AB ORLEN LIETUVA

APPROVED BY:
Director of Quality, Labour Safety
and Environmental Control

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Order No TV1(1.2-1)-2026-0026

OCCUPATIONAL HEALTH AND SAFETY PROCEDURE BDS-22 HYDRAULIC AND PNEUMATIC TESTING OF PRESSURE EQUIPMENT

I. GENERAL

Purpose and Scope of Application

1. The purpose of AB ORLEN Lietuva Occupational Health and Safety Procedure BDS-22 'Hydraulic and Pneumatic Testing of Pressure Equipment' (hereinafter – the Procedure) is to establish occupational health and safety (OHS) requirements for performing hydraulic and pneumatic tests on pressure vessels, pipelines, and other pressure equipment (hereinafter – the tests) within the Company.

2. This Procedure applies to all Company employees and, where specified in a contract (or other agreement) concluded between the Contractor (hereinafter – Contractor) and the Company, to the Contractor's employees who organize and/or perform hydraulic and pneumatic tests within the Company.

II. REFERENCES

3. The present Procedure has been developed in line with effective revisions of the following documents:

3.1. Law of the Republic of Lithuania on Supervision of Potentially Hazardous Installations;

3.2. Directive 2014/68/EU of the European Parliament and the Council on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment;

3.3. Directive 2014/29/EU of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to the making available on the market of simple pressure vessels;

3.4. Rules for the Maintenance of Pressure Vessels, adopted by the Minister of Economy of the Republic of Lithuania;

3.5. Rules for the Installation and Safe Operation of Steam and Water Boilers, adopted by the Minister of Energy of the Republic of Lithuania;

3.6. Rules for the Operation of Pressure Pipelines, adopted by the Minister of Energy of the Republic of Lithuania;

3.7. Rules for the Installation and Safe Operation of Water Steam and Superheated Water Pipelines, adopted by the Minister of Energy of the Republic of Lithuania;

3.8. Technical Regulation for Pressure Equipment, adopted by the Minister of Economy of the Republic of Lithuania;

3.9. Technical Regulation for Simple Pressure Vessels, adopted the Minister of Economy of the Republic of Lithuania;

3.10. Rules for Operation of Oil Processing Facilities, adopted by the Minister of Economy of the Republic of Lithuania.

3.11. ORLEN S.A. Technical Standard ST S7 T12 'Preparation and Safe Execution of Work under Pressure on Vessels, their Components and Pipelines';

3.12. Company Operation Manual BM-2 for Pressure Vessels;

3.13. Company Operation Manual BM-4 for Pressure Pipelines;
3.14. Company Manual 37-CM-2 for Installation and Inspection of Offshore Hoses;
3.15. Company OHS Procedure BDS-6E ‘Issue of Hazardous Work E-Permits’;
3.16. Company OHS Procedure BDS-14E ‘Issue of Hazardous Work E-Instructions’;
3.17. Company OHS Procedure BDS-20 ‘Barriers’;
3.18. Company OHS Procedure BDS-29 ‘Equipment Isolation’.

III. TERMS AND DEFINITIONS

4. Terms and definitions used herein:

Pressure equipment (hereinafter – equipment) – any pressure vessel, pipeline, or any other equipment subjected to hydraulic or pneumatic testing.

Test pressure – the pressure applied to the equipment during testing.

Hydraulic test – verification of the mechanical strength and leak-tightness of the equipment by filling it with water or another suitable non- hazardous liquid and pressurizing it to the specified test pressure.

Pneumatic test – verification of the leak-tightness of the equipment by pressurizing it with compressed air or an inert gas.

Maximum allowable pressure – the highest pressure for which the equipment or its components are designed.

Hazardous zone – the designated area established around equipment under test where personnel may be at risk due to sudden failure of tested equipment or hydraulic testing apparatus, high- pressure jets, or other hazards.

Other terms used in this Procedure shall have the meanings defined in the OHS Procedure BDS-6E ‘Issue of Hazardous Work E-Permits’ and OHS Procedure BDS-14E ‘Issue of Hazardous Work E-Instructions’.

IV. EMPLOYEE RESPONSIBILTIES

5. **The person issuing a permit or instruction** shall, when entering data in the RAP program for the issuance of a work permit or hazardous work instruction, assign an icon indicating that a hydraulic or pneumatic test will be performed.

6. **Work Coordinator shall:**

6.1. Inform the Work Manager of the equipment tag number, any hazardous substances previously contained in it, the test pressure and temperature, the location(s) for venting air from the equipment, and any other data necessary to ensure safe testing;

6.2. Ensure that the required test diagram and other technical documentation are prepared and that a hazardous work permit or instruction for testing is issued;

6.3. Verify that all pressure gauges used for testing have been calibrated and possess valid calibration certificates.

7. **Work Manager shall:**

7.1. Ensure the proper selection, inspection, and compliance of testing equipment (pump, hoses, fittings, pressure gauges) with the requirements of this Procedure;

7.2. Maintain valid calibration certificates for all pressure gauges and present these certificates to the Work Coordinator for verification before commencing work;

7.3. Remain at the worksite at all times, supervise the work being performed, and ensure that no unauthorized personnel are present in the hazardous zone during testing.

8. **Workers shall:**

8.1. Comply with the requirements of this Procedure and the manufacturer’s instructions for hydraulic testing equipment;

8.2. Immediately stop work and notify the Work Manager upon detecting any signs of a hazardous situation (such as leakage, deformation, uncontrolled pressure drop or rise), activation of an emergency alarm or gas detector, and/or upon instruction from an employee of the organizational unit where the work is being performed.

Other employee responsibilities are defined in Company OHS Procedure BDS-6E 'Issue of Hazardous Work E-Permits' and OHS Procedure BDS-14E Issue of Hazardous Work E-Instructions.

V. MAIN HAZARDS

9. **Main hazards during hydraulic and pneumatic testing:**

9.1. Due to high pressure, metal fatigue, or hidden defects, pressure-retaining components or welds may crack, and the sudden release of energy may eject parts at high speed, causing injury;

9.2. High- pressure liquid or compressed air jets. Even a minor leak through a gasket or microcrack can create a jet of extremely high energy and velocity, capable of injuring nearby personnel;

9.3. Failure of testing equipment. A ruptured high-pressure hose or fitting may move uncontrollably and injure personnel;

9.4. Loss of tightness due to sudden expansion of residual compressed air in the system following a failure;

9.5. Hydraulic shock and loss of tightness caused by excessive speed of pressure increase and/or decrease;

9.6. Slipping on water or other liquid spilled in the test area;

9.7. Tripping over hoses, cables, or other obstacles present at the worksite;

9.8. Electric shock;

9.9. Insufficient lighting at the worksite.

VI. REQUIREMENTS FOR TESTING EQUIPMENT

10. Only testing equipment that is certified, in good technical condition, and compliant with occupational health and safety requirements may be used for testing. Safe-use requirements are specified in the manufacturer's documentation and instructions. The Contractor performing such work shall possess all relevant documents and procedures and comply with the requirements established therein.

11. Pressure hoses, fittings, and other accessories used for testing shall be free from defects, in good technical condition, meet applicable safety requirements, and be inspected prior to the commencement of work. Hoses used for testing shall be equipped with specially designed safety cables, chains, or straps (hose restraints) intended to prevent the consequences of accidental hose disconnection (see Figure 1).

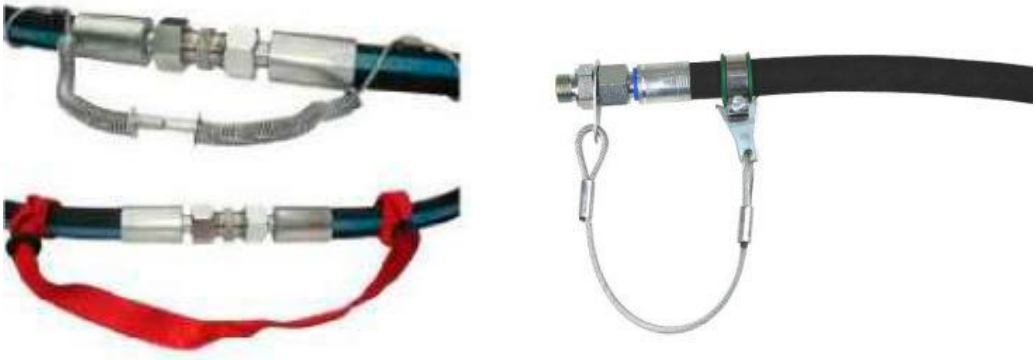

Fig. 1 Examples of host restraint devices.

VII. PRE-TESTING REQUIREMENTS

12. The equipment shall be isolated from existing or potential hazardous energy using energy isolating devices (EID) in accordance with Company OHS Procedure BDS-29 'Equipment Isolation'.

13. The equipment shall be cleaned of any previously contained petroleum products or other chemical substances by washing or steaming with water, or by purging with inert gas.

14. The worksite shall be assessed for potential hazards, including identification of hazardous zone boundaries. All personnel not involved in hydraulic testing shall be removed, and the worksite shall be fenced in accordance with Company OHS Procedure BDS- 20 “Barriers” to restrict entry by unauthorized persons. It is recommended to fence the worksite within a radius of 25 meters, or another distance determined during the work risk analysis and/or calculated by the engineer based on the test pressure. If operational circumstances do not allow maintaining the prescribed distance, additional safety measures (such as screens, shields, etc.) shall be used.

15. Before starting the test, the testing equipment shall be visually inspected (pump operation, safety valve settings, condition of hoses and fittings, validity of pressure gauge calibration) to ensure that the equipment is suitable for the test pressure and free from defects.

16. Before starting the test, all supports specified in the pressure equipment design shall be checked.

17. Water or other non-aggressive liquids at a temperature between +5 °C and +40 °C shall be used for hydraulic testing of equipment, unless otherwise specified by the equipment manufacturer.

18. If the ambient or test liquid temperature is below +5 °C, hydraulic testing may only be carried out if the equipment material has been tested for brittle fracture at temperatures lower than the test temperature. Specially selected liquids that do not freeze at the test temperature and are non-aggressive shall be used for such testing (e.g., 100% ethylene glycol solution). The used test liquid (water or chemical solutions) shall be discharged into a designated industrial sewer system or collected in containers for disposal, in accordance with the Company’s environmental procedures. It is prohibited to discharge test liquids into stormwater drains or onto the ground.

19. The test liquid shall be non-toxic, non-flammable, and shall not crystallize, boil, or solidify under ambient conditions during testing.

VIII. REQUIREMENTS FOR CONDUCTING HYDRAULIC TESTS

20. When filling the equipment with the test liquid, all air shall be completely removed. Air removal shall continue until a continuous, bubble-free stream of liquid flows from all vent points.

21. When filling the equipment with water from a fire hydrant:

21.1. Certified, manufacturer-marked STORZ couplings shall be used for connections (see Figure 2). The marking shall indicate the following information: the applicable standard, the manufacturer’s name or logo, and the nominal size.

Fig. 2. Examples of STORZ couplings.

21.2. Connection points shall be installed no higher than 1 m above ground level or other surface. Nozzles supplying water to the equipment shall be inclined at an angle of 60-70 degrees

from the vertical to ensure even load distribution, mechanical stability, and to minimize the risk of coupling disconnection or deformation.

21.3. The pressure generated by a fire engine shall not exceed 7 bar.

22. After the equipment has been filled with water and all air removed, the test pressure shall be applied using a pump specifically designed for this purpose.

23. During the test, pressure shall be monitored using at least two calibrated pressure gauges of the same type, measuring range, accuracy class, and scale. Where possible, gauges shall be positioned to allow pressure readings at both the lowest and highest points of the equipment. When evaluating the test pressure, the hydrostatic head of the liquid shall be taken into account to ensure that the allowable stress of the equipment is not exceeded at its lowest point.

24. The test pressure shall be increased and/or decreased gradually and uniformly in accordance with the pressure ramp-up/ramp-down recommendations provided by the manufacturer or designer. In the absence of such recommendations, the pressure change rate should not exceed 2–5 bar per minute, while continuously monitoring gauge readings and system condition from a safe distance. A slower pressure change rate shall be applied for large-volume vessels (e.g., reactors, columns) and long pipelines, while a faster rate may be used for small-volume systems. The use of air or any other gases to increase pressure is strictly prohibited.

25. Upon reaching the test pressure, the pump shall be switched off and the pressure maintained for the specified duration. After the hold period, the pressure shall be reduced to the maximum allowable pressure, at which the equipment's leak-tightness shall be checked.

26. If any leakage is detected, further work is prohibited. Leak elimination is permitted only after reducing the pressure to atmospheric; once the leak has been rectified, the test shall be repeated.

27. The following actions are strictly prohibited during hydraulic testing:

27.1. Allowing unauthorized personnel to remain in the hazardous zone while pressure is being increased or maintained at the test pressure.

27.2. Exceeding the specified test pressure;

27.3. Using faulty, uncalibrated, or damaged testing equipment (including pumps, hoses, couplings, or pressure gauges without valid calibration);

27.4. Performing any repair work (e.g., tightening bolts) while the system is pressurized;

27.5. Conducting the test without fully removing air from the system;

27.6. Leaving the equipment under test unattended.

28. Work shall be stopped immediately upon detecting signs of a hazardous situation (such as leakage, equipment deformation, or sudden and unexplained pressure drop or rise), upon activation of an emergency alarm, or upon instruction from the Work Manager or another responsible person.

29. After completing the hydraulic test, the air valve shall be opened first to allow air into the pressure equipment, followed by the opening of the drain valve. The bore of the air valve shall be not smaller than, and preferably larger than, the bore of the drain valve in order to prevent vacuum formation.

IX. REQUIREMENTS FOR CONDUCTING PNEUMATIC TESTS

30. Pneumatic testing shall only be conducted when hydraulic testing is impractical, for example, for vessels designed and/or installed in such a way that filling them with water would be unsafe, or for vessels used in applications where the test liquid cannot be tolerated.

31. Pneumatic testing shall be performed in conjunction with acoustic emission testing.

32. The test pressure shall be increased gradually in multiple stages, such as 10%, 30%, 60%, and 100% of the target pressure. At each stage, the system shall be checked for leaks.

33. If any leakage is detected, further work is prohibited. Leak elimination is permitted only after reducing the pressure to atmospheric; once the leak has been rectified, the test shall be repeated.

X. EMPLOYEE TRAINING

34. Contractor employees participating in testing shall be familiarized with the requirements set forth in this Procedure. The manager of the Company's respective organizational unit shall be responsible for ensuring this familiarization.

35. Contractor employees performing testing shall be familiarized with the operating and maintenance requirements of hydraulic and pneumatic testing equipment. The head of the contracting company shall be responsible for ensuring this familiarization.

XI. FINAL PROVISIONS

36. The Director of Quality, Labour Safety, and Environmental Control shall be responsible for organizing periodic reviews of this Procedure and updating it as required.

Prepared by:
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