator is a self-contained, electrically powered medical device designed to concentrate oxygen from ambient air. This is used on the bedside without MGpS and caters to 1-2 patients at a time.

- **Oxygen Pipeline Systems**- These supply oxygen at high pressure to equipment such as anaesthetic machines and ventilators. A key advantage of pipeline systems is that they obviate the need for handling and transporting heavy cylinders between hospital wards. The high cost of installing centralized oxygen sources with copper pipelines and the high level of specialized maintenance required currently make these systems of oxygen delivery unsuitable for many district-level.

- **Liquid Oxygen**- Facilities can be equipped with large bulk liquid oxygen tanks that are refilled periodically by a truck from a supplier. The liquid oxygen tank supplies a centrally piped system throughout the health facility by self-vapourization, meaning that a power supply is not required. Liquid Medical Oxygen demands a MGPS, a safe, open, unhindered space upto 9M x1'5M in a hospital premise. It also demands installation of a storage tank which needs a PESO license and a third party supply dependence. It also demands one day of oxygen supply through cylinders as a backup. But this is a far better, cheaper, safer method than supply through cylinders, however this is again a supplier dependent method. Although currently an economical option in some locations, liquid oxygen requires high technical knowledge and large, well-ventilated spaces, and can introduce risks in settings with extreme temperature and humidity. It is best practice to also have cylinders as a backup supply.

- **Oxygen Plant (Central Oxygen Supply System)**- An oxygen plant is a large, onsite, central source of oxygen that is piped directly to terminal units within patient areas. Plants can also be set up to refill cylinders for oxygen distribution or backup oxygen supply; these cylinders can be connected to sub-central manifold systems at the health facility or transported to neighbouring health facilities. Oxygen plants require a reliable source of power. It is best practice to also have cylinders as a backup supply.

II. Liquid Oxygen

Oxygen is the second largest component of the atmosphere, comprising 20.8% by volume. Liquid oxygen is pale blue and extremely cold. Although nonflammable, oxygen is a strong oxidizer. Oxygen is necessary to support life. Oxygen will react with nearly all organic materials and metals, usually forming an oxide. Materials that burn in air will burn more vigorously in oxygen. Equipment used in oxygen service must meet stringent cleaning requirements, and systems must be constructed of materials that have high ignition temperatures and that are nonreactive with oxygen under the service conditions. Vessels should be manufactured and designed to withstand the process temperatures and pressures.

Liquid oxygen is a cryogenic liquid. Cryogenic liquids are liquefied gases that have a normal boiling point below –130°F (–90°C). Liquid oxygen has a boiling point of –297°F (–183°C). Because the temperature difference between the product and the surrounding environment is substantial—even in the winter—keeping liquid oxygen insulated from the surrounding heat is essential. The product also requires special equipment for handling and storage.

Oxygen is often stored as a liquid, although it is used primarily as a gas. Liquid storage is less bulky and less costly than the equivalent capacity of high-pressure gaseous storage. A typical storage system consists of a cryogenic storage tank, one or more vaporizers and a pressure control system. The cryogenic tank is constructed, in principle, like a vacuum bottle. There is an inner vessel surrounded by an outer vessel. Between the vessels is an annular space that contains an insulating medium from which all the air has been removed. This space keeps heat away from the liquid oxygen held in the inner vessel. Vaporizers convert the liquid oxygen into a gaseous state. A pressure control manifold then controls the gas pressure that is fed to the process or application. Vessels used in liquid oxygen service should be designed for the pressure and temperatures involved. Piping design should follow similar design and conform to national standards and codes.

III. Medical Uses

Oxygen is generally liquefied so that it can be more effectively transported and stored in large volumes. However, most applications use oxygen after it is vaporized to the gaseous form. The primary uses of oxygen relate to its strong oxidizing and life-sustaining properties. Oxygen is commonly relied upon in health and medical applications.

IV. Health effects

Normally, air contains 21% oxygen, and oxygen is essentially nontoxic. No health effects have been observed in people exposed to concentrations up to 50% at 1 atmosphere for 24 hours or longer. The inhalation at 1 atmosphere of 80% oxygen for more than 12 hours can cause irritation of the respiratory tract, progressive decrease in vital capacity, coughing, nasal stuffiness, sore throat, and chest pain, followed by trachea-bronchitis and later by pulmonary congestion and/or edema. Inhalation of pure oxygen at atmospheric pressure or less can cause pulmonary irritation and edema after 24 hours.

Respiratory symptoms can occur in two to six hours at pressures above 1 atmosphere. One of the earliest responses of the lung is accumulation of water in its interstitial spaces and within the pulmonary cells. This can cause reduced lung function, which is the earliest measurable sign of toxic- ity. Other symptoms include fever and sinus and eye irritation.

When pure oxygen is inhaled at pressures greater than 2 or 3 atmo- spheres, a characteristic neurological syndrome can be observed. Signs and symptoms include nausea, dizziness, vomiting, tiredness, light-headedness, mood changes, euphoria, confusion, incoordination, muscular twitching, burning/tingling sensations (par- ticularly of the fingers and toes), and loss of consciousness. Characteristic epileptic-like convulsions, which may be preceded by visual disturbances such as loss of peripheral vision, also occur. Continued exposure can cause severe convulsions that can lead to death. The effects are reversible after reduction of oxygen pressure.

Premature infants placed in incuba- tors to breathe oxygen in concentra- tions greater than in air can develop irreversible eye damage. Within six hours after an infant is placed in a high-oxygen atmosphere, vasocon- striction of the immature vessels of the retina occurs, which is reversible if the child is immediately returned to air, but irreversible if oxygen-rich therapy is continued. Fully developed blood vessels are not sensitive to oxygen toxicity.Extensive tissue damage or cryogenic burns can result from exposure to liquid oxygen or cold oxygen vapors.

V. Containers

Liquid oxygen is stored, shipped, and handled in several types of containers, depending upon the quantity required by the user. The types of containers in use include the Dewar, Cryogenic Liquid Cylinder and Cryogenic Storage Tank. Storage quantities vary from a few liters to many thousands of litrs. Since heat leak is always present, vaporization takes place continuously. Rates of vaporization vary, depending on the design of the container and the volume of stored product. Containers are designed and manufactured according to the applicable codes and specifications for the temperatures and pressures involved.

Tanks may be spherical or cylindrical in shape and are mounted in fixed locations as stationary vessels or on railcar or truck chassis for easy transportation. Sizes range from 1,893 – 1,589,873 Litres . All tanks are powder- and vacuum-insulated in the annular space and equipped with various circuits to control product fill, pressure build up, pressure-relief, product withdrawal, and tank vacuum. Tanks are designed to national specifications for the pressures and temperatures involved.

Liquid transfer line is used to safely remove liquid product from dewars or cryogenic liquid cylinders. A typical transfer line for dewars is connected to a bayonet that provides a means of using product vapor pressure buildup or an external pressure source to remove the liquid. For cryogenic liquid cylinders, the transfer line is connected to the cylinder's liquid withdrawal valve. Liquid product is typically removed through insulated withdrawal lines to minimize the loss of liquid product to gas. Insulated flexible or rigid lines are used to withdraw product from stor-age tanks. Connections on the lines and tanks vary by manufacturer.

VI. Safety considerations

The hazards associated with liquid oxygen are exposure to cold temperatures that can cause severe burns; over pressurization due to expansion of small amounts of liquid into large volumes of gas in inadequately vented equipment; oxygen enrichment of the surrounding atmosphere; and the possibility of a combustion reaction if the oxygen is permitted to contact a non-compatible material.

The low temperature of liquid oxygen and the vapors it releases not only pose a serious burn hazard to human tissue, but can also cause many materials of construction to lose their strength and become brittle enough to shatter.

It is important to note that fire chemistry starts to change when the concentration of oxygen increases. Materials easily ignited in air not only become more susceptible to ignition but also burn with added violence in the presence of oxygen. These materials include clothing and hair, which have air spaces that readily trap the oxygen. Elevated oxygen levels can be reached very quickly, and all personnel must be aware of the hazard.

Any clothing that has been splashed or soaked with liquid oxygen or exposed to high oxygen concentrations should be removed immediately and aired for at least an hour. Personnel should stay in a well-ventilated area and avoid any source of ignition until their clothing is completely free of any excess oxygen. Clothing saturated with oxygen is readily ignitable and will burn vigorously.

Do not permit smoking or open flames in any areas where liquid oxy- gen is stored or handled. Do not permit liquid oxygen or oxygen-enriched air to come in contact with organic materials or flammable or combustible substances of any kind. Some of the organic materials that can react violently with oxygen when ignited by a spark or even a mechanical shock are oil, grease, asphalt, kerosene, cloth, tar, and dirt that may contain oil or grease. If liquid oxygen spills on asphalt or other surfaces contaminated with combustibles, do not walk on or roll equipment over the area of the spill. Keep sources of ignition away for 30 minutes after all frost or fog has disappeared.

Systems used in oxygen service must meet stringent cleaning requirements to eliminate any incompatible contaminants. . Also, review the Material Safety Data Sheet (MSDS) and follow all recommendations.

VII. Buildings

Because of the large expansion ratio of liquid-to-gas, it is very important to provide adequate ventilation in areas where liquid oxygen is in use. A minimum of six air changes per hour is suggested. The definition of an oxygen-enriched atmosphere is one containing more than 23.5% oxygen. Remember, oxygen has no warning properties!

VIII. Storage

- Store and use liquid containers with adequate ventilation. Do not store containers in a confined area or in area unprotected from the extremes of weather.
- Cryogenic containers are equipped with pressure relief devices de- signed to control the internal pressure. Under normal conditions these containers will periodically vent product. Do not plug, remove or tamper with any pressure relief device.
- Oxygen must be separated from flammables and combustibles by at least 20 feet or a half-hour fire wall. Post "No Smoking" and "No Open Flames" signs.
- Liquid containers should not be left open to the atmosphere for extend-ed periods. Keep all valves closed and outlet caps in place when not in use. If restriction results from freezing moisture or foreign material present in openings and vents, contact the vendor for instructions. Restrictions and blockages may result in dangerous over pressurization. Do not attempt to remove the restriction without proper instructions. If possible, move the cylinder to a remote location.

IX. Handling

- Cryogenic containers must be stored, handled and transported in the upright position. When moving, never tip, slide or roll containers on their side. Use a suitable hand truck for moving smaller containers. Move larger containers by pushing, not pulling. Avoid mechanical and thermal shock.
- Never allow any unprotected part of the body to come in contact with uninsulated pipes or equipment containing cryogenic product. The extreme cold will cause flesh to stick fast and potentially tear on withdrawal.
- Use only oxygen-compatible materials and lubricants.
- If there is any difficulty in operating the container valve or container connections, discontinue use and contact the vendor. Do not remove or interchange connections. Use only the properly assigned connections. Do not use adapters.
- Use only transfer lines and equipment designed for use with cryogenic liquids. Some elastomers and metals, such as carbon steel, may become brittle at extremely low temperatures and may easily fracture. These materials must be avoided in cryogenic service.
- It is recommended that all vents be piped to the exterior of the building.
- On gas withdrawal systems, use check valves or other protective apparatus to prevent reverse flow into the container.
- On liquid systems, pressure relief devices must be used in lines where there is the potential to trap liquid between valves.

X. Personal Protective Equipment (PPE)

Personnel must be thoroughly familiar with properties and safety considerations before being allowed to handle liquid oxygen and its associated equipment. The eyes are the most susceptible to the extreme cold of the liquid and vapours of liquid oxygen. The recommended PPE is a full face shield over safety goggles; clean, loose-fitting thermal-insulated or leather gloves; long-sleeved shirts; and pants without cuffs. Wear this PPE when handling or using liquid oxygen, or whenever the possibility of exposure due to a spill exists. In addition, safety shoes are recommended for those involved with the handling of containers.

In emergency situations, self- contained breathing apparatus (SCBA) must be used. Clothing that is fire- resistant in air may be readily ignitable in oxygen-enriched atmospheres. Only trained and certified emergency responders should respond to emergency situations.

XI. First aid

For skin contact with liquid oxygen, remove any clothing that may restrict circulation to the frozen area. Do not rub frozen parts, as tissue damage may result. As soon as practical, place the affected area in a warm water bath with a temperature not exceed- ing 105°F (40°C). Never use dry heat. Call a physician as soon as possible. Frozen tissue is painless and appears waxy with a possible yellow color. It will become swollen, painful, and prone to infection when thawed. If the frozen part of the body has been thawed, cover the area with a dry sterile dressing with a large bulky protective covering, pending medical care. In case of massive exposure, remove clothing while showering the victim with warm water. Call a physician immediately. If the eyes are exposed to the extreme cold of the liquid or vapors, immediately warm the frostbite area with warm water not exceeding 105°F (40°C) and seek medical attention. Since oxygen is nonflammable but supports combustion, fire-fighting actions require shutting off the source of oxygen, if possible, then fighting the fire according to the material involved.

ANNEXURE VII

STANDARD OPERATING PROCEDURE FOR CONVERSION OF INDUSTRIAL OXYGEN CYLINDERS AND INERT GAS CYLINDERS (NITROGEN, ARGON AND HELIUM ONLY) TO MEDICAL OXYGEN CYLINDERS IN WAKE OF COVID 19 PANDEMIC

Website : http://peso.gov.in
Email: explosives@explosives.gov.in
दूरभाष/ Telephone : **0712-2510248**
फैक्स/ FAX : **2510577**

कार्यालयीन उद्देश्य के सभी पत्रादि "मुख्य विस्फोटक नियंत्रक" के पदनाम से भेजे जाए उनके व्यक्तिगत नाम से नही.
All communications intended for this Office should be addressed to the 'Chief Controller of Explosives' and NOT to him by name.

भारत सरकार
GOVERNMENT OF INDIA
पेट्रोलियम तथा विस्फोटक सुरक्षा संगठन
Petroleum and Explosives Safety Organisation
(पूर्व नाम – विस्फोटक विभाग)
(Formerly- Department of Explosives)
"ए-ब्लाक ú, पाँचवा तल, केन्द्रीय कार्यालय परिसरū,
"A" Block, 5th Floor, CGO Complex,
सेमिनरी हिल्स, नागपूर - 440 006 (महा)
Seminary Hills, Nagpur- 440006

संख्या: D-21013/PBL/18-Exp

दिनांक /Nagpur, dated : 22/04/2020

CIRCULAR

Sub: Standard Operating Procedures (SOP) for conversion of Industrial Oxygen Cylinders and Inert Gas Cylinders (Nitrogen, Argon & Helium only) to Medical Oxygen Cylinders in the wake of COVID-19 pandemic- reg.

In wake of the outbreak of the COVID-19 pandemic in the country and to ensure uninterrupted supply of Oxygen to hospitals and other health care facilities; DPIIT, Ministry of Commerce and Industry, Government of India has advised PESO to formulate an Standard Operating Procedure for conversion of Industrial oxygen cylinders and Non toxic Non flammable Gas Cylinders (Nitrogen, Argon and helium).

The Industrial gas cylinders Filling Units covered under License Form E & F of the Gas Cylinders Rules, 2016 may convert their industrial and inert gas cylinders to Medical Oxygen Cylinders in their endeavor of national interest.

A copy of the SOP is enclosed herewith. It shall be obligatory to adopt Standard Operating Procedure (SOP) during the conversion.

The copy of the same is made available in PESO's website: https://peso.gov.in/index.aspx.

22/4/2020

(M.K. Jhala)
Jt. Chief Controller of Explosives (H.O.D.)

To:

1. Shri R.K. Sood, Deputy Secretary Department for Promotion of Industry and Internal Trade, Ministry of Commerce and Industry, Udyog Bhavan, New Delhi: 110 107: *For information.*
2. Heads of Circle and Sub Circle Offices of PESO and Nodal Officers of PESO: *They are advised to give wide publicity about the Circular and SOP*
3. The President, All India Industrial Gases Manufacturers Association, 215, Square One, C-2 District Centre, Saket, New Delhi: 110 017: *He is advised to inform the gas cylinder filling plants and persuade for conversion of cylinders duly adhering to the SOP.*
4. All the Nodal Officers monitoring the inventory of Oxygen and Gas Cylinders: *They are advised to note and take necessary action*

S O P for conversion of Industrial Oxygen Cylinders to Medical Oxygen

Following procedure is required to be adopted for conversion of Industrial oxygen cylinders to medical oxygen service.

1. **Cylinder shall be completely degassed.**
2. **Removal of Valve and cleaned with cleaning solution, completely dry and flush with air.**
3. **Cleaning of cylinder internally as well as externally with mild detergent and completely de-grease with cleaning solution (May refer ISO 11621). *Organic solvents like carbon tetra chloride should not be used being toxic.***
4. **Cylinders shall be again filled with water/warm water.**
5. **Drain and dry with air.**
6. **During the COVID-19 crisis Industrial Oxygen valves (without chrome plating) may be used and fitted.**
7. **The cylinder shall be painted as required for medical oxygen(IS 3933)**
8. **For any details please refer ISO 11621.**
9. **The cylinders may be converted only at E and F licensed premises.**
10. **Record of converted cylinders shall be maintained in the following format and intimate on mail to seeniraj@explosives.gov.in**

License No.(E and F)

Cylinder No.	Make	Water capacity	Last Hydrotest date	Valves code/chrome plated Yes/No

SOP for conversion of non toxic and non flammable high pressure industrial gas cylinders i.e Argon, Nitrogen and Helium to cylinders for medical oxygen service during COVID-19 Pandemic.

Following procedure is required to be adopted for conversion:

I. The Cylinders shall be completely degassed, adequately cleaned from inside and outside, purged and/or evacuated to remove any contaminations like water, oil, hydrocarbons etc., if any after degassing and safe removal of valve. Refer to ISO 11621 for detailed cleaning procedures. Organic solvents like Carbon Tetra Chloride shall not be used as they are toxic.

II. Ensure that the cylinders have passed last cylinder periodic examination/re-test as per Rule 26 of the Gas Cylinders Rules, 2016. However, the periodic testing of cylinders is extended from 5 years to 5 years 3 Months for those cylinders which are due for statutory hydro testing on 31.03.2020 because of the ongoing COVID-19 pandemic and shall be reverted to 5 years once the Government of India declares that the pandemic is over. The extension of cylinder retest is also applicable to industrial Oxygen cylinders used in medical Oxygen service. The records of such cylinders shall be maintained.

III. Cylinders shall be fitted with appropriate valves according to the medical gas in line with IS:3224. In this case, change valve with IS 3224 No.20 (3/4 BSP RH External thread) to IS outlet No.3 (5/8 BSP, RH, internal thread) for Oxygen. During the COVID-19 crisis industrial oxygen valves (without chrome plating) may be fitted and used in medical oxygen service since the outlets are identical. Where yoke type valves are needed to be installed for small cylinders, it shall be according to IS 3745.

IV. Colour-code of cylinders and warning labels shall be according to "IS 3933: Colour identification of gas cylinders and related equipment intended for medical use". This is also applicable to industrial oxygen cylinders which are converted to medical Oxygen service.

V. These activities shall be carried at the E&F licensed premises only.

VI. The records of such converted cylinders shall be maintained.

VII. Record of converted cylinder shall be maintained in the following format and intimated on mail to seeniraj@explosives.gov.in.

Cylinder Filling & Storage license No.

Cylinder Sr.No	Make	Water capacity in (in litres)	Existing service (Argon/Nitrogen/Helium)	Last Hydrotest date	Valve code-Chrome plated (Yes/no)

TEAM

1. Mr. Alen Abraham, Safety Engineer, KSEOC
2. Mr. Sathyakumar C.J, Hazard Analyst (DM), KSEOC
3. Mr. Reni Lukose, DFO, Kerala Fire Academy
4. Dr. Sreeja M.U, Hazard Analyst, DEOC, Kollam
5. Ms. Mrudu Krishna K.R, Field Assistant (Electrical), KSEOC
6. Mr. Pradeep G.S, Hazard and Risk Analyst, KSEOC
7. Mr. Joe John George, State Project Officer, KSDMA

***

GOVERNMENT OF KERALA

Disaster Management (A) Department

No.DMA2/314/2021-DMD 08/05/2021,Thiruvananthapuram

From

Additional Chief Secretary to Government

To

Member Secretary,
Kerala State Disaster Management Authority,
Observatory Hills, Vikas Bhavan P.O.,
Thiruvananthapuram.

Sir,

Sub: DMD - Compendium of safety protocols for containment of oxygen leakage in hospitals - Reg

Ref: Compendium dated 03/05/2021.

Compendium of safety protocols for containment of oxygen leakage in hospitals is approved and is attached herewith.You are directed to take necessary action to upload the same in website.

Yours Faithfully,
GANGA G R
UNDER SECRETARY
For Additional Secretary to Government.

Approved for Issue,

Validity unknown
Digitally signed by JAYACHANDRAN K P
Date: 2021.05.08 16:38:08 IST
Reason: Approved

Section Officer.