

## **PUBLIC COMPANY ORLEN LIETUVA**

APPROVED BY  
Director of Quality, Labour Safety  
and Environmental Control

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Order No. TV1(1.2-1)-194

### **OCCUPATIONAL HEALTH AND SAFETY PROCEDURE BDS-32 GAS WELDING AND CUTTING**

#### **I. GENERAL PROVISIONS**

##### **Purpose and Scope of Application**

1. The purpose of this Occupational Safety and Health Procedure BDS-32 'Gas Welding and Cutting' (hereinafter the Procedure) is to define the occupational health and safety requirements for gas welding and cutting works.

2. This Procedure applies to the employees of Public Company ORLEN Lietuva (hereinafter the Company) and contractors, if so provided in respective work (service) contracts concluded with Public Company ORLEN Lietuva, involved in the storage, use, inspection and maintenance of gas welding and cutting equipment.

#### **II. REFERENCES**

3. This Procedure shall be used in conjunction with the below listed regulations (as amended):

3.1. Rules for Operation of Liquid Petroleum Gas Systems as approved with Order No. 4-331 of 18 July 2008 by the Minister of Economy of the Republic of Lithuania.

3.2. LST EN 1089-3:2011. Transportable gas cylinders - Gas cylinder identification (excluding LPG) - Part 3: Colour coding;

3.3. LST EN ISO 3821:2010. Gas welding equipment - Rubber hoses for welding, cutting and allied processes (ISO 3821:2008).

#### **III. PROPERTIES OF GASES USED FOR WELDING AND CUTTING**

##### **Properties of oxygen**

4. Oxygen O<sub>2</sub> is an odorless and colorless gas that has a density of 1.33 kg/m<sup>3</sup> (air has a density of 1.2 kg/m<sup>3</sup>). Oxygen is not flammable but accelerates combustion. When pressurized gas-phase oxygen contacts oils, fats and other materials of animal and plant origin (dust, wood chips, peat, etc.), these materials can ignite and cause fire or explosion.

5. Parts that are exposed to oxygen having pressure of 64 bars or more must be fabricated from copper or copper alloys (brass, bronze).

### Properties of acetylene

6. When under normal conditions, acetylene  $C_2H_2$  is a colorless gas with a pungent odor. Its has a density of  $1.09 \text{ kg/m}^3$ . A 40 litre cylinder is filled up with  $5.5 \text{ m}^3$  of acetylene gas.

7. Acetylene, when combined with oxygen, burns at temperatures as high as 3,300 degrees Celsius. The explosive range for acetylene mixed up with oxygen is 2.5 – 80 % by volume.

8. When acetylene reacts with copper and silver, this forms copper acetylide and silver acetylide, which when heated up to  $110\text{-}120 \text{ }^\circ\text{C}$  can explode from physical shock. Therefore it is prohibited to use metal alloys containing more than 70 % of copper for manufacturing equipment intended for storage and handling of acetylene.

### Properties of liquid petroleum gas

9. Liquid petroleum gas (hereinafter LPG) is a mixture of propane and butane. It is heavier than air and has a density of  $1.4\text{-}2.0 \text{ kg/m}^3$ .

10. LPG cylinders are filled to not more than 85 percent of their capacity because liquid hydrocarbons have a high volumetric expansion coefficient. When LPG temperature reaches  $45^\circ\text{C}$ , the liquid gas expands and fills up the total volume of the cylinder. Rising LPG temperature makes the cylinder pressure increase rapidly:  $1^\circ\text{C}$  increase in temperature results in 7-bar increase in pressure. The cylinder explodes after the pressure reaches 48 bars (the operating cylinder pressure is 16 bars).

11. An LPG/oxygen flame burns at  $2400 - 2500^\circ\text{C}$ . The explosive range for propane/air mixture is 2.1 - 9.5 % by volume and for butane/air mixture – 1.8 - 8.4 % by volume.

### Properties of argon

12. Argon is a colorless and odorless gas. It is heavier than air and has a density of  $1.784 \text{ kg/m}^3$ .

13. Since argon is heavier than air, it may accumulate near the ground surface and especially in cavities.

14. At high pressure, argon changes the state of ideal gas. For example, at pressure of 200 bar a gas cylinder contains approximately 7 % more argon compared to idle gas.

## IV. REQUIREMENTS FOR GAS WELDING AND CUTTING

15. Gas welding and cutting is usually performed using mobile welding stations, i.e. special trolleys that carry two cylinders (oxygen & LPG or oxygen & acetylene) secured to the frame of the trolley. Cylinders are placed on the special seats in the trolley and are secured with chains or clamps to protect them from being dropped or bumped. Welding stations must be designed to keep cylinders in the upright position during welding operation.

16. Before starting gas welding or cutting operation, it is essential to check if all torches, hoses, regulators, gauges, gas cylinders are in proper condition, i.e. they do not show any mechanical damage, all connections and equipment are leak-tight and free of any oils or other materials.

17. It is prohibited to remove protective caps using a hammer. If it is impossible to remove the cap, the cylinder must be returned to the gas refilling station.

18. Gas cylinders must be protected against mechanical damage, weld splashes, corrosive gases or fluids.

19. Only one welding or cutting torch can be connected to one welding station (gas cylinder). An LPG pressure regulator (hereinafter the regulator) must be installed on the gas cylinder for reducing or maintaining LPG pressure.

20. Regulators are connected to gas cylinders using oil free gaskets suitable for service in the oxygen environment.

21. Tools made from metals that are non-sparking or coated with non-ferrous metals must be used to connect regulators to gas cylinders. It is prohibited to use copper tools for connecting the regulator to the acetylene cylinder. Cap nut can be tightened only when the cylinder valve is closed.

22. Before lighting the welding (cutting) torch, it is important to open the oxygen cylinder valve first and then the flammable gas cylinder valve.

23. The distance between the place of welding/cutting works and flammable gas (acetylene, LPG) & oxygen cylinders must be at least 5 meters and the distance between separately standing oxygen and flammable gas cylinders must be at least 3 meters. Separately standing cylinders must be reliably secured in the upright position. When performing works in confined areas, the gas cylinder must be kept at least 1 meter from heating devices and at least 5 meters from heat sources with open flame.

24. During the welding operation the torch flame must be directed away from the gas source (cylinder). If this requirement cannot be satisfied, the cylinders shall be fenced off using metal shields or screens made of non-flammable materials.

25. When using oxygen cylinders it is necessary to prevent oil from getting onto surfaces exposed to oxygen, avoid use of greasy clothes, gloves, cleaners or tools, prevent falling and bumping of cylinders and abrupt opening of valve.

26. It is prohibited to perform welding/cutting works and use flammable gas for other purposes in basements and cellars (where the exit door is below the ground level) as well as in manholes, wells, pits and other underground premises.

27. When performing welding/cutting works it is prohibited to empty gas cylinders completely. Gas can be used until the pressure in LPG and oxygen cylinders reaches 0.5 bars, and in acetylene cylinders – 1-1.5 bars. Then the cylinder valve is capped and 'EMPTY' is written with a chalk on the cylinder body (LPG valve must be closed using a seal cap).

28. During welding/cutting works, the pressure in oxygen cylinder must be higher than that in flammable gas cylinder to avoid the risk of gas overflow, flashback and oxygen cylinder explosion.

29. Not used portable welding cylinders (also empty gas cylinders) must be kept only in places (in the process unit) indicated by the head of the process unit. Gas cylinders in process units must be kept in quantities sufficient for one working day.

30. Torches can be connected to LPG, acetylene and oxygen cylinders using hoses designed for 6 bar pressure with length of up to 30 meters and made up from not more than 3 interconnected segments. Hoses are connected to each other and to gas cylinders using corrugated sleeves. The interconnections must be tightened with clamps.

31. When laying down the flammable gas and oxygen hoses at the place of works, it is necessary to protect them from any mechanical damage, sharp bends or twists, pressing and exposure to heat and aggressive media.

32. Welding and cutting hoses shall be used for their intended purpose only, i.e. acetylene hoses can not be used for oxygen and vice versa.

33. In case of break or rupture of flammable gas or oxygen hoses or gas leaks from loose fittings, it is necessary to immediately extinguish the torch flame and close the cylinder valve.

34. At the end of the works, the welding (cutting) torch must be extinguished by shutting off flammable gas first and then oxygen; gas cylinders and other equipment must be moved to their regular storage place.

## V. REQUIREMENTS FOR GAS WELDING AND CUTTING EQUIPMENT

### Requirements for gas cylinders

#### 35. Tag

35.1. For identifying hazards related to the contents of gas cylinders, the top spherical part of the cylinder must be painted in appropriate color as required by LST EN 1089-3:2011 [4.2]: oxygen – white, acetylene – maroon, LPG – red, argon – dark green.

35.2. The top spherical part of the cylinder or the special ring located there must bear the following legibly inscribed data: manufacturer's trade mark, cylinder identification number, actual weight of empty cylinder (kg), date (month, year) of manufacturing and all routine inspections (if the cylinder was regularly tested), test station marks (stamps), operating and hydraulic (testing) pressure in bars (MPa), cylinder capacity in liters.

#### 36. Storage

36.1. Full and empty LPG cylinders must be stored with seal caps in place and oxygen and acetylene cylinders - with valve protection caps in place. If the cylinder has a regulator, the cylinder's valve must be closed and regulator's spring loosened.

36.2. Cabinets made from metal or other non-flammable materials as well as open-type containers can be used for storing gas cylinders with a fill volume of not more than 2 m<sup>3</sup>.

36.3. Gas cylinder cabinets must have good top and bottom ventilation and must be designed to prevent the accumulation of gas that may leak from cylinders. The flooring of cabinets and containers must be 0.2 m above the ground level of the site where the cabinets or containers are stored. Cabinets and containers must have flooring produced from non-sparking materials.

36.4. Gas cylinder cabinets have to be painted in light color to reduce heat build-up from direct sunlight.

36.5. Gas containers must have shields above them to protect them from sunlight and rainfall.

36.6. Gas cylinder cabinets and containers must have locks.

36.7. Maximum heating temperature of LPG cylinders may not exceed 45°C, acetylene cylinders – 40°C, and oxygen cylinders – 60°C.

36.8. Empty cylinders must be kept separately from full cylinders (in separate cabinets or containers).

#### 37. Transportation

37.1. When gas cylinders are transported in motor vehicles, they have to be transported in special containers and be secured with chains or clamps.

37.2. It is prohibited to transport both oxygen and flammable gas cylinders (both full and empty) in one vehicle, except when cylinders are carried to the place of works in special trolleys.

37.3. Gas cylinders are allowed to be transported only with valve protection and seal caps in place.

37.4. It is required to remove regulators and to put on cylinder protective caps if they are not secured to the frame of the trolley.

37.5. It is prohibited to carry gas cylinders in the hands. Cylinders are allowed to be carried on special stretchers if secured with belts. Gas cylinders may be moved at the place of works by tilting and rolling them on their bottom edges.

37.6. When hoisted, cylinders must be placed in special containers with separate seats for each cylinder (not more than eight cylinders). Each container must have a label indicating the weight of empty container and the maximum weight of its load (weight of loaded containers). The container must ensure the stability of the cylinders in their seats, prevent them from bumping against each other and ensure separate securing devices for each cylinder. Lifting ropes must have 9 times of their breaking strength.

### **38. Inspection**

38.1. Gas leaks are detected by applying soap emulsion to possible leak places.

38.2. After finding cylinder defects, the cylinder must be returned to the gas refilling station. If due to the defects the safe transportation of cylinder is not possible, gas should be gradually and carefully released from the cylinder within a safe 40 m distance from open fire sources, basements, manholes, pits and water bodies to prevent the accumulation or ignition of released gas.

38.3. Cylinders must be periodically inspected in the refilling station: acetylene and oxygen cylinders - at least once in 5 years, LPG and argon cylinders – at least once in 10 years. In case of positive inspection results, each cylinder shall be attached with stamps containing the following information:

38.3.1. Date of conducted technical inspection (month and last two digits of year);

38.3.2. Date of next technical inspection (month and last two digits of year);

38.3.3. Logo of inspecting company.

### **Requirements for hoses**

#### **39. Tag**

39.1. For gas welding and cutting it is required to use hoses of appropriate colors specifically designed for that purpose [4.3]: oxygen - blue, acetylene - red, LPG - orange, argon - black.

#### **40. Inspection**

40.1. Rubberized-fabric hoses are tested as recommended by their manufacturers but not less than once every 6 months. Rubber hoses are hydro-tested using pressure that is 1.25 times higher than their operating pressure, if not otherwise specified in their technical documents.

40.2. During testing it must be verified if the conductor inside the rubber hose is intact. The resistance of the conductor must not exceed 10  $\Omega$ . The rubber hose testing results must be indicated in the test report.

40.3. Rubber hoses showing excessive wear, cuts, bumps, fractures or other defects must be replaced.

40.4. Tested rubber hoses shall be marked to be able to recognize them and have an indicated date of the next inspection.

### **Requirements for regulators and pressure gauges**

41. Regulators and pressure gauges shall be used solely for gases and pressures for which they are designed. They must be tested and be in good condition.

42. Prior to gas welding or cutting operation, it is necessary to check the pressure gauges and make sure that:

42.1. The pressure gauge glass is not cracked or broken, and there are no other defects that could affect the gauge readings;

42.2. The gauge pointer returns to zero position after the gauge is disconnected;

42.3. The dial of the gauge has an indication (symbol or colour mark) of the highest operating pressure. The maximum allowable working pressure shall not be greater than  $\frac{2}{3}$  of the maximum scale value of the gauge.

42.4. Pressure gauge has an inspection tag and its inspection deadline has not yet expired (pressure gauges are inspected at least once in a year).

43. Each time before and after connecting the regulator to the gas cylinder, the cylinder valve is opened for purging. The welder opening the valve must stand opposite to the gas flow direction.

44. The regulator is attached to the cylinder only when the cylinder valve is closed.

45. The oxygen cylinder valve must be opened slowly in order to prevent the risk of adiabatic shock during which temperature may rise to 1020°C and burn the valve, spring and membrane or the regulator.

46. At the end of welding/cutting operation, it is required to close the valves and to loosen the regulator's clamping screws.

## **VI. FINAL PROVISIONS**

47. The Occupational Health and Safety Manager is responsible for periodic review and, where appropriate, revision of this Procedure.

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