PNEUMATIC TESTS

COVER PAGE

Rev	Date	Prepared by	Approved by	Revision
A	Sep-02	I. Losada / S. Rousse	S. Rousse	Initial issue (replaces 395.10.GS and includes European Directive Requirements)
B	27-Nov-02	S. Rousse	G. Nollet	Comments added.
C	13-Oct-03	S. Rousse	S. Rousse	Modifications §:2.7.2.2, 2.7.2.3, 3
D	27-Nov-09	L. Lienard	G. Villet	Add §2.8 Compressor type

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1 INTRODUCTION

1.1 Scope

1.1.1 Purpose

This standard defines the procedures, rules, standards and quality of workmanship applicable to the execution of pneumatic strength tests and pneumatic leak tests.

1.1.2 Scope of Application

This standard applies to the work of prefabrication, manufacture, assembly in the workshop and installation in situ of industrial piping networks.

This standard defines the procedures, rules, standards and quality of workmanship applicable to the execution of pneumatic strength tests and pneumatic leak tests.

Standard E-GS-9-5-1, Prefabrication and Erection of Pipes, defines the rules applicable to the manufacture of industrial pipes and indicates when the pneumatic tests are carried out.

The realization of the pressure tests is compulsory at the end of the piping works. The tests are considered under any circumstances as acceptance of work. The tests are used to check and validate with respect to applicable codes the quality of the work carried out.

The tests are carried out either during manufacture in workshop or during erection in situ.

It is strictly forbidden to modify in any way an item of equipment or a pipe after test (welding, grinding, cutting, repair, heat treatment, etc.). Any modification will cancel ***de facto*** the tests carried out previously. New tests must be carried out after all modifications.

The rules of this standard can be amended, partially complemented by the imperatives of the construction code or particular project specifications.

1.2 Definitions

Subcontractor	Contractor responsible for the manufacturing, prefabrication and/or construction of industrial pipes
TPAI	Third party authorized inspection
PID	Piping and instrument diagram
PS	Maximum Allowable pressure (see DEP reference) (old: design pressure)

1.3 Codes, Standards, Regulations and AL Reference Documents

1.3.1 Codes, Standards, Regulations

1.3.1.1 European Union

In the following order of precedence: European Directives, European Standards, Local Regulations, Recognized National Construction Codes, EN 13480, ASME Code B 31.3 and ASME Code B 31.1.

1.3.1.2 Out of European Union

In the following order of precedence: Local Regulations, Recognized National Construction Codes, ASME Code B 31.3 and ASME Code B 31.1.

1.3.2 AL Reference Documents

1.3.2.1 AL standards

E-GS-9-5-1	Prefabrication and Assembly of Pipes. *Old 395.02.SG*
E-GS-3-0-4	General welding requirements for pressure equipments manufacturing
E-GS-9-5-3	Non-Welded Assembly. *Old 395.02.SG*
E-GS-9-5-4	Non Destructive Tests of welds for piping. *Old 395.03.SG and 395.04.SG*
E-GS-9-5-6	Hydraulic Tests. *Old 395.13.SG*
GD-SR-ASU-007	Carbon pollution of compressed air
GD-SR-COM-004	Piping isolation systems

1.3.2.2 AL inspection forms to use (as a minimum)

Inspection form of standard E-GS-9-5-1 to be completed.

E-FRM-9-0-19	Notification of work on site
E-FRM-9-5-3	Hydraulic Test
E-FRM-9-5-4	Pneumatic test
E-FRM-9-5-8	Piping Works Test Pack

1.4 Contradictions, Omissions, Deviations

Order of precedence as follows:

1. Agreements made and approved by the different parties, reported in minutes of progress meetings after the order has been sent in,
2. Order and appended correspondence,
3. Agreements made and approved by the different parties, reported in minutes of invitation to tender clarification meetings (appended to order),
4. Project-specific technical annexes or waivers,
5. This standard and appended inspection sheets.

In the event of contradiction in the application of the different codes, standards, regulations or AL standards, the toughest imposition applies.

1.5 Subcontractor's liability

The subcontractor is reputed to be qualified and possess the expertise and resources to perform this type of work as defined in the invitation to tender. Subcontractor must have monitoring capabilities to enable him to check achievement of required quality.

In no circumstances shall AL liability preclude the subcontractor from full liability for all services provided by him, whether or not the pipes are subject to local regulations. Before submitting his bid, the subcontractor must inform AL representative in writing of any contradictions, deviations from or omissions compared to the stipulations of the above-mentioned documents, before starting any manufacture, assembly or installation between this specification and the applicable local regulations.

2 TESTS PREPARATION

2.1 Test philosophy

The test philosophy is determined in the pre-inspection meeting, before commencing any prefabrication / erection work. Test philosophy is validated by the subcontractor, the AL representative and the TPAI and if necessary by the local authority representative.

During the pre-inspection meeting, it will determined whether tests shall be

- Pneumatic or hydraulic (according to E-GS-9-5-1; hydraulic tests are performed according to E-GS-9-5-6),
- Static or dynamic.

2.1.1 Static test definition

A static test is a test for which, once the test pressure is reached, the pressure supply is stopped and the pressurization manifold is disconnected. To be efficient such test shall be performed with the test network being isolated with blinds only (isolation with valves is not recommended: valves leak).

Validation of static tests can be done

- By monitoring the pressure loss during a holding period (pressure loss and holding period being related to the test pressure and the test network volume),
- By applying soapy water on the elements of the network to be tested.

Pressure loss monitoring is considered by AL as a complementary method and as a recording method only. **A test is considered as acceptable by AL if and only if the test network has been fully inspected by application of soapy water according to the following section.**

Static test is efficient for small networks (for big networks, the pressure loss due to a leak through the holding period might not be significant if the test network volume is important).

Static tests involve heavy network preparation.

2.1.2 Dynamic test definition

A dynamic test is a test for which the pressure supply is maintained and regulated (manually or automatically) through the complete test duration. A dynamic test can be done with the test network being isolated with valves, the valves leak being compensated.

Validation of dynamic tests

- Can not be done by pressure loss monitoring,
- Can be done by soapy water application only.

Dynamic tests allow to save time and resources, existing valves being used instead of blinds to isolate the test network. Dynamic tests are recommended for big networks for which the pressure loss monitoring is not significant.

Dynamic tests might be refused by the TPIA or the local official authorities.

2.2 General Remarks

The prefabrication and erection welds are not painted 2 cm either side of each weld. The subcontractor is responsible for painting these areas on completion of the pneumatic tests.

2.3 Test Network definition

The unit on which the construction/installation works are performed is composed of several piping networks operating at different pressures and having been calculated for different PS.

A Test network is a group of piping lines **and equipment** operating at the same pressure and interconnected together (i.e. there can be two test networks operating at the same pressure if there is no continuity). Are included in the tests network and shall be tested within the test network all vessels, spools, skids and elements connected to the network and operating at the same pressure, even if those not fabricated, supplied or installed by the subcontractor (I.E., skids, packages….).

Machines (pumps, compressors, turbines….) are not included in the test networks and shall not be pressurized during the tests.

Tests PID are PID on which the tests networks have been highlighted. Tests PID are the basic document for the tests works.

Test network PS: the tests network PS is equal to the lowest PS of all the elements of the test network. The subcontractor shall check that all elements of the test network are designed for the test network PS.

2.4 Test Packages

The test package is the file gathering the documentation concerning a test network. The test package is used to validate that the test network is ready for test.

Prior to any test and from the test PID, the subcontractor shall prepare the test package and submit it to the AL representative in charge of the test.

The test package shall at least include:

- The test PID indicating the position of the blinds, the valves to be locked open or closed, the pressurization and depressurization points,

- Isometrical drawings concerning all the lines of the test network, updated with the welds positions and n°, the welders number etc…(weld maps),
- The welding books concerning all the lines of the test network: traceability of material certificates of pipes and fittings, traceability of welding operations (WPS & PQR n°, welder n°, consumable lot n°, NDT performed, welds repairs performed, heat treatment certificates…),
- The supports books concerning the test network,
- The traceability records of the operations performed on the test networks: internal treatment (oxygen service degreasing, passivation: E-FRM-9-5-8), prefabrication records (E-FRM-9-5-8), installation records E-FRM-9-5-8 or E-FRM-9-5-4),
- The calibration certificates of the safety valves and of the pressure gauges used for the tests,
- The safety procedure implemented for the concerned test : plot plan with the safety area and Admittance restriction for test in progress, notification for tests (E-FRM-9-0-19), list of the personnel participating to the tests,
- Tests certificates already prepared (E-FRM-9-5-4).

2.5 Inspection by Third Party

Pneumatic tests shall often obey by strict local regulations. Unless otherwise indicated in the project specifications, it is the subcontractor's responsibility to organize the pneumatic tests according to local regulations and to get authorizations from local authorities to perform the pneumatic tests.

Unless otherwise indicated in the project specifications, the costs relating to interventions of local the authorities or of the TPIA delegated by the local authorities and the administrative costs are supported by the subcontractor.

For the European Union, the organizations of the intervention of the TPIA according to the European directive are discussed during the pre-inspection meeting.

2.6 Safety Precautions

The subcontractor is in charge of pneumatic tests organization from a safety point of view.

The Subcontractor shall submit to the AL representative a safety procedure for the tests realization including at least:

- The safety rules applicable for the project and according to the local regulations,
- The restricted area definitions,
- The protections installed around the pressurization manifold (sand bags…),
- The name of the person in charge of the tests organization,
- The management of interference with nearby on-going works.

In all cases, access to the areas where tests are carried out is prohibited to unauthorized personnel.

AL is entitled to demand the subcontractor to perform the tests outside normal working hours, at no extra charge.

One day before the beginning of any test, the subcontractor shall prepare the "NOTIFICATION FOR TEST" (E-FRM-9-0-19) and submit it to the AL representative. The notification must include a least:

- The test area on the plot plan,

- the date and time of the tests,
- Names of personnel participating to the tests.

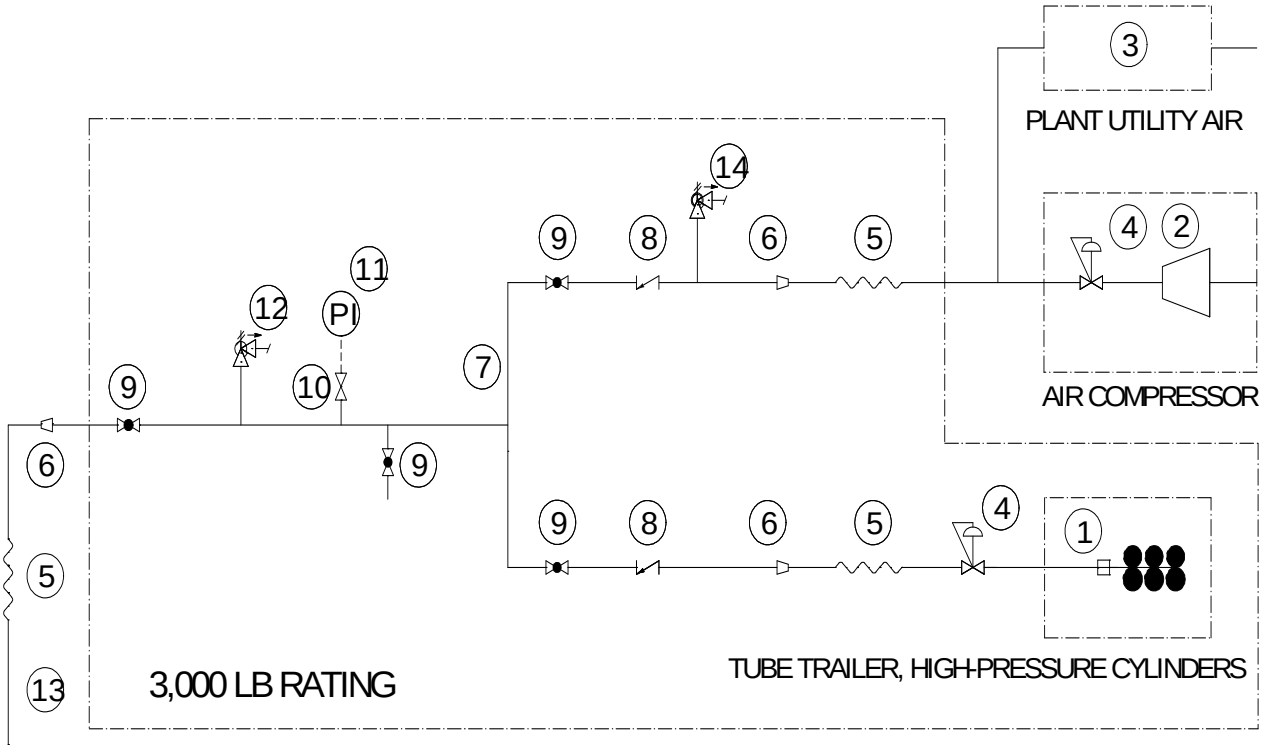
The AL representative shall sign the notification and authorize the test beginning only if the notification as been signed and accepted by the site managers of all the companies working on site (other contractors, client…).

2.7 Tools and Equipment for Tests

2.7.1 Pressurization Manifold

The subcontractor shall provide a pressurization manifold mounted on a rigid frame according to the following sketch, figure 1.

Figure 1



SYSTEM TO TEST:

1. Cylinders, racks or assembly on truck,
2. Site air compressor or temporary air compressor,
3. Air utility from nearby existing plant,
4. HP regulator (Pressure and rate),
5. Flexible hose DN 25 class 3000,
6. Reduction,
7. Pipe DN 25 class 3000,
8. Non return valve class 3000,
9. Ball valve Class 3000,
10. Instrumentation valve class 3000,
11. Pressure gauge suitable for the pressure of the test to be carried out.

    The scale of the pressure gauges will be suitable for the pressure of the test considered. These pressure gauges can only be used between 50 % and 75 % of their range, with a sensitivity of 1 % of the measurement range. If there is a difference in the readings on the pressure gauges ≥ 5 %, they must be replaced. The subcontractor will supply the inspection instruments with the calibration certificate.
12. Safety valve suitable for the pressure of the test to be carried out.

    Safety valves are supplied by the subcontractor. Calibration of the safety valves shall be equal to 1.3 x PS of the concerned network. The Safety valves are checked before each test. The minimum admissible flow of the safety valves shall be equal to the maximum possible pressurization flow.
13. Connection between manifold and system to be tested.
14. Safety valve suitable for the pressure of the test to be carried out.

Whenever possible, according to work progress and after approval by AL, the unit's DCS might be used for some tests to control the valves, and to measure and record the test in progress.

The equipment used to make the pressurization manifold must never be taken from the unit's equipment.

The class of the elements on this frame must correspond to the highest class of the equipment to be tested. The cleanliness of all equipment will be oxygen quality, degreased and passivated before use.

Welded socket type unions and valves will be used.

The pressurization manifold assembly is tested to 1.5 times the maximum test pressure encountered in the plant.

In case of important and/or complex test networks, pressure gauges shall be added to the test network dead ends and/or extremities to check the complete and homogeneous pressurization.

2.7.2 Blinds

2.7.2.1 Blinds: definitions

There are four types of blind:

- "Pan blinds" : carbon steel discs with a "pan handle", installed between two existing flanges,
- Carbon steel blind flanges with a rating corresponding to the test network class,
- Carbon or stainless steel caps (flat or dished end), welded to the extremities of the pipe, preferably on a horizontal spool. For this type of assembly, the subcontractor must provide a extra-length of 50 mm of pipe, at the position of each cap to eliminate the weld heat affected area,
- Screwed plugs (male or female) with a rating corresponding to the test network class.

The blinds, the temporary gaskets and the bolting required for the tests are supplied by the subcontractor and must withstand at least the test pressures.

Blinds are identified by an order number cold stamped on a visible part of the blind and copied on the test diagrams. Blinds are visible, painted in red or yellow. Each blind is presented to the AL representative before installation.

Carbon steel blinds are perfectly clean (no loose scale or rust dust) and degreased.

Parts assembled with flanges are equipped with new gaskets (supplied by the subcontractor).

The dimensions (thickness, diameter) of the blinds are calculated by the subcontractor and submitted to AL for approval.

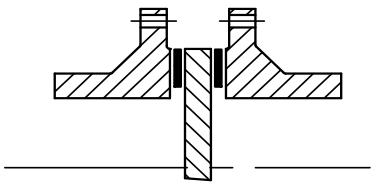
2.7.2.2 Pan blinds thickness calculation

Unless otherwise indicated in the codes, regulations or specifications related to the on going project, the subcontractor shall apply the ASME B31.3 formula:

$$\text{Minimum Thickness} = d\sqrt{\frac{3P}{16SE}} + C \qquad (1)$$

Where:

- d= Inside diameter of the gasket for raised face or flat flanges, pitch diameter for ring joints or fully retained gaskets (mm)
- E= 1
- P= Design pressure in bar
- S= 1379 for carbon steels of type (A 515 Gr 60 - A 516 Gr 60 6 – A 42CP – P265Gh)
- S= 1150 for stainless steel steels (304, 304L, 309, 309L, etc.)
- For the other material grades the subcontractor will propose a new value of: S



- C= 0

2.7.2.3 Flat welded caps thickness calculation

Unless otherwise indicated in the codes, regulations or specifications related to the on going project, the subcontractor shall apply the ASME B31.3 formula:

For authorized assembly, the subcontractor will refer to the applicable code.

$$\text{Minimum Thickness} = d\sqrt{\frac{CP}{SE}} \qquad (2)$$

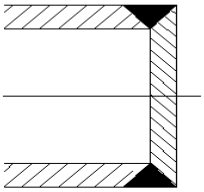
Where:

- d= Inner diameter of the pipe in millimeters
- E= 1
- P= Design pressure in bar
- S= 1379 for carbon steels of type (A 515 Gr 60 - A 516 Gr 60 6 – A 42CP – P265Gh)
- S= 1150 for stainless steels (304, 304L, 309, 309L, etc...)
- For the other material grades the subcontractor will propose a new value of: S
- C= 0.33

a. Advised erection method:

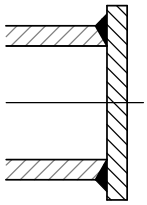
1 2 3 4

5



Case 1-2-3: Must comply with Weld thickness = 0,7* pipe thickness
Case 4-5: Weld must be full penetration type

b. Unadvised erection method:



2.8 Compressor type

2.8.1 Use of non-lubricated air compressor

Use of non-lubricated air compressor is recommended for permanent installations, given that it does not involve oil or carbon to be in contact with test air, and make their elimination unnecessary (except in case of oil contamination of the ambient atmosphere).

2.8.2 Use of lubricated air compressor

Use of lubricated screw compressor is tolerated for temporary or small installations (under 4000 Nm³/h of air).

It requires complete oil removal downstream, by means of a coalescer, followed by an activated carbon adsorber designed to stop oil*.

It is proven that dust may be generated downstream of the adsorber or activated carbon filter.

- When using an activated carbon filter, it is mandatory to add **one dust filter** downstream (1µm),
- When using an activated carbon adsorber, it is mandatory to add **two dust filters** downstream (1µm).

Specific requirement for temporary test facilities:

A back pressure regulator, downstream of the two filters, will control the air flow to maintain the activated carbon adsorber under pressure whatever the air demand is, in order to avoid fluidization of the carbon bed.

2.9 Test Medium

2.9.1 Air

Unless otherwise indicated in the project specifications, and for safety reasons, the subcontractor shall supply and use dry and oil free air in sufficient quantity and quality to perform the tests.

Supplied air shall meet the following characteristics:

* Note that activated carbon has a selective preference for non-polar molecules (mineral oil vapor) over polar molecules (water and synthetic oil vapors).

a. Dew point ≤ - 40°C

b. Oil content ≤ 1 mg / m^3

It is highly recommended to use Atlas Copco machine "ZT" type oil free screw compressor to produce compressed air meeting the above characteristics.

2.9.2 Nitrogen

If and only if it is not possible to supply dry and oil free air according to the above mentioned characteristics, the subcontractor might use nitrogen to perform the tests.

The nitrogen used to perform the tests shall meet the same dew point and oil content characteristics as the dry and oilfree air defined above.

In any case of nitrogen use for the tests (as single test medium or as complementary medium to reach higher pressure), the subcontractor shall apply for a waiver request to the AL representative. The waiver request shall be attached with a detailed safety procedure defining all measures to be taken to perform the tests using nitrogen.

This safety procedure must give full details concerning the risk due to insufficient oxygen and the means to be implemented to ensure safety of personnel (analyzer, prevention and rescue means, ventilation, nitrogen supply control...).

2.9.3 Other Gaseous Fluids

Under specific circumstances, it might be necessary to use other gas than air or nitrogen to perform the tests. The subcontractor shall then submit to the AL representative a specific test procedure. Authorization shall then be given by AL on a case by case basis.

2.10 Test Networks preparation

Preparation operations of the tests networks shall be performed by the subcontractor.

One week before the test beginning at last and once the subcontractor considers that the test network is ready for test, the subcontractor shall submit the test package to the AL representative and call the AL representative for the network review. The AL representative shall issue a punch list in regards with the test pack and the test network. The punch list shall be cleared before the beginning of the tests.

A network is considered as ready for tests only once:

- All construction and assembly works (including NDT) concerning the network are completed,
- Fragile equipment is removed for the test
- Blinds have been fitted, valves have been locked in the appropriate position, pressurization manifold is installed and connected, additional pressure gauges and recorder are installed and ready for operations
- Test package has been checked and accepted by AL representative : all punch items concerning the network have been cleared,
- Safety measures have been implemented,
- The direct supervision provided by AL is available,
- The complete network is accessible for the soapy water application,
- The local authority representative or the TPIA representative (if required) is available.

3 STRENGTH TEST AND LEAK TEST

Nota: Strength test on P11 & P22 after unit start-up are forbidden before site construction department agreement.

3.1 Strength Test

The strength test pressure is equal to X times PS of the considered test network.

The value of the X coefficient is imposed by **the construction code** and/or **the regulations** applicable in the country of installation.

Strength test pressure is indicated on line list.

If no there is no specific imposition by the construction code, the subcontractor shall take after project agreement:

$$X=1.1x\ PS \qquad (3)$$

For information only: Reminder for European Norm EN 13480:

$1{,}43 \times PS$ Or, for hot temperature service: $1{,}25PS \times \frac{fe}{ft}$

- fe = Nominal design constraint at test temperature for a normal service situation,
- ft = Nominal design constraint for a normal service situation with the most stringent in pressure at the design temperature corresponding.

In any case the pressure test cannot be less of the higher of the two values here above.

For information only: Reminder for ASME B31.3 – Codeti "With or Without DEP":

- **For ASME:**

  Pneumatic: 1,1 x PS

- **For Codeti:**

  Pneumatic: 1,25 (corrected) x PS or 1,43 x PS as EN 13480.

The subcontractor must check that the taken X value complies with the list of lines indications.

Pressurization is performed according to the below mentioned procedure. Once the pressure of **X × PS** is reached, pressure variations shall be recorded during one hour.

When required by local regulations, the strength test certificate is signed or written by a local authority representative or a TPIA representative.

The subcontractor carries the leak test out after the strength test.

3.2 Leak Tests

3.2.1 General remarks

Once the strength test is satisfactory and validated, the pressure is reduced to perform the leak test.

Leak tests are especially critical when the concerned test network is located inside a cold box.

The leak test pressure is equal to Y times PS of the considered test network.

The value of the Y coefficient is imposed by the construction code and/or the regulations applicable in the country of installation.

If no there is no specific imposition by the construction code, the subcontractor shall take after project agreement:

$$Y=0.8 \times PS \quad (4)$$

The subcontractor must check that the taken Y value complies with the list of lines indications.

Pressurization is performed according to the below mentioned procedure.

When required by local regulations, the leak test certificate is signed or written by a local authority representative or a TPIA representative.

3.2.2 Leak Test Inspection Method

Soapy water inspection is carried out twice (first check and final check) by the subcontractor in the presence of the AL supervisor.

Soapy water is applied on all test blinds, flange junctions, test equipment, all welds, unions, branch connections, instrumentation, stuffing boxes, valve body gaskets, etc. included in the test network even if those have not been performed or installed by the subcontractor (skid integrated in the test network for example).

Soapy water shall be applied methodically from one network extremity to the according to the test PID.

All points of the network shall be inspected and therefore accessible. It is the duty of the subcontractor to install scaffoldings where necessary.

3.2.3 Static tests: pressure and temperature variations

During a static test, temperature variations have an impact on the pressure. Following formula is given to check if the pressure variations are due to the temperature variations only.

$$Pt = \frac{P0 \times (T1+273.15)}{T0+273.15} \quad (5)$$

Where:

- Pt = Theoretical pressure at the end of the test,
- P0 = Stabilized pressure at the start of the test,
- T0 = Temperature recorded at the start of the test,
- T1 = Temperature at the end of the test.

3.3 Pressurization Procedure

The same procedure is applied in case of static or dynamic test.

The pressurization point is always chosen so that the pressurization does not involve particles spraying into the test network. The depressurization point is always chosen so that the depressurization does not involve particles spraying into the various circuits. The depressurization point(s) may be different from the pressurization point.

If the test fluid is nitrogen, the deflation points must be located within an area marked out and ventilated, away from a work area.

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The networks from which the network under test is isolated are vented to atmosphere to avoid pressure increase in the event of a leak.

The network can be pressurized when the test preparation has been carried out according to the above section.

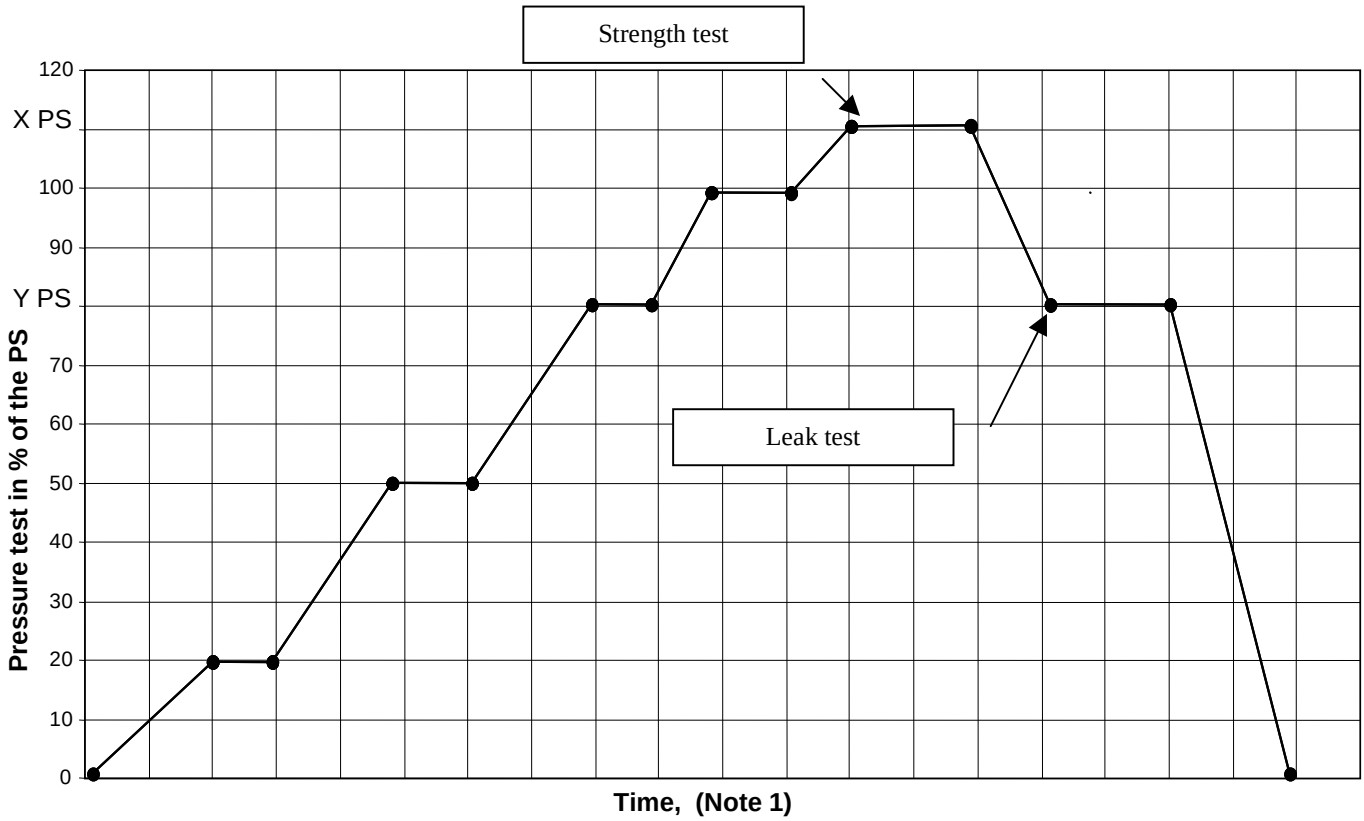
All pressurization operations are carried out in the presence of the AL representative and according to the diagram below, the pressurization rate shall not exceed 0.3b per minute.

- The network is first pressurized to 20% of the PS. Pressurization is stopped (or maintained in the case of a dynamic test) for 15 minutes. The network is inspected (flanges and screwed connection are controlled with soapy water) to detect eventual leaks.
- The network is then pressurized to 50% of the PS. Pressurization is stopped (or maintained in the case of a dynamic test) for 15 minutes. The network is inspected (flanges and screwed connection are controlled with soapy water) to detect eventual leaks.
- The network is then pressurized to 80% of the PS. Pressurization is stopped (or maintained in the case of a dynamic test) for 15 minutes. The network is inspected (flanges and screwed connection are controlled with soapy water) to detect eventual leaks. **From this step, access to the tests area is restricted and no-one is allowed in the direct vicinity of the test network.**

For safety reasons, when pressure is first increased from 0.8 PS, no-one is allowed to enter the test area.

- The network is then pressurized to 100% of the PS. Pressurization is stopped (or maintained in the case of a dynamic test) for 15 minutes. **No inspection is allowed**.
- To perform the strength tests, the test network is then pressurized to X×PS. Pressurization is stopped (or maintained in the case of a dynamic test) for a minimum duration of one hour. **No inspection is allowed**.
- To perform the leak test, the network is then depressurized to Y×PS. Depressurization is stopped (or pressure is maintained in the case of a dynamic test) in order to achieve the leak test (soapy water application and pressure loss monitoring).
- The network is finally depressurized (Cf. Figure 2).

Figure 2



3.4 Detecting and Repairing Leaks

All leaks detected are marked and recorded on the tests PID.

After applying soapy water on the complete test network, the network shall be depressurized to repair the leaks. Repair of the leaks the network being pressurized is forbidden.

It is not allowed to perform the strength test with leaks not having been repaired.

Once leaks have been repaired, the complete test shall be redone from the initial point according to the above procedure. If leaks are repaired after the strength test, test shall be performed again.

3.5 Traceability & recording

In order to keep a traceability of the tests performed, following steps of the tests shall be recorded (pressure & temperature), and the record sheets shall be attached to the test certificate.

a. Pressurization (traceability of steps),

b. A recording of one hour at X PS,

c. A recording of one hour at Y PS.

3.6 Re-instatement of the test network

Once the test network is depressurized, the subcontractor shall carry out all necessary operations to get the test network ready for operation and/or for blowing/flushing.

The test is considered as completed only once the test network is handed over by the subcontractor to the AL representative ready for operation or ready for flushing/blowing.

The Subcontractor shall coordinate with the AL representative to define how the network shall be prepared if the network is to be handed over ready for flushing/blowing.

The re-instatement operations include but are not limited to:

- Blinds removal - all blinds shall be gathered, accounted and verified in the presence of the AL representative to ensure that no blind has been left over,
- Valves unlocking (open of closed position),
- Re-installation of fragile equipment dismantled for test,

Special attention shall be paid when welded caps are removed (cutting shall not pollute the inside of the pipes) and the inside of the pipe shall be cleaned before re-instatement welding.

After the test, all re-instatement welds (welded caps) done are 100 % controlled by radiography **and** dye penetrate.

Where blind flanges or "pan" blinds have been fitted, new gaskets are supplied and installed by the subcontractor.

4 GENERAL LEAK TEST

Once the blowing/flushing operations have been carried out, and once the piping networks have been re-instated "ready for operation", the subcontractor shall carry out the general leak tests.

General leak tests are performed on the biggest possible piping network. The test pressure is then the lowest PS of all the test networks included in the general test. Usually, general leak tests are organised as follow:

- One single general leak test for the networks upstream of the cold box,
- One single general leak test for the cold box,
- One or more general leak tests for the networks downstream the cold box (number of tests depending on the number of networks not being physically interconnected).

General leak test networks are isolated from each other by blinds.

Targets of the general leak tests are:

- Checking the integrity of the plant,
- Checking that there is no leak at the test blinds former locations and at the blowing outlet locations (soapy water),
- Checking the tightness of the drain valves, vent valves or isolation valves.

General leak tests can be either static or dynamic.

General leak tests shall be recorded with tests PID and reports for traceability purpose.

Table of Revisions

Section	Description