The standard is binding for all departments of the company and external organizations which perform pressure leak and strength tests (pneumatic).
The departments are obliged to present the standard to all external organizations performing pneumatic pressure leak and strength tests for them as well as to all organizations the standard is also binding for. Does not apply to the Litvínov and Kralupy Refinery unit.

Table of contents:

1. General provisions

1.1. Scope of validity

1.1.1. The standard is valid for performing pneumatic tests of pressure vessels, tanks, individual components of the pipeline, pipeline sections, valves, machinery equipment components and the whole assembly.

1.1.2. Machinery equipment components are understood as working cylinders of compressors, pressure pump or turbine casings, etc.

1.2. This standard does not apply to testing of new equipment delivered by external suppliers in scope of an investment construction. The standard does not apply to pressure equipment intended for compliance assessment pursuant to the Act No. 22/1997 Coll. and Government regulation No. 26/2003 Coll. prior to launching to the market.

1.3. Strength and tightness of pipeline is tested using the pressure test.

1.4. In case the non-asbestos sealing materials are used, it is necessary to take into account their properties when used under certain operating conditions (operating pressure, temperature and operating medium) , see N 13 020-1, N 13 021-1, N 13 026.

1.5. Terms, definitions and abbreviations

Operator – UNIPETROL RPA, s.r.o. represented by its Executive in compliance with the articles of the company. The executive is authorized to ensure the obligation to duly manage all means entrusted by the employer and to guard and protect assets against any damage, loss, destruction or misuse, no tot act contrary to legitimate interest of the employer and to ensure adoption of timely and effective measures to protect its assets. In order to adhere to related obligations, he/she determines the user and maintainer through controlling, organizational and technical standards.

User – Head of organization unit (e.g. Director of the section, plant, or head of department, production unit or subsection) to whom the asset was entrusted for use by the operator. The user is responsible for adherence to conditions for safe and reliable operation in compliance with instructions and regulations intended for its use, operation and service.

Maintainer – head of the maintenance department, LDS system, site administrator department or otherwise authorized employee, who is responsible for technical status of determined individual tangible asset groups including maintenance, repairs, revisions/inspections and tests.

Contractor – authorized legal or physical entity owning authorization for certain activities (e.g. assembly or repairs of equipment)

OTD TS – technical supervision department, technical service section

OKJ (OTK) – quality inspection department, works technical staff

TIČR – Technical Inspection of the Czech Republic

TNS – Stable pressure vessels

OOPP – personal protective equipment, protective equipment that must protect the employees from hazards, must not endanger the health and prevent from execution of works.

Pressure test – pressure leak test, or leak test is a test, where the foaming solution or detector proves tightness of one stable pressure vessel, or one pipeline or whole pressure groups (loops) under operational pressure.

2. Principles for performing the tests

2.1 In case inert gases are used (or other testing working medium) it is necessary to adhere to all safety and relevant regulations. Physical properties of the compressed gas (owing to higher amount of accumulated energy against the liquid) create high risk of potential consequences. In case of unsuccessful result of the test (pipeline deformation) for the tested and adjacent equipment and for the employees participating in the strength test at the same time. This is why the technological procedure of the test must contain safety precautions aiming at elimination of impact on health and life of employees and loss to property.

2.2 Working procedure = technological procedure of the test, in case of gas equipment tests, the inspection technician is obliged to prepare the working procedure (technological procedure). What concerns stable pressure vessels, the procedure is prepared by the organization providing the tests in cooperation with the user, maintainer and inspection technician.

2.3 Persons, who manage the works during tests, have to be older than 21 years, and have at least three-year practice in the given field.

2.4 Workers, who perform technical supervision and expert inspection of the tested equipment or component during the tests and assess the results of the testing, have to have a respective qualification for the type of pressure vessels – relevant authorization pursuant to Decree No. 18/1979 Coll. § 7, par. 1 for stable pressure vessels and pursuant to Decree No. 21/1979 Coll., § 4 for reserved gas equipment, have to have respective qualification pursuant to § 11 of the Decree No. 85/1978 Coll. (inspection technician), what concerns other equipment pursuant to respective regulations.

2.5 Scope of competences and responsibilities during the tests is determined in table No. 1.

3. Conditions for performing the pressure tests

3.1. Pneumatic pressure may be used to perform pressure leak and strength tests.

3.2. Pneumatic pressure leak tests are usually performed as additional ones after previous hydraulic pressure strength tests.

3.3. Without previous hydraulic pressure strength tests, the pneumatic pressure leak test may be performed in the following cases:

3.3.1 Vessels with operating overpressure up to 0,07 MPa, where the hydraulic test may not be performed because of jeopardising the construction with load (weight) of the testing liquid, in case securing of the construction is not possible.

3.3.2 Non-pressure vessels (tanks, etc.)

3.3.3 Pipeline for steam or gaseous medium provided that it was made of rated material and branch welds were executed, designated and tests pursuant to respective standards, e.g. N 15 010.

3.3.4 Used high pressure valves after previous inspection and measuring the valve body.

3.3.5 In cases determined by the maintainer.

3.4. Pressure leak tests are divided to short-term or long-term ones with determination of loss by calculation.

3.4.1 Short-term pressure leak tests are performed on equipment with easily accessible surface.

3.4.2. Long-term pressure leak tests are performed on equipment of large dimensions, i.e. large vessels and long pipeline of bridges.

3.5 Pressure vessels may be put to a pneumatic pressure leak test only if the vessels has a prescribed documentation and had already been put to a construction and first pressure strength test before and if execution of hydraulic pressure strength test is not possible or is connected with serious technical obstacles.

3.6 Pneumatic pressure strength tests may be performed only on pipeline in the following cases:

3.6.1. In case calculation of structure did not count with filling the pipe with water.

3.6.2. Ambient air temperature below 0ºC
3.6.3 In case the hydraulic test may not be performed (e.g. test liquid is not available)
3.6.4 In case the gaseous medium may not come into contact with water.
3.6.5. In case the operating overpressure is not higher than 2,5 MPa.
3.6.6 In case the arithmetic product of volume capacity of tested part of pipeline expressed in litres and testing overpressure in MPa is not higher than 10 000.
3.7 Prior to performing pneumatic pressure strength tests of the pipeline, the following conditions have to be met:
3.7.1. Pipeline material is of certified quality and documented by metallurgical certificates of material quality and inspection record concerning occurance of surface defects.
3.7.2 Certificate of executed hydraulic pressure strength test of all used pipeline segments is provided.
3.7.3. Branch welds were executed, designated and tests pursuant to respective standards, e.g. N 15 010.
3.7.4. Visual inspection of the tested part was performed.

4. Principles for work during pressure tests

4.1 Pressure tests should be performed using the inert gas or air. In places where these gases are not distributed or in places where their usage would be connected with troubles, the operating medium may be used for the pressure leak test upon agreement with the employee carrying out the technical supervision.
4.2 Hot water pipeline is tested using the heat transferring agent in parameters it was designed for.
4.3 It is prohibited to use oxygen for pressure leak tests.
4.4. Unauthorized persons must be prevented from entering the testing area during pressure leak tests.
4.4.1. The person in charge of the test demarcates the test area as per the test overpressure mentioned above and local situation during the pressure leak tests.
4.4.2 What concerns pressure strength tests, the test area is demarcated by the borders of the protective zone determined by the person in charge of the test as per the test overpressure mentioned above and local situation. Special guards are established behind the protective zone. Number of guards around external pipeline is determined so that there was one guard per each 200 meters. In other cases, the number of guards is determined so that the zone protection was reliably ensured. When performing the tests through evening or night, the protective zone must be properly lit.

4.5. It is prohibited to transport any load (manual, using any vehicles, cranes or hoist) at the test area during the pressure strength testing. All cranes interfering above the test work place must be secured during the testing to prevent any move over the test work place.

4.6. Appropriate scaffolding must be erected around the tested equipment for safe inspection of the tested equipment of larger dimensions or located at height, the work place must be maintained in good order to ensure safe access to the tested equipment and enable its proper inspection.

4.7. Special attention must be paid to the equipment with fitted glass parts (e.g. gauge glass, glass inspection hole, etc.) both during air vent and the inspection after pressurizing.

4.8. In case the equipment is fitted with apparatuses that are not dimensioned for test overpressure, these have to be gasproof disconnected prior to the test.

4.9. It is not recommended to perform pressure test on open spaces during rain and short-term pressure leak tests and pressure strength tests during night.

5. Scope of external inspection

5.1 The scope of external inspection when performing the strength and leak tests of the pipeline is determined by the maintainer. When assessing the scope of external inspection, it is necessary to consider the working agent, working pressure and temperature, total technical status of the pipeline and possibility of external corrosion influence under the insulation and attenuation of the wall thickness. Scope of insulation removal during pressure strength and leak test is determined by the inspection technician so that he could assess successful performance of the test.

5.2. In case there are unplanned deviations from the technological mode during operation, that could influence status and life time of the equipment, the user is obliged to notify the maintainer (contractor) immediately in writing. Furthermore he is obliged to advise of any extraordinary circumstances that could influence the external corrosion and that were ascertained in the course of operation during equipment supervision.

5.3. It is necessary to take into account, that pressure strength test, or the pressure leak test proves reliability and safety of the pipeline for next working cycle. When determining scope of external inspection, it is necessary to focus on all flange joints including connecting branches on de-insulated pipeline, welds, expansion bends, inbuilt valves and height break of the pipeline.

5.4. In case of pipeline repair, when the pipeline is welded, the pressure strength and leak tests are performed on such a pipeline accompanied by external inspection of the repaired section before paint works (insulating).

5.5 What concerns high capacity units, it is necessary to opt for a different procedure than what concerns individual aggregate units and to proceed in such a way to enable not complete de-insulation of the whole section of pipeline with respect to accumulation of works during turn around/shut down during the respective pressure and leak tests of the pipeline carried out in prescribed cycles. These cases mainly use experience gained in operation and maintenance of the pipeline, furthermore taking into account working parameters, type of media and results of diagnostic methods.

5.6 In the period of one cycle of the pressure test, it is necessary to disassemble insulation gradually section by section (technically selected) to revise influence of the environment on external surface of the pipeline, while it is necessary to consider the working parameters as well as to influence of environment and gained experience with operation and maintenance. If need be, the paint under insulation is renewed.

5.7 It is recommended to remove insulation of vessels and pipeline for minus temperature only during extensive works as overhauls, reconstructions or during repairs of the insulation itself. At the same time, it is necessary to execute waterproof removable insulation under the insulation on several places of the same equipment to check influence of external corrosion.
5.8 In case the results of inspection of un-insulated parts of the pipeline is without any defects, however the inspection manometer shows decrease, it is necessary to consider the test as unsatisfactory and to repeat the test again.

6. Work procedure for short-term pressure leak tests

6.1 Blinding
Prior to the test, the pressurized part is divided from other equipment and from external atmosphere by sufficiently designed blinds (pursuant to N 13 719)
6.2 Pressurizing
6.2.1 Pressurizing is executed by:
6.2.1.1 operating medium, inert gas or air after previous hydraulic strength test.
6.2.1.2 inert gas or air without previous hydraulic strength test.
6.2.2 Increase in pressure must be steady and not sudden. It must not exceed 0,5 MPa per minute.
6.2.3 When using gas from the source with higher overpressure than acceptable for the pressurized space, the pressurizing must be done through a pressure control valve set for test overpressure increase by 5%.
6.2.4 Downstream the pressure control valve (on the part of lower pressure) a pressure relief valve has to be installed and set for test overpressure increase by max. 5%. Dimension of its cross-section must be such to be able to relieve all incoming gas.
6.2.5 In order to check the pressure, the testing equipment must be fitted with operating manometer fitted with such a valve that could be parallel connected with a testing manometer for check of the operating manometer.
6.3 Inspection
After pressurizing to a test overpressure the tested equipment is thoroughly inspected for tightness, mainly in joints, and potential deformations. Tightness of equipment is checked by covering the joints with foaming solutions, submerging to a liquid, leakage finder, etc.
6.4 Leakage removal ascertained during the inspection. In case of a leakage, it is necessary to relieve the pressure and to remove the leakage professionally. Their folding is forbidden. After removal of the leakage the test has to be repeated.
6.5 Depressurizing
Pressure in the tested equipment is decreased in such a way the pressure decrease velocity was the same as pressure increase when filling.

7. Work procedure for long-term pressure leak tests

7.1 Blinding
Prior to the test, the pressurized part is divided from other equipment and from external atmosphere by sufficiently designed blinds (pursuant to N 13 719)
7.2 Pressurizing
By inert gas or air without previous hydraulic strength test

7.2.1. Increase in pressure must be steady and not sudden. It must not exceed 0,5 MPa per minute
7.2.2 When using gas from the source with higher overpressure than acceptable for the pressurized space, the pressurizing must be done through a pressure control valve set for test overpressure increase by 5%.
7.2.3 Downstream the pressure control valve (on the part of lower pressure) a pressure relief valve has to be installed and set for test overpressure increase by max. 5%. Dimension of its cross-section must be such to be able to relieve all incoming gas
7.2.4. During long-term leak test, the overpressure in tested equipment is measured by a registered manometer for the whole period of testing.
7.3 <u>Measuring of loss</u>
7.3.1 All measurements are to be executed in summer period in time without intensive sunshine to exclude influence of one-sided temperature rise.
7.3.2 <u>The test measures:</u>
7.3.2.1 Overpressure in tested equipment at the beginning and end of the tests.
7.3.2.2 Temperature of external atmosphere at the beginning and end of the test.
7.3.2.3 Barometric pressure at the beginning and end of the test.
7.3.3 Loss in % is calculated from the formula:

$$p = \left(1 - \frac{p_2 \,.\, T_1}{p_1 \,.\, T_2}\right) .\ 100\ (\ \%\ )$$

where p – pressure drop in pipeline in % of the testing overpressure
p1 – sum of manometric and barometric pressure at the beginning of the test
p2 - sum of manometric and barometric pressure at the end of the test
T1 – absolute temperature in K of air or inert gas in pipeline at the beginning of the test
T2 - absolute temperature in K of air or inert gas in pipeline at the end of the test

7.3.4 Time period between beginning and end of the measurement is usually 24 hours. In case the test is performed for a period shorter than 24 hours, it is necessary to recalculated ascertained losses for the period of 24 hours.
7.3.5 Acceptable pressure loss for 24 hours may amount to max 5% of the original overpressure. What concerns toxic gases, only one half of the given value is allowed. What concerns pipeline with rated diameter exceeding 250 mm, the allowed values of acceptable drop are multiplied by a correction factor determined by the formula:

$$K = \frac{250}{D}$$

where D is inner diameter of the tested pipeline expressed in mm

7.3.5.1 Toxic gases are understood as gases determined by N 13 700 in numeric codex of working substances and marked by “N”.

7.4 <u>Inspection</u>

In case of larger losses, leaking places are checked by covering the surface with foaming solutions (mainly welding and other joints)
7.5 Leakage removal ascertained during the inspection. In case of a leakage, it is necessary to relieve the pressure and to remove the leakage professionally. Their folding is forbidden. After removal of the leakage the test has to be repeated.
7.6 Depressurizing
Pressure in the tested equipment is decreased in such a way the pressure decrease velocity was the same as pressure increase when filling.

8. Work procedure for pressure strength tests

8.1 Blinding
8.1.1 When performing tests, the assembled valve on the tested segment have to be fully open, packing sealed, bellmouths, bosses for testing and control apparatuses and other open holes have to be reliably blinded by blinds (N13 719)
8.1.2. Places with blinds, covers etc. have to be fitted with warning signs during the tests and no people are permitted in their vicinity.
8.2 Pressurizing
8.2.1 Pressure strength test has to be performed using air or inert gas.
8.2.2 Required testing overpressure is acquired by a compressor or other source of pressure through two checking valves. Strength of pipeline providing the compressed air for the tested pipeline has to be tested hydraulically. After reaching the testing pressure, the pipeline is disconnected from the compressor. The compressor must be located outside the protective zone established pursuant to art. 4.4.2.
8.2.3 Increase in pressure must be steady and not sudden. It must not exceed 0,5 MPa per minute. The pressure is increased step by step to reach the testing pressure that is maintained for 5 minutes, what concerns pipeline for toxic and flammable gases it is for ten minutes. ("toxic gases" term is defined in art. 7.3.5.1.)
8.2.4 Afterwards the pressure is decreased to the operating pressure.
8.2.5 The tested pipeline must be fitted with at pressure relief valve size of which corresponds with performance of the used compressor. The pressure relief valve is set for a value by 5% higher than the testing overpressure.
8.2.6 In the period when the tested pipeline is under pressure, there has to be established protective zone around the tested pipeline both inside the room and outside, pursuant to art. 4.4.2.
8.2.7 In the period when the pressure is increased and the testing overpressure is reached, no persons are allowed in the protective zone. In the period, when the pressurizing is interrupted, only employees authorized to inspect the pipeline are allowed to enter.
8.2.8 A manometer is connected to the pipeline to measure the pressure, data of which may be compared with concurrently connected control manometer. Both manometers are located outside the protective zone.

8.3 Inspection
8.3.1 Inspection of the pipeline is performed after each interruption of pressurizing pursuant to art. 8.2.3. If the pressure of pipeline is higher than the operating pressure, no persons are

allowed in the protective zone. The inspection continues only after decrease in testing pressure to the operating pressure pursuant to art. 8.2.4.
8.3.2 During the inspection tested welded and other joints are covered with a foaming solution. Hammer taps are not executed.
8.3.3 Results of inspections and thus tests are considered as satisfactory if the pressure on manometers did not drop during the tests and in case no air leaks through welded joints of pipeline, valve bodies, flange joints, adapting pieces, etc.
8.4 Leakage removal
8.4.1. It is necessary to remove ascertained leakages after releasing the pressure.
8.4.2 Their folding is forbidden. If there are leakages in welds, the defect places must be cut off from the weld root and expertly repaired. The same repair has to be carried out for potential pores and cracks of the material.
8.4.3 After removal of leakages, the test has to be repeated.

8.5. Depressurizing
8.5.1 Decrease in pressure when discharging the testing medium must by steady and not sudden. It must not exceed the velocity of pressure increase during pressurizing.

8.6 It is advisable to connect successfully performed pressure test with follow-up long-time pressure leak test with loss calculation.

9. Protective equipment and work aids

9.1 Personal protective equipment
All employees participating in the test must use the personal protective equipment in compliance with the standard and extra personal protective equipment in accordance with risk assessment in UNIPETROL RPS, s.r.o.
9.2 Work aids
During pneumatic pressure test the following aids are used:

- Compressor or other source of pressure
- 2 manometers, one of them as checking manometer with denominated degree of accuracy
- Pulse pipeline for manometers
- Blinds
- Brushes
- Foaming solution
- Mirror
- Inspection el. lamp, or portable el. lamp 24 V
- Pressure control valve (in case the testing medium is taken from a source having higher pressure than the testing one)
- Pressure relief valve

Tab. 1

Type of equipment	Pressure test	Person in charge of the test	Technical supervision, inspection, evaluation	Czech Standards
Stable pressure vessels	Leak test	Authorized representative of contractor or user	Authorized inspection technician OTD TS	ČSN 69 0010-7-1 ČSN 69 0012 ČSN EN 13 445-5
Non- pressure vessels (tanks, etc.)	Leak test	Authorized representative of contractor or user	Worker of OKJ (OTK) if not systemized then representative of contractor	ČSN 69 0015
Pipeline	Strength test	Authorized representative of contractor *	Worker of OKJ (OTK) if not systemized then representative of contractor*	ČSN EN 13480-5 (13 0020) ČSN EN 1594 (38 6410) ČSN 38 6461 ČSN 38 6462 ČSN EN 12 007-1 (38 6413)
	Leak test	Authorized representative of contractor and user		
Valves	Leak test	Authorized representative of contractor (e.g. foreman of valve shops or valve tester with min 3 year practice), or user	Worker of OKJ (OTK) if not systemized then the shift leader, pressure relief valves it is worker of OKJ (OTK) with respective qualification (TIČR certificate)	ČSN 13 3060 part 2
Machinery equipment components	Leak test	Authorized representative of contractor or user	Worker of OKJ (OTK) if not systemized then authorized representative of contractor	ČSN EN 378-2 +A1 (14 0647)
Pipeline and assembled equipment after repair	Leak test	Authorized representative of contractor or user	Worker of OKJ (OTK) if not systemized then authorized representative of	ČSN EN 378-2 +A1 (14 0647)

			contractor or user*	
Assembled equipment of production units	Leak test	Authorized representative of operation, contractor or user	Worker of OKJ (OTK)*	Performed in accordance with respective operating regulations

- * in case it is gas pipeline pursuant to Decree No. 21/1979 Coll., the worker of OKJ (OTK) with respective qualification (TIČR certificate) or the worker of a technical supervision department, (OTS TS) of UNIPETROL RPA s.r.o.

10. List of quoted and related standards and documents
Quoted

ČSN EN 13 445-5 Unfired pressure vessels - part 5: Inspection and testing
ČSN EN 13480-5 (13 0020) Metal industrial pipeline – part 5: Inspection and testing
ČSN 13 3060-2 Valves. Industrial valves. Technical regulations. Valve inspection
ČSN EN 378-2 +A1 (14 0647) Cooling equipment and heat pumps – Safety and environmental requirements - part 2: Construction, manufacture, testing, denomination and documentation
ČSN EN 1594 (38 6410) Gas supply – Gas pipeline with the highest operating pressure exceeding 16 bar – Functional requirements
ČSN EN 12 007-1 through 4 (38 6413 Gas supply – Gas pipeline with the highest operating pressure not exceeding 16 bar incl. – part 1: general functional requirements
ČSN EN 15001-1 Gas supply – Gas pipeline with operating pressure higher than 0,5 bar for industrial use and gas pipeline with operating pressure higher than 5 bar for industrial and non-industrial use - part 1: Detailed functional requirements for designing, material, construction, inspection and testing
ČSN 38 6461 Oxygen pipeline
ČSN 38 6462 Gas supply – LPG – pressure station, distribution and use
ČSN 690010-7-1 Stable pressure vessels. Technical rules. Testing and documentation. part 7-1 – Construction and first pressure test
ČSN 69 0012 Stable pressure vessels. Operating requirements
ČSN 69 0015 Vessels of stable category 5. Technical rules
N 13 719 Blinds for pipeline
N 15 010 Acceptable classification degrees of welds and scope of weld inspection using radiography and ultrasonic methods
N 13 020-1 Repair and maintenance of industrial valves (fitted with appropriate gasket)
N 13 021-1 Repair and maintenance of industrial valves for oxygen (fitted with appropriate gasket)
N 13 026 Flat soft and combined gaskets for flange joints of pipeline and apparatuses
N 13 700 Pipeline denomination as per internal agents
Decree No. 21/1979 Coll. Czech inspectorate of occupational safety and Czech Mining Administration defining reserved gas equipment and determining conditions to ensure its safety.
Act No. 22/1997 Coll. on technical requirements for products and amendment of some acts
Governmental decree No. 26/2003 Coll. determining technical requirements for pressure equipment
Decree No. 18/1979 Coll. of the Czech Inspectorate of occupational safety and Czech Mining Administration defining reserved gas equipment and determining conditions to ensure its safety

Decree No. 85/1978 Coll. of the Czech Inspectorate of occupational safety on inspections, revisions and testing of gas equipment

Related

N 11 004 Operating rules for gas equipment
N 11 005 Operating rules for gas equipment
Directive S 520: Long-term and low-value assets. Register, administration and deletion
ČSN EN 378-1+A1 (14 0647) Cooling equipment and heat pumps – Safety and environmental requirements - part 1: Basic requirements, definitions, classification and criteria for selection
ČSN EN 1775 (38 6441) Gas supply – Gas pipeline inside buildings – the highest operating pressure of 5 bar – operating requirements
ČSN EN 12327 (38 6414) Gas supply– pressure tests, procedures for commissioning and shut down – Functional requirements
TPG 706 01 Oxygen pipeline– technical rules
TPG 706 02 Nitrogen pipeline – technical rules